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Analysis of the Efficacy of Multi-Target Receptor Modulators Combined with Modified Electroconvulsive Therapy in BD Patients with Comorbid Multisystem Somatic Diseases

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Abstract: *Objective*: To evaluate the efficacy of multi-target receptor modulators combined with modified electroconvulsive therapy in BD patients with comorbid multisystem somatic diseases. *Methods*: A total of 68 BD patients with comorbid multisystem somatic diseases treated from May 2022 to May 2025 were selected as samples and randomly divided into groups by drawing lots. Group A received modified electroconvulsive therapy (MECT) combined with the multi-target receptor modulator quetiapine, while Group B received quetiapine alone. *Results*: Group A showed superior efficacy, Mini-Mental State Examination (MMSE) scores, Hamilton Depression Rating Scale (HAMD) scores, Bech-Rafaelsen Mania Rating Scale (BRMS) scores, and serum factor indicators compared to Group B, with $p < 0.05$; there was no significant difference in the adverse reaction rate between Group A and Group B, with $p > 0.05$. *Conclusion*: The combination of multi-target receptor modulators and modified electroconvulsive therapy can improve intellectual status, alleviate manic and depressive symptoms, and is highly effective and feasible in the treatment of BD patients with comorbid multisystem somatic diseases.

Keywords: Bipolar disorder; Quetiapine; MECT; MMSE

Online publication: May 15, 2026

1. Introduction

Bipolar Disorder (BD) with comorbid multisystem somatic diseases is characterized by recurrent episodes and is a common clinical affective disorder. During episodes, patients may experience alternating depressive and manic symptoms. Additionally, BD patients with comorbid multisystem somatic diseases often have cognitive impairments, manifested as decreased memory, difficulty concentrating, and reduced executive

function, necessitating early pharmacological intervention. When treating BD patients, quetiapine, a multi-target receptor modulator, is recommended for its significant antipsychotic effects. However, monotherapy with this drug has limited efficacy and requires combination with other treatment modalities. MECT is a modified version of traditional electroconvulsive therapy and can be used as an adjunctive treatment for severe BD patients with comorbid multisystem somatic diseases [1]. Based on this, this study explored the efficacy of MECT combined with quetiapine in 68 BD patients with comorbid multisystem somatic diseases from May 2022 to May 2025.

2. Materials and methods

2.1. Materials

A total of 68 BD patients with comorbid multisystem somatic diseases treated from May 2022 to May 2025 were selected as samples and randomly divided into groups by drawing lots. The baseline data of BD patients with comorbid multisystem somatic diseases in Group A were compared with those in Group B, with $p > 0.05$. See **Table 1**.

Table 1. Baseline data analysis table for BD patients with comorbid multisystem somatic diseases

Group	n	Gender (%)		Age (years)		Disease duration (months)	
		Male	Female	Range	Mean ± SD	Range	Mean ± SD
Group A	34	19 (55.88)	15 (44.12)	63–87	73.84 ± 4.29	1–9	4.56 ± 1.28
Group B	34	20 (58.82)	14 (41.18)	63–88	73.91 ± 4.31	1–8	4.61 ± 1.31
χ^2/t	-	0.0673		0.0502		0.1564	
p	-	0.7952		0.9601		0.8763	

2.2. Inclusion and exclusion

2.2.1. Inclusion criteria

(1) Meeting the criteria for BD as outlined in the third edition of the "Chinese Classification and Diagnostic Criteria of Mental Disorders" [2];
(2) Signing the informed consent form;
(3) Scoring ≥ 13 on the BRMS.

2.2.2. Exclusion criteria

(1) Individuals with severe suicidal tendencies;
(2) Those with a history of hypersensitivity to antipsychotic drugs;
(3) Patients with poor treatment compliance.

2.3. Treatment methods

(1) Group A

On the first day, patients received a single oral dose of 50 mg quetiapine once daily, followed by a gradual increase in the daily dose to 300–400 mg, administered over 4 weeks. Prior to MECT treatment, heart rate and blood pressure were regulated to 90 beats/min and 140/90 mmHg, respectively.

Subsequently, patients received an intravenous injection of 0.01 mg/kg atropine plus an intravenous bolus of 1.5 mg/kg propofol. Once the absence of eyelash reflex was observed in BD patients, an intravenous injection of 1 mg/kg succinylcholine chloride injection was administered. Throughout the procedure, patients were provided with pressurized oxygen via a mask. After medication, the patient's muscles relaxed completely. Electrodes were placed bilaterally on the brain, and the current was adjusted for impedance testing. Subsequently, MECT parameters were adjusted, with current, voltage, and stimulus frequency set to 0.9–1.2 A, 220 V, and 30–50 Hz, respectively. Each treatment session lasted 1–3 seconds, with three consecutive stimulations. Successful stimulation was defined by the patient exhibiting muscle tonus leading to clonus and then relaxation upon electrical stimulation. Stimulation was administered three times in the first week, twice in the second week, and once in weeks 3–4.

(2) Group B

On the first day, patients received a single oral dose of 50 mg quetiapine once daily, followed by a gradual increase in the daily dose to 300–400 mg, administered over 4 weeks.

2.4. Statistical analysis

SPSS 23.0 was used to process data on BD patients with comorbid multisystem somatic diseases. Count data for BD patients with comorbid multisystem somatic diseases were recorded as percentages and analyzed using the χ^2 test, while measurement data were recorded as mean ± standard deviation ($\overline{x} \pm s$) and analyzed using the *t*-test. Statistical significance was defined as $P < 0.05$.

3. Results

3.1. Efficacy analysis of BD with comorbid multisystem somatic diseases

The efficacy of BD treatment with comorbid multisystem somatic diseases was higher in Group A than in Group B, with $p < 0.05$. See **Table 2**.

Table 2. Efficacy analysis table for BD with comorbid multisystem somatic diseases (n, %)

Group	Markedly effective	Effective	Ineffective	Total effective rate
Group A (n = 34)	22 (64.71)	11 (32.35)	1 (2.94)	33 (97.06)
Group B (n = 34)	17 (50.00)	10 (29.41)	7 (20.59)	27 (79.41)
χ^2	-	-	-	5.1000
p	-	-	-	0.0239

3.2. Analysis of prognostic evaluation indicators for BD with comorbid multisystem somatic diseases

After treatment, the MMSE scores of BD patients with comorbid multisystem somatic diseases in Group A were higher than those in Group B, while the HAMD scores and BRMS scores were lower than those in Group B, with $p < 0.05$. See **Table 3**.

Table 3. Analysis table of prognostic evaluation indicators for bd with comorbid multisystem somatic diseases ($\overline{x} \pm s$)

Group	MMSE score (points)		HAMD score (points)		BRMS score (points)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Group A (n = 34)	24.68 ± 3.42	29.72 ± 3.81	36.42 ± 5.43	20.66 ± 2.43	23.73 ± 4.11	10.18 ± 1.89
Group B (n = 34)	24.71 ± 3.39	26.25 ± 3.68	36.44 ± 5.47	25.73 ± 4.11	23.71 ± 4.09	14.33 ± 2.43
t	0.0363	3.8198	0.0151	6.1917	0.0201	7.8605
p	0.9711	0.0003	0.9880	0.0000	0.9840	0.0000

3.3. Analysis of serum factor indicators in BD patients with comorbid multisystem somatic diseases

After treatment, the serum factor indicators of BD patients with comorbid multisystem somatic diseases in Group A were superior to those in Group B, with $p < 0.05$. See **Table 4**.

Table 4. Analysis table of serum factor indicators in BD patients with comorbid multisystem somatic diseases ($\overline{x} \pm s$)

Group	TNF-α (ng/L)		IL-1β (g/L)		MDA (nmol/mL)		SOD (ng/L)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Group A (n = 34)	101.88 ± 4.29	82.44 ± 2.42	91.42 ± 3.82	76.09 ± 2.19	7.54 ± 0.88	1.71 ± 0.43	96.28 ± 4.08	154.28 ± 6.72
Group B (n = 34)	101.91 ± 4.31	93.28 ± 3.29	91.38 ± 3.79	82.44 ± 2.88	7.59 ± 0.91	2.78 ± 0.62	96.33 ± 4.06	131.26 ± 5.33
t	0.0288	15.4762	0.0433	10.2338	0.2303	8.2690	0.0507	15.6496
p	0.9771	0.0000	0.9656	0.0000	0.8186	0.0000	0.9598	0.0000

3.4. Analysis of adverse reaction indicators in BD patients with comorbid multisystem somatic diseases

There was no significant difference in the adverse reaction rate between Group A and Group B of BD patients with comorbid multisystem somatic diseases, with $p > 0.05$. See **Table 5**.

Table 5. Analysis table of adverse reactions in BD patients with comorbid multisystem somatic diseases (n, %)

Group	Nausea and vomiting	Anorexia	Constipation	Lethargy	Incidence (%)
Group A (n = 34)	1 (2.94)	1 (2.94)	1 (2.94)	1 (2.94)	4 (11.76)
Group B (n = 34)	1 (2.94)	2 (5.88)	1 (2.94)	1 (2.94)	5 (14.71)
χ^2	-	-	-	-	0.1281
p	-	-	-	-	0.7205

4. Discussion

Bipolar disorder (BD) is a prevalent and severe mental disorder in clinical settings, characterized by

alternating episodes of mania and depression. The disease course is protracted and recurrent, impairing patients' social functioning and leading to suicidal ideation and behaviors. In recent years, the incidence of comorbid multisystem somatic diseases in BD patients has been increasing annually, becoming a critical factor affecting treatment prognosis and exacerbating disease burden [3]. The etiology of BD comorbid with multisystem somatic diseases is complex, and the specific pathogenesis remains unclear in clinical practice. It is generally believed that the onset of this disease is closely related to genetic predisposition factors, neurobiochemical disturbances, immune-inflammatory imbalances, and environmental stress factors. Genetic predisposition factors determine the innate propensity for disease onset in patients. Individuals carrying BD susceptibility genes inherently have potential abnormalities in neurotransmitter regulation, making them susceptible to manic or depressive episodes triggered by external stimuli. At the neurobiochemical level, imbalances in the secretion of monoamine neurotransmitters not only constitute the core pathological basis for the psychiatric symptoms of BD but also affect the function of various systems in the body through the neuro-immune-endocrine network, potentially inducing cardiovascular, digestive, endocrine, and other multisystem somatic diseases. Immune-inflammatory disturbances play a crucial mediating role in the development of comorbidities. BD patients often experience chronic inflammatory states, and abnormal activation of inflammatory factors can damage neuronal function while also affecting somatic tissues and organs, exacerbating the severity of somatic diseases. Environmental stress factors serve as triggers for the disease, disrupting the balance of the neuro-immune-endocrine system and promoting the comorbidity of BD and somatic diseases [4]. Patients with BD comorbid with multisystem somatic diseases exhibit more complex clinical symptoms. In addition to the typical alternating episodes of mania and depression, they also present with corresponding symptoms of the somatic systems, such as abnormal blood pressure and arrhythmia in the cardiovascular system, abdominal distension and decreased appetite in the digestive system, and blood glucose fluctuations and abnormal thyroid function in the endocrine system. Moreover, psychiatric symptoms and somatic symptoms interact and form a vicious cycle, leading to recurrent episodes of somatic diseases and even exacerbating patients' emotional fluctuations, triggering acute episodes of BD. Conversely, the psychiatric symptoms of BD can reduce patients' treatment compliance, affecting the therapeutic outcomes of somatic diseases and resulting in uncontrolled conditions for both, thereby increasing the difficulty of clinical treatment.

Quetiapine is a commonly used multi-target receptor modulator in the clinical treatment of BD. By regulating the activity of various neurotransmitter receptors in the brain, it improves the imbalance in neurotransmitter secretion and exerts a certain control over manic and depressive symptoms in BD patients, accumulating substantial practical experience in clinical applications. However, for BD patients comorbid with multisystem somatic diseases, the limitations of monotherapy with quetiapine are evident, and it fails to meet clinical treatment needs. Monotherapy with quetiapine has a slow onset of action. For patients experiencing acute manic or depressive episodes of BD, it cannot rapidly alleviate symptoms triggered by extreme emotions. Prolonged emotional deterioration can further exacerbate disturbances in the neuro-immune-endocrine network, inducing pathological damage to somatic diseases and even leading to acute episodes of somatic conditions. Monotherapy with quetiapine cannot simultaneously improve psychiatric and somatic symptoms. Its primary target sites are concentrated on neurotransmitter receptors, with limited regulatory effects on pathological states such as immune-inflammatory disturbances and oxidative stress imbalances present in comorbid BD patients. It cannot fundamentally break the vicious cycle between

psychiatric symptoms and somatic diseases, resulting in incomplete remission of psychiatric symptoms and recurrent somatic disease conditions in some patients after treatment, leading to suboptimal overall therapeutic outcomes [5]. Additionally, long-term monotherapy with quetiapine may induce various adverse reactions, such as weight gain, metabolic abnormalities, and cardiovascular discomfort, which can further increase the somatic burden of comorbid patients and even affect their treatment compliance, leading to treatment discontinuation.

Modified electroconvulsive therapy (MECT) is a physical treatment method that significantly reduces the adverse reactions of traditional electroconvulsive therapy while preserving its therapeutic efficacy by modifying electrode placement and controlling electrical stimulation dosage. It has been widely applied in the clinical treatment of severe mental disorders such as BD. MECT has a rapid onset of action. By inducing synchronous neuronal discharge in the brain through brief electrical stimulation, it can rapidly regulate abnormal activation states of brain neural circuits, improve neurotransmitter secretion balance, and effectively control acute manic and depressive symptoms in BD patients within a short period, creating favorable conditions for the treatment of somatic diseases. Based on this, adopting MECT in combination with the multi-target receptor modulator quetiapine to treat BD patients comorbid with multisystem somatic diseases can produce a synergistic therapeutic effect, compensating for many deficiencies of monotherapy with quetiapine and demonstrating significant treatment advantages. After MECT rapidly alleviates acute emotional symptoms of BD, quetiapine can continuously stabilize neurotransmitter levels through its multi-target regulatory effects, consolidate the therapeutic efficacy of MECT, reduce the recurrence of psychiatric symptoms, and simultaneously improve patients' cognitive and social functioning [6]. The synergistic action of the two can effectively regulate immune-inflammatory pathways in comorbid patients, inhibit excessive release of inflammatory factors, regulate oxidative stress balance, alleviate pathological damage to somatic tissues and organs, simultaneously improve somatic disease symptoms, and break the vicious cycle between psychiatric symptoms and somatic diseases. The synergistic effect of MECT and quetiapine can also reduce the dosage of single drugs, lower the risk of adverse reactions, and improve patients' treatment compliance. It is particularly suitable for BD patients comorbid with multisystem somatic diseases who have poor tolerance, providing a safer and more effective treatment option for clinical management of such complex cases.

The data in this article indicate that the therapeutic efficacy in BD patients comorbid with multisystem somatic diseases increased after treatment with MECT + quetiapine. The reasons for this are as follows: This study strictly adhered to clinical treatment guidelines for BD and comorbid somatic diseases, individually adjusting the quetiapine dosage and MECT treatment frequency and course based on the severity of patients' conditions, the type of somatic diseases, and their tolerance. This ensured the targeted and reasonable nature of the treatment plan, avoiding suboptimal efficacy due to improper dosages or non-standardized treatment. Simultaneously, a comprehensive efficacy evaluation system was established, adopting unified efficacy evaluation criteria to regularly assess improvements in patients' psychiatric and somatic symptoms, ensuring the objectivity and accuracy of efficacy evaluation results and truly reflecting the efficacy advantages of the combined treatment plan, resulting in a stable increasing trend in efficacy-related data [7]. The synchronous standardized intervention for patients' somatic diseases during the study also provided important guarantees for the increased efficacy, avoiding the impact of fluctuations in somatic disease conditions on the treatment outcomes of psychiatric symptoms.

Another set of data indicates that after treatment with MECT + quetiapine, the MMSE scores increased,

while the HAMD and BRMS scores decreased in BD patients comorbid with multisystem somatic diseases. The reasons for this are as follows: The MMSE score is primarily used to assess patients' cognitive function, including multiple dimensions such as attention, memory, and orientation. The HAMD score is used to evaluate the severity of depressive symptoms, and the BRMS score is used to assess the severity of manic symptoms. This study selected reasonable time points for score detection, enabling the timely capture of dynamic changes in patients' cognitive function and emotional states. Simultaneously, all scoring personnel underwent unified training and strictly adhered to scoring standards, reducing human assessment errors and ensuring the reliability of scoring data, allowing each scoring indicator to truly reflect the treatment outcomes. Analyzing the treatment mechanism, MECT can rapidly alleviate patients' acute emotional symptoms, reducing the inhibitory effect of emotional abnormalities on cognitive function and creating conditions for cognitive function recovery. Quetiapine gradually improves patients' cognitive function and emotional stability by regulating neurotransmitter balance through multi-target effects. The synergistic action of the two promotes an increase in MMSE scores and a decrease in HAMD and BRMS scores. Additionally, dynamic monitoring of patients' cognitive function and emotional states during treatment allows for timely adjustment of the treatment plan, avoiding cognitive impairment or emotional fluctuations during the treatment process and facilitating improvements in each scoring indicator.

Another set of data indicates that after treatment with MECT + quetiapine, the levels of TNF-α, IL-1β, MDA, and SOD improved in BD patients comorbid with multisystem somatic diseases. The reasons for this are as follows: TNF-α and IL-1β are important inflammatory factors, and their elevated levels indicate the presence of chronic inflammatory responses in the body. MDA is a marker of oxidative stress damage, and its elevated level reflects increased oxidative stress damage in the body. SOD is an important antioxidant enzyme in the body, and its elevated level indicates enhanced antioxidant capacity. This study strictly standardized the specimen collection process, selecting fasting venous blood as the detection specimen and promptly processing and storing it after collection to avoid factors such as specimen contamination and hemolysis affecting the detection results. Standardized detection methods and calibrated detection instruments were used to ensure the accuracy and repeatability of the detection results, truly reflecting changes in patients' immune-inflammatory and oxidative stress states. The synergistic action of MECT and quetiapine can effectively regulate the body's neuro-immune-endocrine network, inhibit excessive secretion of inflammatory factors, reduce the production of oxidative stress products, and enhance the body's antioxidant capacity, thereby promoting a decrease in TNF-α, IL-1β, and MDA levels and an increase in SOD levels. The effective exertion of this treatment mechanism results in significant improvements in immune-inflammatory and oxidative stress-related indicators.

The final set of data indicates that after treatment with MECT + quetiapine, the incidence of adverse reactions did not increase in BD patients comorbid with multisystem somatic diseases. The reasons for this are as follows: Based on patients' somatic disease conditions and tolerance, the quetiapine dosage and MECT treatment parameters were individually adjusted to reduce the occurrence of dosage-dependent adverse reactions. For example, for patients comorbid with cardiovascular diseases, the initial quetiapine dosage was appropriately reduced, and blood pressure and heart rate changes were closely monitored. For patients comorbid with digestive system diseases, the medication administration time was adjusted to reduce gastrointestinal adverse reactions.

5. Conclusion

In summary, BD patients comorbid with multisystem somatic diseases who received MECT + quetiapine treatment experienced suppression of inflammatory and oxidative stress responses, alleviation of manic and depressive symptoms, and optimization of cognitive function. Moreover, MECT demonstrated high safety and has promotional value.

Disclosure statement

The author declares no conflict of interest.

References

[1] Liu X, Jiang L, Wang X, et al., 2024, Efficacy of Seizure-Free Electroconvulsive Therapy Combined with Quetiapine in the Treatment of Manic Episodes of Bipolar Disorder and Its Effects on Manic Symptoms and Cognitive Function. Reflex Therapy and Rehabilitation Medicine, 5(5): 47–49 + 53.

[2] Chinese Medical Association Psychiatry Branch, 2001, Chinese Classification and Diagnostic Criteria for Mental Disorders, Third Edition (Classification of Mental Disorders). Chinese Journal of Psychiatry, 34(3): 184–188.

[3] Li Z, Huang W, 2023, Effects of Quetiapine on Manic Episodes of Bipolar Disorder and Patients' Cognitive Function. Modern Medicine and Health Research Electronic Journal, 7(1): 57–60.

[4] Xiong T, 2021, Observation of the Efficacy of Seizure-Free Electroconvulsive Therapy Combined with Quetiapine in the Treatment of 42 Cases of Manic Episodes of Bipolar Disorder in Middle-Aged and Elderly Patients. Drug Evaluation, 18(10): 598–600.

[5] He L, Yang Y, Jiang F, 2021, Effects of Quetiapine Combined with Lithium Carbonate on Manic Severity and Inflammatory Indicators in Patients with Manic Episodes of Bipolar Disorder. Heilongjiang Medicine Journal, 45(7): 694–696.

[6] Chen Z, 2021, Effects of Quetiapine Combined with Magnesium Valproate on the Efficacy and Serum Inflammatory Factor Levels in Female Patients with Bipolar Disorder. Chinese Health Care and Nutrition, 39(8): 178–180.

[7] Zheng D, Huang L, 2022, Observation of the Efficacy of Quetiapine Fumarate Combined with Lithium Carbonate in the Treatment of 30 Cases of Bipolar Disorder. Chinese Journal of Primary Medicine, 29(2): 207–211.

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The Effect of Music Therapy on Anxiety and Physiological Indicators in Patients Undergoing Colonoscopy: A Meta-analysis

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Abstract: *Purpose*: To evaluate the effect of music therapy on anxiety, physiological indicators and successful colon intubation rate in patients undergoing colonoscopy. *Methods*: Randomized controlled trials (RCTs) on music therapy during colonoscopy published up to December 2025 were retrieved from 8 databases. Study quality was assessed using the Cochrane risk-of-bias tool (ROB 2.0), and meta-analysis was performed with R software. *Results*: 25 RCTs involving 4,525 patients were included. Music therapy significantly reduced anxiety (SMD = -0.61; 95% CI [-0.84, -0.38]; $p < 0.0001$), systolic blood pressure (MD = -8.63; $p = 0.015$), diastolic blood pressure (MD = -0.92; $p = 0.034$), mean arterial pressure (MD = -7.77; $p = 0.005$) and heart rate (MD = -11.65; $p < 0.0001$), and improved intubation success rate (RR = 1.04; $p = 0.002$). No significant effect on respiratory rate was observed. Results were robust, but study quality was generally low. *Conclusion*s: Music therapy is safe and effective for alleviating anxiety and improving physiological indicators in colonoscopy patients, warranting clinical promotion. More high-quality RCTs are needed.

Keywords: Music therapy; Colonoscopy; Randomized controlled trial; Meta-analysis; Anxiety

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1. Introduction

Colonoscopy is an intuitive and clear endoscopic examination method with a high diagnostic rate for lower gastrointestinal diseases. It can be used to confirm the diagnosis of hematochezia, abdominal pain, diarrhea and unexplained anemia, as well as to perform endoscopic procedures such as polypectomy, hemostasis and stricture dilation [1]. As the gold standard for colorectal cancer screening and detection, it is widely used in clinical practice [2]. However, as an invasive procedure, colonoscopy can cause abdominal pain and distension during the examination. The resulting anxiety and strong physiological and psychological stress responses often lead to examination failure and affect disease diagnosis [3].

Although music therapy has been applied to patients undergoing colonoscopy in existing studies, its

effects on pain and anxiety remain controversial. For example, Demirci et al. showed that music therapy significantly reduced anxiety scores and systolic blood pressure in patients during colonoscopy, while Sun et al. reported opposite results [4,5]. Therefore, this study aimed to systematically evaluate the effect of music therapy on anxiety, hemodynamic parameters (systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate) and respiratory rate in patients during colonoscopy, so as to provide the latest evidence-based basis for clinical practice.

2. Method

2.1. Search strategy

Computerised searches were conducted in PubMed, Embase, The Cochrane Library, Web of Science, CNKI, Wanfang, VIP and CBM databases from their inception to December 2025. The Chinese search terms included: “colonoscopy”, “colonoscopic examination”, “colonoscopic surgery”, “sigmoidoscopy”, “colonoscopic biopsy”, “colonoscopic diagnosis”, “colonoscopic treatment”, “music therapy”, “music treatment”, “music intervention”, “music”, “random*”, “randomised controlled trial”. The English search terms included: “Colonoscopy”, “Colonoscopies”, “Colonoscopic Surgical Procedure”, “Sigmoidoscopy”, “Colon capsule endoscopy”, “Ileocolonoscopy”, “Music Therapy”, “Music intervention”, “Music Listening”, “Receptive music therapy”, “random*”. Subject headings combined with keywords and Boolean operators were used for searching, with no language restrictions. Supplementary searches were performed by tracking references and searching Baidu Academic.

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

(1) Study type
Randomized controlled trials;

(2) Study subjects
Adult patients diagnosed by doctors requiring colonoscopy, with no hearing impairment, no mental illness, conscious and capable of signing informed consent;

(3) Intervention measures
The experimental group received music intervention in addition to routine nursing, including any form of music therapy (e.g., MP3 and headphone playback, background music), with no restrictions on music type, intervention duration or playback method. The control group only received routine nursing without any music intervention or other additional adjuvant treatment;

(4) Outcome indicators
Including anxiety, hemodynamic parameters (systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate), success rate of colon intubation, etc.

2.2.2. Exclusion criteria

(1) Duplicate publications;
(2) Reviews, conference abstracts, systematic reviews/meta-analyses;
(3) Studies combining music therapy with other intervention measures;
(4) Studies unable to provide valid data;

(5) Studies with unavailable full text.

2.3. Study selection and data extraction

Two researchers independently screened literature and extracted data according to the inclusion and exclusion criteria. Discrepancies during the screening process were resolved through consultation with a third researcher. The extracted data mainly included the following aspects:

(1) General information

Title, author, publication year;

(2) Study characteristics

Age of study subjects, music type, playback time and method, etc.;

(3) Outcome indicators

Mainly anxiety, blood pressure, heart rate, respiratory rate, success rate of colon intubation, etc.

If a single study contained multiple independent experimental groups meeting the inclusion criteria (e.g., different types of music intervention, different control settings), data were extracted separately and marked with author + year + lowercase letter suffix to ensure the independence of each effect size during statistical pooling.

2.4. Quality assessment

The Cochrane Risk of Bias 2.0 (ROB 2.0) tool recommended by the Cochrane Handbook for Systematic Reviews of Interventions was used to assess the quality of included RCTs. The assessment covered five domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. The risk of bias for each domain was classified as “low risk”, “some concerns” or “high risk”. Two researchers independently performed the assessment, and discrepancies were resolved through third-party consultation. Risk of bias summary and graph were plotted.

2.5. Data synthesis and analysis

R software was used to analyze the extracted data. For continuous outcome indicators (anxiety, respiratory rate, heart rate, blood pressure, etc.), data were presented as mean ± standard deviation. If the same measurement tool was used for an outcome indicator, mean difference (MD) was used as the pooled effect size; if different measurement tools were used, standardized mean difference (SMD) was used, both with 95% confidence intervals (CI). The effect size for anxiety was the change value before and after music therapy intervention, calculated as: Anxiety change value = post-intervention anxiety scale score − pre-intervention anxiety scale score. A positive value indicated increased anxiety level after intervention, while a negative value indicated decreased anxiety level after intervention. The effect sizes for blood pressure (systolic, diastolic, mean arterial), heart rate and respiratory rate were all change values before and after music therapy intervention, calculated as: Change value = Post-intervention value − Pre-intervention value. A positive value indicated an increase in the outcome indicator after intervention, while a negative value indicated a decrease.

For dichotomous outcome indicators (success rate of colon intubation), risk ratio (RR) was used as the effect size, also with 95% CI. Heterogeneity was assessed using I^2 statistic. Significant heterogeneity was considered when $I^2 > 50\%$ with $p < 0.10$, in which case a random-effects model was applied. Otherwise,

a fixed-effects model was used. Subgroup analysis and sensitivity analysis were conducted to explore the sources of heterogeneity and the robustness of heterogeneous results. The statistical significance level was set at $p < 0.05$.

3. Results

3.1. Study selection

A total of 315 articles were initially retrieved. After removing duplicates, further screening by reading titles, abstracts and full texts, 25 articles were finally included, including 10 Chinese articles and 15 English articles [3–27]. The literature screening process and results are shown in **Figure 1**.

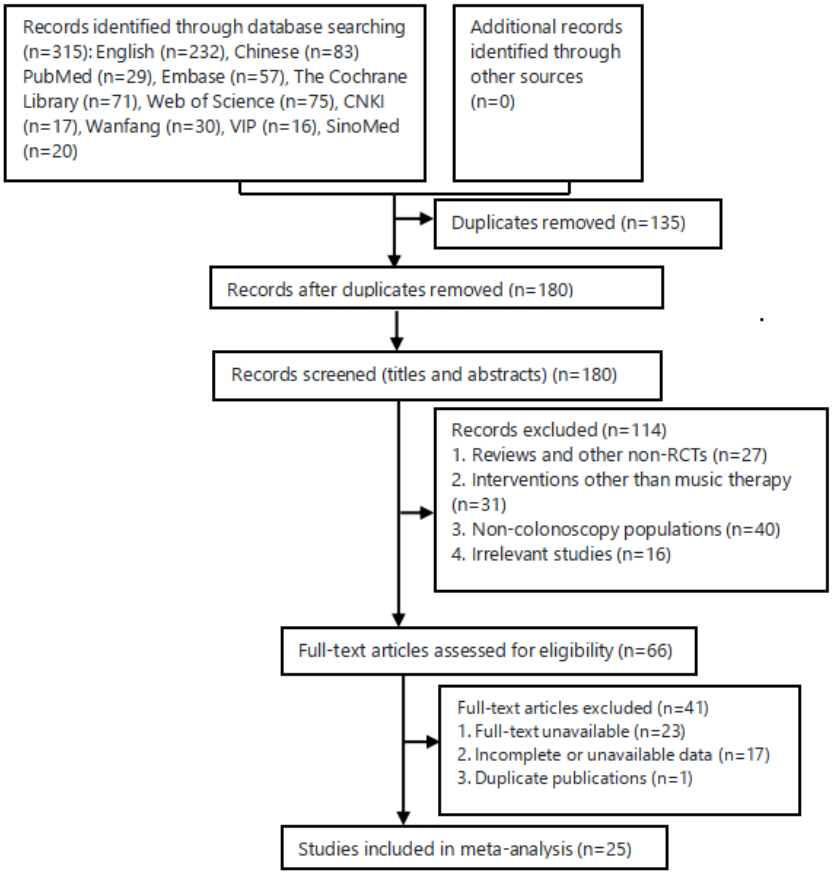


Figure 1. PRISMA flow diagram of literature screening.

Note: CNKI = China National Knowledge Infrastructure; CBM = Chinese Biomedical Literature Database; VIP = Chinese Scientific Journal Database.

3.2. Quality of the studies

All 25 included RCTs mentioned "random" grouping. Among them, 5 studies used random number method and were rated as "low risk"; 1 study used block random sampling, 1 used random sampling grouping, 1 used lottery random grouping, and 9 only mentioned "random" without specifying the method, rated as "some concerns"; 4 studies grouped by examination date, 1 by examination number, and 1 by patient preference, rated as "high risk". Four studies (16%) implemented allocation concealment, and 6 studies

(24%) implemented blinding. No incomplete data or selective outcome reporting was found. The risk of bias summary and graph are shown in **Figure 2**.



Figure 2. Risk of bias summary (A) and risk of bias graph (B).

3.3. Study characteristics

The basic information of the 25 included studies is shown in **Tables 1** and **2**.

Table 1. Basic characteristics of included studies

Included study	Country	Multicentre	Registered	Sample size		Age (years)	
				Music group	Control group	Music group	Control group
Martindale 2014 [6]	Australia	No	Yes	17	17	——	——
Nagata 2014 [7]	Japan	No	Yes	56	56	51.6	52.9
Ko 2019 [8]	China	No	Not mentioned	40	40	57.68 ± 11.07	57.68 ± 11.92
Sun 2022 [5]	China	No	Not mentioned	112	104	44.71 ± 13.32	44.98 ± 12.09
Hirani 2024 [9]	Pakistan	No	Not mentioned	55	55	49.15 ± 15.55	50.89 ± 16.80
Costa 2010 [10]	Italy	No	Not mentioned	56	53	50.0 ± 14.2	52.7 ± 15.3
Bashiri 2018a [11]	Turkey	No	Not mentioned	33	25	28–65	28–69

Included study	Country	Multicentre	Registered	Sample size		Age (years)	
				Music group	Control group	Music group	Control group
Bashiri 2018b [11]	Turkey	No	Not mentioned	41	55	24–65	28–60
Selda 2023 [12]	Turkey	No	Not mentioned	30	30	57.66 ± 13.43	59.26 ± 13.74
Li 2018a [13]	China	No	Not mentioned	40	38	——	——
Li 2018b [13]	China	No	Not mentioned	35	38	——	——
Çelebi 2019 [14]	Turkey	No	Not mentioned	56	56	54.34 ± 14.20	54.04 ± 13.77
Demirci 2025 [4]	Turkey	No	Not mentioned	46	46	49.17 ± 10.83	53.54 ± 13.11
Brix 2022 [15]	Denmark	No	Not mentioned	169	168	56 ± 13.9	59 ± 13.2
Andrada 2003 [16]	Spain	No	Not mentioned	63	55	46 ± 14.22	49 ± 13.88
Hayes 2003 [17]	USA	No	Not mentioned	100	98	61	61
Silva 2016 [18]	Sri Lanka	No	Yes	66	67	54.4 ± 12.5	56.5 ± 13.8
Zhou 2014 [19]	China	No	Not mentioned	50	50	19–55	
Deng 2007 [3]	China	No	Not mentioned	133	133	43.40 ± 34.60	45.02 ± 30.98
Wang 2010 [20]	China	No	Not mentioned	594	556	19–87	17–84
Zhang 2022 [21]	China	No	Not mentioned	68	78	49. 82 ± 11. 202	58. 57 ± 13. 189
Wang 2010 [22]	China	No	Not mentioned	32	32	43.54 ± 11.32	44.21 ± 10.14
Luo 2016 [23]	China	No	Not mentioned	100	100	21–69	
Wang 2009 [24]	China	No	Not mentioned	62	70	l8–66	22–67
Luo 2010 [25]	China	No	Not mentioned	93	85	18–65	18–67
Huang 2010 [26]	China	No	Not mentioned	40	40	——	——
Li 2008a [27]	China	No	Not mentioned	60	60	——	——
Li 2008b [27]	China	No	Not mentioned	60	60	——	——

Table 2. Basic intervention protocols of included studies

Included study	Intervention measure		Music type	Method	Intervention time point	Duration
	Music group	Control group				
Martindale 2014 [6]	Music therapy	Routine nursing	Classical music	MP3 + headphones	10 minutes before examination	10 minutes before + entire examination
Nagata 2014 [7]	Music therapy	Routine nursing	Soothing background music	Speaker	After entering examination room	Entire examination
Ko 2019 [8]	Music therapy	Routine nursing	Other	MP3 + headphones	20 minutes before examination	20 minutes before + entire examination
Sun 2022 [5]	Music therapy	Routine nursing	Light music	Headphones	After entering examination room	Entire examination
Hirani 2024 [9]	Music therapy	Routine nursing	Light music	Headphones	Before examination (waiting area)	Before + entire examination
Costa 2010 [10]	Music therapy	Routine nursing	Self-selected music	Headphones	3 minutes before examination	3 minutes before + entire examination
Bashiri 2018a [11]	Music therapy	Routine nursing	Self-selected music	Headphones	After entering examination room	Entire examination
Bashiri 2018b [11]	Music therapy	Routine nursing	Self-selected music	Headphones	After entering examination room	Entire examination

Selda 2023 [12]	Music therapy	Routine nursing	Classical music	MP3 + headphones	10 minutes before examination	10 minutes before + entire examination
Li 2018a [13]	Music therapy	Routine nursing	Other	Headphones	10 minutes before examination	10 minutes before + entire examination
Li 2018b [13]	Music therapy	Routine nursing	Classical music	MP3 + headphones	10 minutes before examination	10 minutes before + entire examination
Çelebi 2019 [14]	Music therapy	Routine nursing	Classical music	MP3 + headphones	After entering examination room	Entire examination
Demirci 2025 [4]	Music therapy	Routine nursing	Other	MP3 + headphones	After entering examination room	Entire examination
Brix 2022 [15]	Music therapy	Routine nursing	Light music	Headphones	30 minutes before examination	30 minutes before + entire examination
Andrada 2003 [16]	Music therapy	Routine nursing	Classical music	Headphones	Before examination	Before + entire examination
Hayes 2003 [17]	Music therapy	Routine nursing	Self-selected music	Not mentioned	15 minutes before examination	15 minutes before + entire examination
Silva 2016 [18]	Music therapy	Routine nursing	Self-selected music	Headphones	After entering examination room	Entire examination
Zhou 2014 [19]	Music therapy	Routine nursing	Self-selected music	Not mentioned	Not mentioned	Not mentioned
Deng 2007 [3]	Music therapy	Routine nursing	Self-selected music	MP3	15 minutes before examination	15 minutes before + entire examination
Wang 2010 [20]	Music therapy	Routine nursing	Soothing background music	Not mentioned	Not mentioned	Not mentioned
Zhang 2022 [21]	Music therapy	Routine nursing	Self-selected music	Headphones	5 minutes before examination	5 minutes before + entire examination
Wang 2010 [22]	Music therapy	Routine nursing	Self-selected music	Not mentioned	20 minutes before examination	20 minutes before examination
Luo 2016 [23]	Music therapy	Routine nursing	Self-selected music	Not mentioned	Not mentioned	Not mentioned
Wang 2009 [24]	Music therapy	Routine nursing	Soothing background music	Speaker	After entering examination room	Entire examination
Luo 2010 [25]	Music therapy	Routine nursing	Self-selected music	Headphones	20 minutes before examination	20 minutes before + entire examination
Huang 2010 [26]	Music therapy	Routine nursing	Light music	Not mentioned	Not mentioned	Not mentioned
Li 2008a [27]	Music therapy	Routine nursing	Self-selected music	Headphones	Not mentioned	Not mentioned
Li 2008b [27]	Music therapy	Routine nursing	Self-selected music	Speaker	Not mentioned	Not mentioned

3.4. Quantitative syntheses

3.4.1. Anxiety

Ten groups of data from 9 RCTs involving 1,130 patients reported the effect of music intervention on anxiety levels in patients undergoing colonoscopy [4–6,11,12,14,16,17,21]. The overall heterogeneity test showed $I^2 = 73.9\%$, so a random-effect model was used for meta-analysis. The pooled results showed that compared with the control group, music intervention significantly improved patients' anxiety (SMD = -0.61; 95% CI [-0.84, -0.38]; $p < 0.0001$), with a statistically significant difference between the two groups (**Figure 3**)

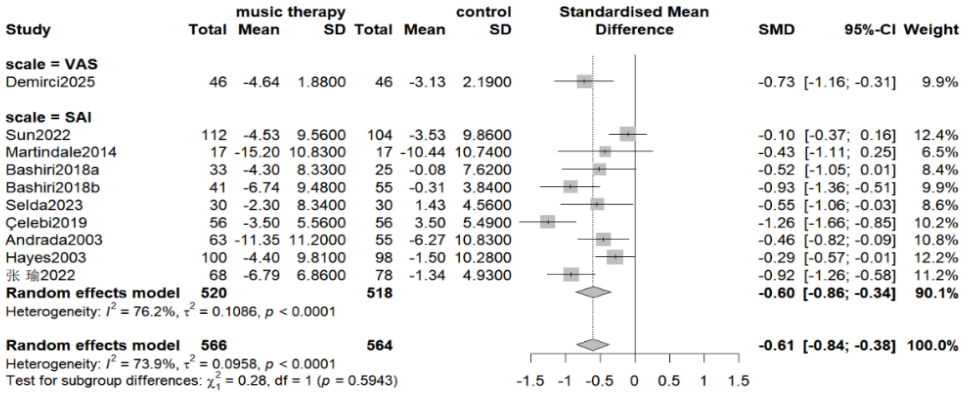


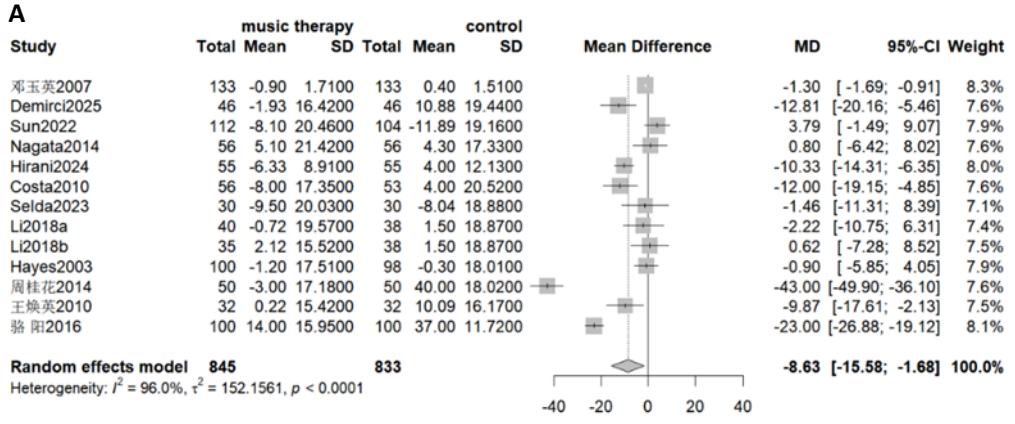
Figure 3. Meta-analysis of anxiety in patients after music therapy intervention.

3.4.2. Blood pressure

Thirteen groups of data from 12 RCTs involving 1,678 patients reported the effect of music intervention on systolic blood pressure [3–5,7,9,10,12,13,17,19,22,23]. The heterogeneity test showed I^2 = 96.0%, so a random-effect model was used. The pooled results showed that music intervention significantly reduced systolic blood pressure compared with the control group (MD = -8.63; 95% CI [-15.58, -1.68]; p = 0.015), with a statistically significant difference.

Thirteen groups of data from 12 RCTs involving 1,592 patients reported the effect on diastolic blood pressure [3–5,7,8,10,12-14,17,22,24]. The heterogeneity test showed I^2 = 48.4%, so a fixed-effect model was used. The pooled results showed that music intervention significantly reduced diastolic blood pressure (MD = -0.92; 95% CI [-1.77, -0.07]; p = 0.034), with a statistically significant difference.

Five groups of data from 4 RCTs involving 628 patients reported the effect on mean arterial pressure [5,11,25,26]. Bashiri 2018a was excluded from the pooled analysis because the standard deviation of the control group was 0 and the effect size could not be calculated. The overall heterogeneity test showed I^2 = 94.2%, so a random-effect model was used. The pooled results showed that music intervention significantly reduced mean arterial pressure (MD = -7.77; 95% CI [-13.24, -2.29]; p = 0.005), with a statistically significant difference (**Figure 4**).



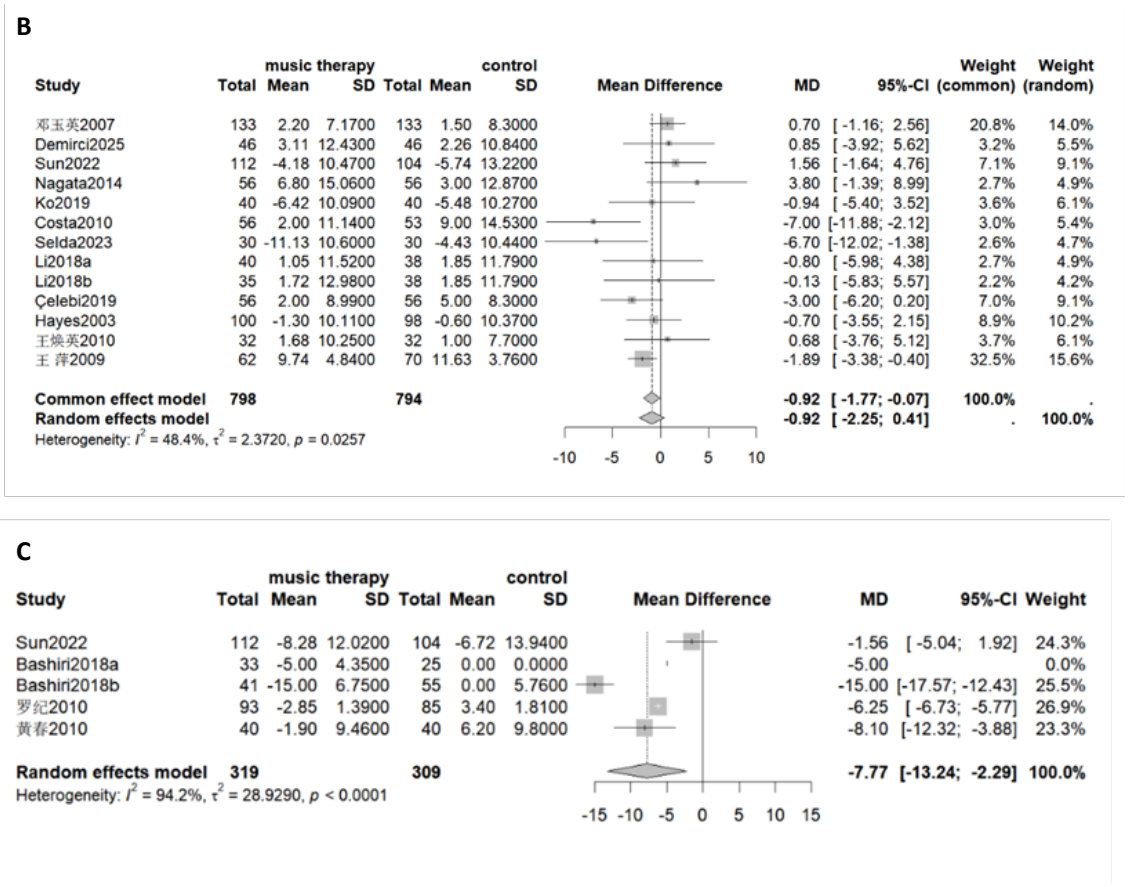


Figure 4. Meta-analysis of blood pressure in patients after music therapy intervention: (A) Systolic blood pressure; (B) Diastolic blood pressure; (C) Mean arterial pressure.

3.4.3. Heart rate

Seventeen groups of data from 15 RCTs involving 2,182 patients reported the effect of music intervention on the change difference of heart rate before and after intervention. The overall heterogeneity test showed I^2 = 91.9%, so a random-effect model was used [3–5,7,9,11,12,14,17,19,22,23,25–27]. The pooled results showed that music intervention significantly reduced overall heart rate compared with the control group (MD = -11.65; 95% CI [-15.72, -7.58]; p < 0.0001), with a statistically significant difference.

Subgroup analysis results: ① Subgroup with unspecified music listening method: Pooled MD=-15.66 (95% CI [-26.34, -4.98]; p = 0.004), statistically significant; ② In-ear listening subgroup: Pooled MD = -10.27 (95% CI [-14.49, -6.05]; p < 0.0001), statistically significant; ③ Non-in-ear listening subgroup: Pooled MD = -9.11 (95% CI [-18.96, 0.74]; p = 0.070), not statistically significant. Overlapping CIs between subgroups indicated no significant difference in the effect of different music listening methods on heart rate. High heterogeneity existed within all subgroups (unspecified group I^2 = 96.3%, in-ear group I^2 = 88.5%, non-in-ear group I^2 = 85%), suggesting large differences in intervention protocols and study populations within subgroups (**Figure 5**).

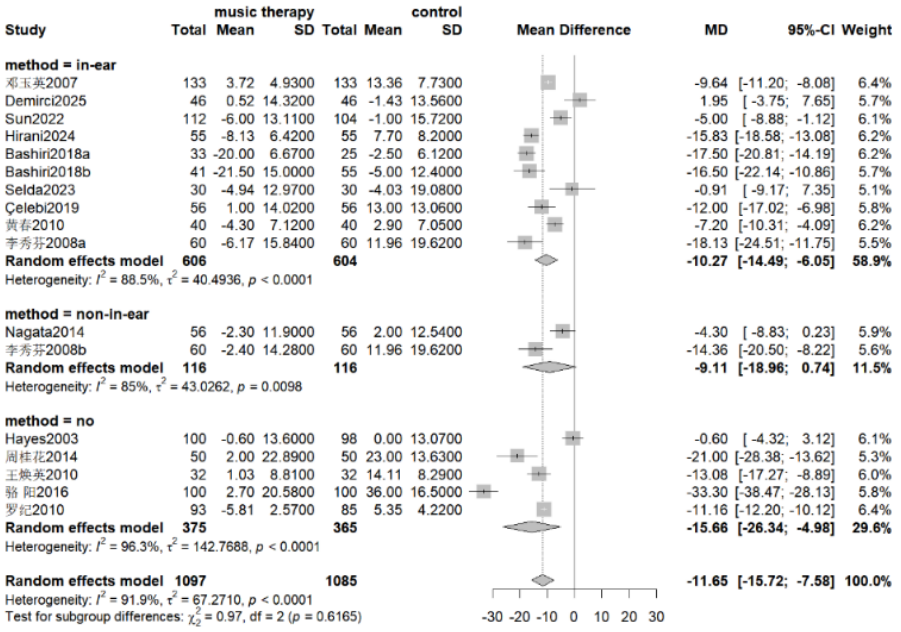


Figure 5. Meta-analysis of heart rate change difference in patients after music therapy intervention.

3.4.4. Respiratory rate and colon intubation success rate

Three RCTs involving 354 patients reported the effect of music intervention on respiratory rate. The heterogeneity test showed I^2 = 96.6%, so a random-effect model was used [14,22,25]. The pooled results showed no statistically significant difference in respiratory rate between the music intervention group and the control group (MD = -1.18; 95% CI [-2.38, 0.02]; p = 0.055).

Five RCTs involving 1,798 patients reported the effect on colon intubation success rate [12,15,16,18,20]. The heterogeneity test showed I^2 = 29.9%, so a fixed-effect model was used. The pooled results showed that music intervention significantly improved the success rate of colon intubation compared with the control group (RR = 1.04; 95% CI [1.01, 1.07]; p = 0.002), with a statistically significant difference (**Figure 6**).

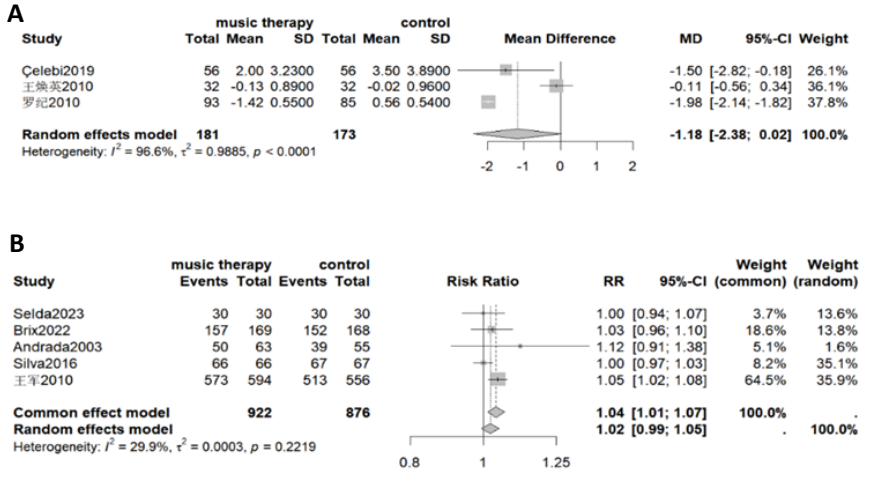


Figure 6. Meta-analysis of (A) respiratory rate and (B) colon intubation success rate in patients after music therapy intervention.

3.5. Sensitivity analysis

Sensitivity analysis was performed for the four indicators of anxiety, systolic blood pressure, diastolic blood pressure and heart rate by sequentially excluding each included study. The results showed that the direction of pooled effect sizes, statistical significance and inter-study heterogeneity levels did not change substantially. No reversal of effect results or significant changes in statistical significance were observed. The meta-analysis conclusions for anxiety, systolic blood pressure, diastolic blood pressure and heart rate were robust and reliable, with little influence from single studies (**Figure 7** and **8**).

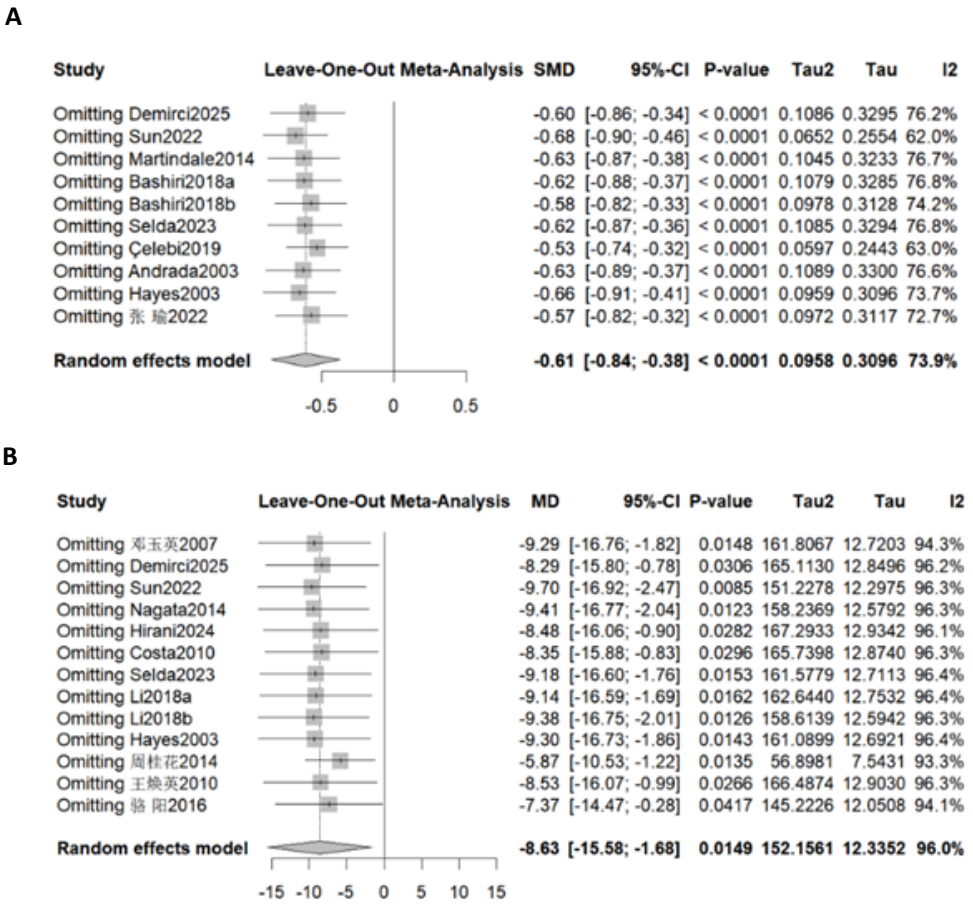


Figure 7. Sensitivity analysis: (A) Anxiety; (B) Systolic blood pressure.

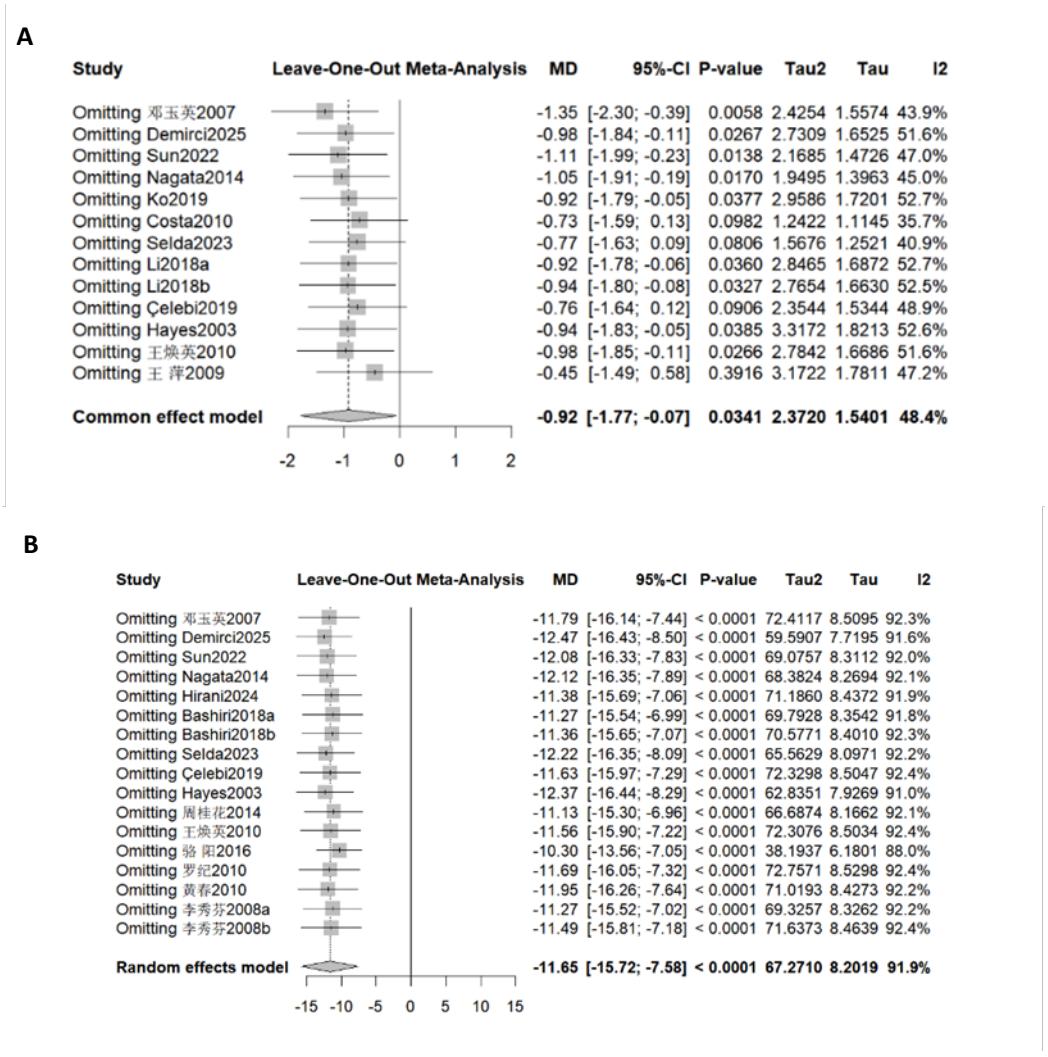


Figure 8. Sensitivity analysis: (A) Diastolic blood pressure; (B) Heart rate change difference.

4. Discussion

4.1. Summary and interpretation of results

This meta-analysis evaluated the intervention effect of music therapy during colonoscopy. The results showed that music therapy could alleviate patients' anxiety during the examination. Existing studies suggest that music can induce psychophysiological responses through the right hemisphere via the limbic system, coordinate muscle tension and movement, and produce anti-anxiety effects [14]. It has also been confirmed that music can stimulate the pituitary gland to secrete more endorphins, thereby relieving pain and reducing anxiety levels [28]. At the psychological and behavioral level, music reduces negative experiences by diverting attention and inducing positive imagination. The acoustic vibration information of music through coordination, rhythm and melody can divert patients' attention, help them forget worries, increase a sense of security and comfort, and reduce anxiety and fear [26]. Even 15 minutes of self-selected music can significantly reduce anxiety before gastrointestinal examinations [17].

From a physiological perspective, anxiety is mainly a defensive biological process mediated by the sympathetic nervous system. Sympathetic nervous system excitation leads to vasoconstriction (increased

blood pressure) and tachycardia. Music therapy can help patients adapt physiologically to the colonoscopy procedure, reduce sympathetic nervous system excitation and anxiety, thereby lowering blood pressure and heart rate [29].

In terms of regulating physiological indicators, the meta-analysis results showed that music therapy could reduce blood pressure (systolic, diastolic and mean arterial) and heart rate. Studies have found that light music can inhibit efferent impulses from the cerebral cortex, reduce visceral sympathetic nerve excitation, and prevent intestinal spasm and sudden increases in blood pressure and heart rate [26]. When the music rhythm is lower than the heart rate (average 72 beats per minute), slow and regularly paused, and at a moderate volume, it can achieve a relaxation effect by slowing and deepening breathing, lowering blood pressure and relaxing muscles [6]. In addition, endoscopic procedures can induce a typical endocrine metabolic stress response [30]. Music can promote the secretion of enkephalins and reduce catecholamine levels, regulating endocrine function and thereby lowering heart rate and blood pressure [19]. Meanwhile, music can reduce sympathetic nervous system activity and increase parasympathetic nervous system activity to attenuate this response [31]. It can also affect the release of brain neurotransmitters such as acetylcholine and norepinephrine, leading to decreased blood pressure and slowed respiratory and heart rates [20].

The meta-analysis results also showed that music therapy could improve the success rate of colon intubation. Studies have shown that piano light music can reduce patients' anxiety, improve satisfaction with colonoscopy, pain management and service satisfaction, and reduce the difficulty of colonoscopy operation [5].

No statistically significant improvement in respiratory rate was observed in this meta-analysis, although Çelebi 2019 and Luo 2010 reported that music therapy could reduce respiratory rate changes during examination [14,25]. This discrepancy may be due to individual differences in sample sizes, music types, intervention durations and geographical regions among included studies. The effectiveness of music in reducing respiratory rate during examination requires further in-depth investigation in future studies to identify the specific reasons for the differences.

Both Demirci and Sun confirmed that music therapy significantly reduced anxiety levels in patients undergoing colonoscopy, but no significant changes were observed in vital signs in either study [4,5]. These results are not contradictory but complementary: Demirci used binaural beats (theta waves), while Sun used piano light music, and both reached consistent conclusions on anxiety improvement [4,5]. The differences may stem from variations in music type, intervention timing and patient baseline characteristics, which require further verification through standardized intervention studies in the future.

4.2. Limitations

There are various restrictions on this study. Firstly, the quality of included studies was generally low, with most not describing random allocation and allocation concealment methods in detail, and poor implementation of blinding. Secondly, some studies had small sample sizes, and insufficient statistical power may affect the stability of results. Thirdly, lack of standardized intervention protocols (no uniform standards for music type, intervention duration, equipment type and intervention mode), which may be a source of high heterogeneity in some outcome indicators. Fourthly, individual factors such as patient age, music preference and cultural background were not fully considered as moderators of intervention effect. Lastly, inconsistent outcome indicator monitoring, including differences in measurement time points and tools for physiological indicators, increased heterogeneity in pooled analysis. Existing evidence supports music therapy as an

effective adjuvant intervention during the peri-colonoscopy period, but its clinical application still lacks standardized protocols, and the quality of included studies is limited. More high-quality, standardized large-sample RCTs are needed in the future to verify its effect and clarify the optimal intervention mode, so as to provide more comprehensive evidence-based support for optimizing peri-colonoscopy nursing.

5. Conclusion

As the gold standard for the diagnosis and screening of colorectal diseases, the invasive nature of colonoscopy often leads to patient refusal. Music therapy has the advantages of being safe, non-invasive, cost-effective and easy to implement. It requires no special equipment and can be routinely promoted in hospitals at all levels, especially primary endoscopy centers, as an important supplement to routine nursing to reduce cardiovascular stress responses during the peri-examination period.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Al-Shamali M, Kalaoui M, Hasan F, et al., 2001, Colonoscopy: Evaluating Indications and Diagnostic Yield. Ann Saudi Med, 21(5–6): 304–307.

[2] Hoffman A, Teubner D, Kiesslich R, 2014, Competition in Colon Cancer Screening? What Is the Role of Colonoscopy? Visceral Medicine, 30(1): 18–25.

[3] Deng Y, Chen X, Li X, et al., 2007, Study on Individualised Music Intervention to Relieve Pain in Patients Undergoing Colonoscopy. Nursing Practice and Research, 4(13): 3–6.

[4] Demirci S, Sezer S, Pirincci S, 2025, Effect of Binaural Beats on Pain, Anxiety, and Procedure Tolerance in Patients Undergoing Colonoscopy Without Sedation: A Randomised Controlled Trial. European Research Journal, 11(2): 270–278.

[5] Sun D, You Y, He X, et al., 2022, Effects of Light Music Played by Piano Intervention on Satisfaction, Anxiety, and Pain in Patients Undergoing Colonoscopy: A Randomised Controlled Trial. Medicine, 101(52): e32339.

[6] Martindale F, Mikocka-Walus A, Walus B, et al., 2014, The Effects of a Designer Music Intervention on Patients' Anxiety, Pain, and Experience of Colonoscopy: A Short Report on a Pilot Study. Gastroenterology Nursing, 37(5): 338–342.

[7] Nagata K, Iida N, Kanazawa H, et al., 2014, Effect of Listening to Music and Essential Oil Inhalation on Patients Undergoing Screening CT Colonography: A Randomised Controlled Trial. European Journal of Radiology, 83(12): 2172–2176.

[8] Ko S, Leung D, Wong E, 2019, Effects of Easy Listening Music Intervention on Satisfaction, Anxiety, and Pain in Patients Undergoing Colonoscopy: A Pilot Randomised Controlled Trial. Clinical Interventions in Aging, 14: 977–986.

[9] Hirani A, Ismail F, Abdulaziz F, et al., 2024, The Effects of Music Therapy on Patients Undergoing Colonoscopy in a Tertiary Care Hospital at Karachi, Pakistan: A Comparative Study. Journal of Pain & Palliative Care Pharmacotherapy, 38(3): 233–243.

[10] Costa A, Montalbano L, Orlando A, et al., 2010, Music for Colonoscopy: A Single-Blind Randomised Controlled Trial. Digestive and Liver Disease, 42(12): 871–876.

[11] Bashiri M, Akçali D, Coşkun D, et al., 2018, Evaluation of Pain and Patient Satisfaction by Music Therapy in Patients with Endoscopy/Colonoscopy. Turkish Journal of Gastroenterology, 29(5): 574–579.

[12] Cakir S, Evirgen S, 2023, Three Distraction Methods for Pain Reduction During Colonoscopy: A Randomised Controlled Trial Evaluating the Effects on Pain and Anxiety. Journal of Perianesthesia Nursing, 38(5): e1–e7.

[13] Li L, Shu W, Li Z, et al., 2019, Using Yoga Nidra Recordings for Pain Management in Patients Undergoing Colonoscopy. Pain Management Nursing, 20(1): 39–46.

[14] Çelebi D, Yılmaz E, Şahin S, et al., 2020, The Effect of Music Therapy During Colonoscopy on Pain, Anxiety and Patient Comfort: A Randomised Controlled Trial. Complementary Therapies in Clinical Practice, 38: 101084.

[15] Brix L, Pedersen A, 2022, Effect of Music Intervention in Colonoscopy-Naïve Adults: A Randomised Controlled Trial. British Journal of Nursing, 31(10): 526–532.

[16] López-Cepero Andrada J, Amaya Vidal A, Castro Aguilar-Tablada T, et al., 2004, Anxiety During the Performance of Colonoscopies: Modification Using Music Therapy. European Journal of Gastroenterology & Hepatology, 16(12): 1381–1386.

[17] Hayes A, Buffum M, Lanier E, et al., 2003, A Music Intervention to Reduce Anxiety Prior to Gastrointestinal Procedures. Gastroenterology Nursing, 26(4): 145–149.

[18] De Silva A, Niriella M, Nandamuni Y, et al., 2016, Effect of Audio and Visual Distraction on Patients Undergoing Colonoscopy: A Randomised Controlled Study. Endoscopy International Open, 4(11): E1211–E1214.

[19] Zhou G, Luo Y, 2014, Application of Background Music in Electronic Colonoscopy in Primary Hospitals. Guide of China Medicine, 12(29): 176–177.

[20] Wang J, Yue Q, Yuan J, et al., 2010, The Role of Background Music in Colonoscopy. Journal of Hunan University of Chinese Medicine, 30(2): 30–31 + 36.

[21] Zhang Y, Yang F, Zhao J, et al., 2022, Effects of Attention Distraction Methods on Pain and Anxiety in Patients Undergoing Colonoscopy. Jilin Medical Journal, 43(8): 2065–2070.

[22] Wang H, 2010, Effect of Music Therapy on Preoperative Anxiety and Vital Signs in Patients Undergoing Colonoscopy. Modern Medicine & Health, 26(1): 68–69.

[23] Luo Y, 2016, Effect of Background Music Intervention on Patients Undergoing Colonoscopy. Medical Information, 29(15): 375.

[24] Wang P, Cai X, Xu J, et al., 2009, Application of Background Music in Ordinary Colonoscopy. China Journal of Endoscopy, 15(6): 630–632 + 635.

[25] Luo J, Man L, 2010, Effect of Music Therapy Intervention on Patients Undergoing Colonoscopy. Chinese Journal of Modern Nursing, 16(6): 670–671.

[26] Huang C, Lü L, Tan Y, et al., 2010, Nursing Application of Light Music in Colonoscopy. Medical Innovation of China, 7(33): 92–93.

[27] Li X, Yang L, Yin Y, 2008, Study on the Effect of Relaxing Music on Pain in Patients Undergoing Colonoscopy. Chinese Journal of Practical Nursing, 24(8C): 15–17.

[28] Ko C, Chen Y, Wu K, et al., 2017, Effect of Music on Level of Anxiety in Patients Undergoing Colonoscopy Without Sedation. Journal of the Chinese Medical Association, 80: 154–160.

[29] Smolen D, Topp R, Singer L, 2002, The Effect of Self-Selected Music During Colonoscopy on Anxiety, Heart Rate, and Blood Pressure. Applied Nursing Research, 16(2): 126–136.

[30] Tonnesen H, Puggaard L, Braagaard J, et al., 1999, Stress Response to Endoscopy. Scandinavian Journal of Gastroenterology, 34(6): 629–631.

[31] Zhang Y, Basnet D, Zhao Y, et al., 2025, One-Hour Music Intervention to Improve the Quality of Recovery in Female Patients Undergoing Elective Surgery After General Anaesthesia: A Single-Centre Randomised Clinical Study. Journal of Clinical Anaesthesia, 106: 111955.

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The Application Value of Empathy Training Based on Reflective Practice Theory in Enhancing Empathy Among Young Nurses

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Abstract: *Objective*: To explore the application effect of empathy training based on reflective practice theory among young nurses. *Methods*: Fifty young nurses from Suzhou Wuzhong People's Hospital from January 2020 to January 2025 were selected as the research subjects and randomly divided into an experimental group (25 individuals) and a control group (25 individuals) using a random number table method. The control group received conventional training, while the experimental group received empathy training based on reflective practice theory for a 6-month training period. The empathy abilities and nurse satisfaction of both groups were compared. *Results*: After 1, 3, and 6 months of training, the cognitive empathy scores of the experimental group were (52.52 ± 3.28), (57.14 ± 3.85), and (62.35 ± 4.85) points, respectively, and the emotional empathy scores were (50.22 ± 3.98), (53.12 ± 4.27), and (58.17 ± 4.23) points, respectively, all higher than those of the control group [(46.72 ± 3.02), (50.26 ± 3.54), (56.77 ± 4.03), (54.18 ± 4.13), (58.99 ± 4.85), and (63.06 ± 5.12) points], with statistically significant differences (t = 6.504, 6.577, 4.425, 3.452, 4.542, 3.682, $p < 0.05$). The nurse satisfaction rate in the experimental group was 96.00% (24/25), higher than that in the control group (68.00%, 17/25), with a statistically significant difference ($\chi^2 = 4.878$, $p = 0.027$). *Conclusion*: Empathy training based on reflective practice theory can effectively enhance the empathy abilities of young nurses and improve their job satisfaction, demonstrating high clinical application value.

Keywords: Young nurses; Reflective practice theory; Empathy training; Application value

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1. Introduction

Empathy is a crucial component of a nurse's core professional qualities, referring to the ability to understand a patient's emotional experiences, needs, and suffering from their perspective and provide appropriate emotional responses [1,2]. Young nurses, as the new force in the nursing team, possess solid professional theoretical knowledge but often face challenges such as weak empathy awareness and rigid empathy

expression due to insufficient clinical experience and lack of communication skills [3]. Reflective practice theory emphasizes promoting practitioners' critical examination of their behaviors, thoughts, and emotional responses through reflection-in-action and reflection-on-action, thereby summarizing experiences and improving practice [4]. Applying this theory to the empathy training of young nurses helps guide them to actively identify deficiencies in empathy expression during clinical interactions, analyze the reasons in depth, and enhance their ability to perceive and respond to patients' emotions. Currently, research on the application of reflective practice theory in empathy training for nurses in China is insufficient, especially lacking systematic training programs tailored to young nurses. In view of this, this study divided 50 young nurses into groups to analyze the application effect of empathy training based on reflective practice theory. The results are as follows.

2. Materials and methods

2.1. General information

Fifty young nurses from Suzhou Wuzhong People's Hospital from January 2020 to January 2025 were selected as the research subjects and randomly divided into two groups, with 25 individuals in each group.

2.1.1. Control group

1 male and 24 females; aged 21–26 years, with an average age of (24.06 ± 1.08) years; body mass index (BMI) of 17.9–27.2 kg/m^2, with an average BMI of (22.54 ± 1.93) kg/m^2.

2.1.2. Experimental group

1 male and 24 females; aged 22–26 years, with an average age of (24.11 ± 1.02) years; BMI of 17.5–26.8 kg/m^2, with an average BMI of (22.58 ± 1.85) kg/m^2. There were no significant differences in baseline data between the two groups ($p > 0.05$), indicating comparability.

2.2. Inclusion criteria

(1) Holding a nurse practitioner qualification certificate;
(2) Able to complete the entire training and evaluation process.

2.3. Exclusion criteria

(1) Presence of mental illness or cognitive dysfunction;
(2) Severe somatic diseases;
(3) Unable to participate fully during the training period due to reasons such as maternity leave or sick leave;
(4) Participating in other similar empathy training programs concurrently.

2.4. Methods

The control group received conventional training, with teacher-led lectures as the core teaching method. Teachers were responsible for systematically imparting theoretical knowledge, and students summarized and mastered the knowledge through writing reflective diaries, discussing case studies, and completing after-class exercises. The experimental group received empathy training based on reflective practice theory:

(1) Theoretical foundation and cognitive awakening

Lectures were conducted by nursing psychology experts and senior head nurses, covering the core concepts and clinical value of empathy, the current status of empathy abilities among young nurses, the connotation of reflective practice theory, and the basic principles and techniques of empathy expression in nurse-patient communication. Additionally, two case analyses were incorporated during the lectures to guide students in analyzing the manifestations and consequences of insufficient empathy in clinical typical cases and discussing improvement directions based on the theory, thereby initially establishing their awareness of empathy and reflection.

(2) Practical experience and reflection training

Scenario simulations and role-plays were conducted, with students divided into three roles: nurses, family members, and patients, to experience emotions and needs from different perspectives through role rotation. After each role-play, nurses shared their performance, deficiencies, and improvement directions, which were then commented on and supplemented by trainers and other nurses. In daily nursing work, nurse-patient interaction cases with successful or unsuccessful empathy were recorded, with 1–2 cases recorded each time. A reflective diary was filled out, including the event process, the nurse's emotions, thoughts, and behaviors at the time, the patient/family member's reactions, analysis of the reasons for insufficient empathy based on reflective practice theory, and formulation of improvement measures for the next time. Trainers reviewed the reflective diaries weekly and provided one-on-one guidance to students.

(3) Skill enhancement and in-depth reflection

Group exercises and immediate feedback were conducted for high-frequency scenarios such as non-verbal expression, verbal response, and communication in conflict situations. Additionally, two group reflection seminars were organized, during which each group deeply discussed selected reflective diary cases, analyzed differences and deficiencies in empathy practice, and explored paths to transform reflection outcomes into sustained improvement motivation. Trainers provided final comments and summaries.

(4) Summary enhancement and outcome consolidation

One personal summary and plan session was arranged, during which each nurse systematically reviewed their own growth and formulated a long-term plan for enhancing empathy abilities. Finally, an experience-sharing session was held, inviting outstanding nurses to share their insights and cases, promoting experience dissemination. Trainers summarized the entire training system and emphasized the core value of reflective practice for the sustained development of empathy abilities. Both groups received continuous training for 6 months.

2.5. Observation indicators

(1) Empathy abilities

Before training and after 1, 3, and 6 months of training, the Jefferson Scale of Empathy (JSE-HP) was used for evaluation, covering two dimensions: cognitive empathy (10 items, 10-70 points) and emotional empathy (10 items, 10–70 points) [5]. Higher scores indicated better empathy abilities.

(2) Nurse satisfaction

Assessed using a self-made satisfaction questionnaire from our hospital, covering three aspects: job achievement, harmony in nurse-patient relationships, and occupational self-worth. The total score

was 100 points, with scores of 90–100 indicating very satisfied, 60–89 indicating satisfied, and 0–59 indicating dissatisfied.

2.6. Statistical analysis

Statistical data were analyzed using SPSS 29.0 software. Count data were expressed as "n (%)" and subjected to χ^2 tests. Measurement data were expressed as "$\overline{x} \pm s$" and subjected to *t* tests. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of empathy abilities between the two groups

Before training, there were no statistically significant differences in cognitive empathy and emotional empathy scores between the two groups ($p > 0.05$). After 1, 3, and 6 months of training, the cognitive empathy and emotional empathy scores of the experimental group were higher than those of the control group, with statistically significant differences ($p < 0.05$). See **Table 1**.

Table 1. Comparison of empathy abilities between the two groups ($\overline{x} \pm s$, points)

Group	n	Cognitive empathy				Affective empathy			
		Before training	1 month after training	3 months after training	6 months after training	Before training	1 month after training	3 months after training	6 months after training
Control group	25	35.91 ± 3.87	46.72 ± 3.02*	50.26 ± 3.54*	56.77 ± 4.03*	38.95 ± 3.72	50.22 ± 3.98*	53.12 ± 4.27*	58.17 ± 4.23*
Experimental group	25	35.99 ± 3.75	52.52 ± 3.28*	57.14 ± 3.85*	62.35 ± 4.85*	38.59 ± 3.94	54.18 ± 4.13*	58.99 ± 4.85*	63.06 ± 5.12*
t		0.074	6.504	6.577	4.425	0.332	3.452	4.542	3.682
p		0.941	< 0.001	< 0.001	< 0.001	0.741	0.001	< 0.001	0.001

Note: Compared with the same group before training, *$p < 0.05$.

3.2. Comparison of nurse satisfaction between the two groups

The nurse satisfaction rate in the experimental group was higher than that in the control group, with a statistically significant difference ($p < 0.05$). See **Table 2**.

Table 2. Comparison of nurse satisfaction between the two groups (n (%))

Group	n	Very satisfied	Satisfied	Dissatisfied	Overall satisfaction
Control group	25	7 (28.00)	10 (40.00)	8 (32.00)	17 (68.00)
Experimental group	25	20 (80.00)	4 (16.00)	1 (4.00)	24 (96.00)
χ^2					4.878
p					0.027

4. Discussion

Insufficient empathy among young nurses can easily lead to poor nurse-patient communication, resulting in patient dissatisfaction, complaints, and even medical disputes. This not only affects the quality of nursing

services but also reduces nurses' professional identity and job satisfaction [6,7]. Currently, conventional empathy training for young nurses primarily focuses on theoretical instruction, where experts deliver lectures and demonstrate cases to convey empathy concepts and communication skills. This approach can quickly help nurses establish a foundational understanding and recognize the importance of empathy in clinical practice. However, conventional training relies excessively on one-way knowledge transfer, lacking immersive practical experiences. As a result, nurses can only passively receive theoretical knowledge, making it difficult to translate abstract skills into clinical behaviors. Moreover, conventional training lacks targeted reflective guidance [8,9].

The results of this study show that after 1, 3, and 6 months of training, the experimental group demonstrated significantly higher scores in cognitive empathy and emotional empathy compared to the control group ($p < 0.05$). This suggests that empathy training based on reflective practice theory can improve young nurses' empathy abilities. The professional lectures delivered by nursing psychology experts and senior nurse managers, grounded in reflective practice theory, provided nurses with a solid theoretical framework. The course content clearly explained the core concepts of empathy and distinguished between cognitive and emotional empathy. By integrating clinical realities, it highlighted the critical role of empathy in alleviating patient anxiety and reducing nurse-patient conflicts. Additionally, the course offered an in-depth interpretation of the connotations of reflective practice theory, enabling nurses to better understand how to apply the two modes of reflection, reflection-in-action and reflection-on-action, to optimize their empathetic behaviors. Furthermore, by presenting specific clinical scenarios, nurses were guided to actively analyze their own or others' deficiencies in empathy, facilitating a shift from passive knowledge acquisition to proactive thinking about improvement directions. The establishment of self-awareness in empathy and reflection laid a solid cognitive foundation for subsequent skill enhancement [10].

During the practical experience and reflective training phase, nurses took turns playing the roles of nurses, patients, and family members in simulated clinical settings, experiencing the emotions and needs of different identities firsthand. This deepened their understanding of empathy from theoretical cognition to emotional identification. After role-playing, nurses reviewed the strengths and weaknesses of their performances, clarified their improvement directions, and received feedback from peers and trainers on their strengths and weaknesses, enhancing their awareness. The continuous recording of reflective journals, with detailed descriptions of interaction processes, personal emotions and behaviors, and patient and family responses, enabled nurses to better analyze the underlying causes of empathy deficiencies. Weekly one-on-one guidance ensured the depth and effectiveness of reflection, allowing nurses to steadily improve their empathy abilities through cycles of practice and reflection. Personal summaries enabled nurses to comprehensively review their growth journeys during the training period, identify empathy shortcomings, and develop targeted, personalized long-term improvement plans. Sharing clinical cases where empathy was successfully applied by outstanding nurses provided practical examples for reference, facilitating the widespread dissemination of excellent experiences. Finally, the lasting value of reflective practice theory was re-emphasized in the concluding summary, guiding nurses to internalize reflection as a professional habit and ensuring continuous self-optimization in future clinical work. The results of this study show that nurse satisfaction in the experimental group was significantly higher than that in the control group ($p < 0.05$), suggesting that empathy training based on reflective practice theory helps improve nurse satisfaction. The reasons are as follows: Through systematic empowerment from theory to practice, the training enabled

nurses to gradually master empathy communication skills, allowing them to respond to negative emotions more calmly and find a sense of self-worth, thereby reducing frustration caused by insufficient abilities. After the training, improved empathy skills enabled nurses to proactively inquire about patients' feelings and respond patiently to their needs, making patients feel understood and respected. This reduced nurse-patient communication conflicts, meaning nurses did not need to frequently handle complaints and nurse-patient confrontations, creating a more harmonious work atmosphere. Meanwhile, positive feedback from patients provided nurses with positive incentives, giving them a sense of job accomplishment. Additionally, during the training, nurses felt supported and attended to through peer evaluations during role-playing, one-on-one guidance for reflective journals, and positive incentives from experience-sharing sessions. The learning methods were more diverse, and nurses were more proactive. The guidance in personal summaries and long-term planning made nurses feel their own growth, strengthening their identity and sense of belonging in nursing work and thus significantly improving satisfaction.

5. Conclusion

To explore the application value of empathy training based on reflective practice theory among young nurses, 50 young nurses from Suzhou Wuzhong People's Hospital were selected and randomly divided into an experimental group and a control group, with 25 nurses in each group. The control group received conventional training, while the experimental group underwent systematic training based on reflective practice theory over a 6-month period. The empathy abilities and nurse satisfaction of the two groups were compared. The results showed that after 1, 3, and 6 months of training, the experimental group demonstrated significantly higher scores in cognitive empathy and emotional empathy compared to the control group ($p < 0.05$). Nurse satisfaction in the experimental group was 96.00%, much higher than the 68.00% in the control group ($p < 0.05$). The study indicates that this training model, through theoretical foundation-building, practical reflection, skill enhancement, and outcome consolidation, can effectively guide young nurses to proactively reflect on deficiencies in nurse-patient interactions, improve their empathy perception and response abilities, while also improving nurse-patient relationships, enhancing nurses' professional identity, and significantly increasing their job satisfaction. In conclusion, empathy training based on reflective practice theory has important clinical application value in improving the core competencies of young nurses and optimizing the quality of nursing services, making it worthy of promotion.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Li P, Yin X, 2025, A Study on the Mediating Effect of Empathy Ability Between Nurses' Professional Identity and

Reflective Ability. China Medical Herald, 22(1): 104–109.

[2] Xu L, Song M, Wu X, et al., 2024, A Study on the Mediating Effect of Medical Narrative Ability Between Clinical Nurses' Empathy and Humanistic Care Qualities. Journal of Nursing Administration, 24(5): 408–412.

[3] Yan J, Hu G, Wu Y, et al., 2023, The Correlation Between Empathy Ability, Communication Ability, and General Self-Efficacy Among Junior Nurses. Journal of Clinical Psychosomatic Diseases, 29(2): 50–54.

[4] Zhao M, Zhuang W, Li Y, et al., 2018, An Exploratory Application of In-Depth Discussions Based on Reflective Practice Theory in Midwifery Simulation Training. Chinese Journal of Medical Education, 38(3): 341–345.

[5] Zheng J, Zhu L, Xu H, et al., 2019, Reliability and Validity Testing of the Jefferson Scale of Empathy in Evaluating the Empathy Ability of Medical Undergraduates in Local Universities. Journal of Baotou Medical College, 35(12): 84–87.

[6] Wu Y, Shi C, Gong G, et al., 2023, An Analysis of the Mediating Effect of Empathy Ability Between Pediatric Nurses' Professional Identity and Clinical Communication Ability. Chinese Journal of Nursing Education, 20(7): 784–789.

[7] Zhao J, Jiang W, Cheng Y, et al., 2025, The Current Status and Influencing Factors of Empathy Ability Among Junior Nurses in an International Medical Center. International Journal of Nursing, 44(13): 2485–2489.

[8] Li L, Hua C, 2025, The Impact of Narrative Nursing Training Based on the Plan-Do-Check-Act Concept on Pediatric Nurses' Empathy and Humanistic Care Abilities. China Contemporary Medicine, 32(1): 142–145.

[9] Tian J, Fan L, 2024, The Application Effect of Balint Groups in Improving Junior Nurses' Empathy and Communication Abilities. Smart Healthcare, 10(22): 125–127.

[10] Wei J, Fang M, Chen T, 2024, The Application of a Reflective Practice Training Program Based on the RE-AIM and Kirkpatrick Models in Undergraduate Medical Teaching. China Continuing Medical Education, 16(16): 122–126.

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A Systematic Review of the Psychometric Properties of Patient Safety Culture Assessment Instruments

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Abstract: *Objective*: A comprehensive analysis of patient safety culture assessment tools for domestic and international patients was conducted to provide references for healthcare institutions in investigating safety culture and safety awareness, as well as for the development of related tools. *Methods*: A systematic search across nine databases, identified studies on tool development or validation. Data extraction was followed by methodological quality assessment using the COSMIN Risk of Bias checklist and evaluation of psychometric properties against updated criteria. *Results*: From 42 included studies (24 development, 18 validation), 24 distinct instruments were identified: 13 generic and 11 setting-specific. Commonly assessed dimensions were teamwork, communication openness, organizational learning, event reporting, staffing, and patient safety. *Conclusion*: Findings reveal a wide variety of instruments but no unified standard, underscoring the need for context-specific tools. It is recommended to develop concise, theoretically grounded localized instruments to support safety management. In China, independently developed tools remain limited. Future work should prioritize creating culturally adapted instruments with strong psychometric stability and applicability for the Chinese context.

Keywords: Patient safety; Patient safety culture; Measuring tools; Scoping review

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1. Introduction

As a core component of healthcare quality management, patient safety culture refers to the shared attitudes, beliefs, values, and behaviors among healthcare professionals in the process of ensuring patient safety [1]. In 2010, Sammer et al. identified seven subcultures of patient safety culture: leadership, teamwork, evidence-based practice, communication, learning, justice, and patient-centeredness [2]. The World Health Organization (WHO) emphasizes that establishing a positive patient safety culture is a strategic foundation for achieving healthcare safety goals, highlighting its role in fostering open communication, non-punitive

incident reporting, and continuous improvement mechanisms [3]. Studies have demonstrated that a positive safety culture is associated with reduced incidences of adverse nursing events, such as pressure injuries, medication errors, and patient falls [4,5]. However, as culture is an implicit and dynamic complex system, it cannot be directly assessed through subjective observation alone. Consequently, the development of scientifically sound and reliable measurement instruments has become a critical approach for quantitatively assessing safety culture levels and identifying organizational vulnerabilities. Patient safety culture assessment instruments enable the identification of latent safety risks within organizations and facilitate the implementation of targeted improvement strategies. To date, researchers worldwide have developed a variety of patient safety culture (PSC) assessment tools applicable to diverse healthcare settings, which have been widely used to evaluate the safety culture of hospitals and nursing institutions. These instruments are typically questionnaire-based and encompass multiple dimensions, including management commitment to safety, communication openness, teamwork, and incident reporting [6]. At present, internationally recognized patient safety culture assessment instruments are primarily represented by the Hospital Survey on Patient Safety Culture (HSOPS) developed by the Agency for Healthcare Research and Quality (AHRQ) and the Safety Attitudes Questionnaire (SAQ) [7,8]. These tools have evolved into multidimensional and standardized measurement instruments and have demonstrated progress in areas such as cross-cultural adaptation and intelligent data analysis. In China, existing studies have largely focused on the translation and cross-cultural adaptation of well-established international instruments. However, further evidence is still needed regarding the reliability and validity of these tools, as well as their practical applicability across diverse settings, including hospitals, long-term care facilities, and community healthcare environments [9]. Currently, this field faces several challenges, including insufficient development of localized assessment instruments, a lack of dynamic monitoring and longitudinal intervention studies, unclear mechanisms linking assessment outcomes with clinical safety endpoints, and limited cross-institutional data comparability due to heterogeneity in measurement indicators. Therefore, a systematic synthesis of the content, structure, and psychometric performance of existing domestic and international PSC assessment instruments is warranted. In accordance with the PRISMA extension for scoping reviews (PRISMA-ScR) published by Andrea et al. in 2018, this study conducts a scoping review of patient safety culture assessment instruments to provide evidence-based references for future research and clinical practice [10].

2. Materials and methods

2.1. Search strategy

This scoping review was conducted in accordance with the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis: Chapter on Scoping Reviews [11]. A comprehensive electronic search was performed in nine Chinese and international databases, including The Cochrane Library, PubMed, Web of Science, Embase, CINAHL, Wanfang Data, CNKI, VIP Database, and the Chinese Biomedical Literature Database (CBM). The search covered the period from database inception to August 26, 2025. In addition, manual searches of the reference lists of included studies were conducted to identify potentially relevant literature. A combination of controlled vocabulary terms and free-text keywords was used. Taking CNKI as an example for Chinese databases, the search strategy was as follows: SU% = (‘Patient Safety Culture’ OR ‘Patient Safety Culture’ OR ‘Safety Culture’ OR ‘Safety Awareness’ OR ‘Safety Attitude’ OR ‘Safety Climate’) AND

('Questionnaire' OR 'Survey' OR 'Scale' OR 'Measurement' OR 'Assessment' OR 'Tool'). For English databases, PubMed was used as an example, and the search strategy was: (("patient safety culture"[Title/Abstract]) OR ("patient safety climate"[Title/Abstract]) OR ("patients' safety climate"[Title/Abstract]) OR ("patients safety culture"[Title/Abstract]) OR ("safety culture"[Title/Abstract]) OR ("safety climate"[Title/Abstract])) AND (("Questionnaire"[Text Word]) OR ("Scale"[Text Word]) OR ("Survey"[Text Word]) OR ("Assessment"[Text Word])).

2.2. Eligibility criteria

2.2.1. Inclusion criteria

Studies focusing on the development, validation, or Chinese translation and cross-cultural adaptation of patient safety culture assessment instruments.

2.2.2. Exclusion criteria

(1) Studies published in languages other than Chinese or English;
(2) Publication types such as reviews, study protocols, or conference abstracts; and
(3) Studies for which the full text was unavailable.

2.3. Study selection and data extraction

All retrieved records were imported into EndNote 21 software for deduplication. Two members of the research team independently screened the literature. Initially, titles and abstracts were reviewed to exclude studies irrelevant to the research objectives. Subsequently, full-text screening was conducted for studies that met the inclusion and exclusion criteria. Any discrepancies were resolved through discussion between the two reviewers; if consensus could not be reached, a third reviewer was consulted for adjudication. Data were extracted from the included studies using a standardized form. Extracted information included the instrument name, authors, country of origin, year of publication, target population, scoring method, and primary assessment domains.

2.4. Quality assessment

Quality assessment was conducted in accordance with the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) guideline [12]. Two researchers independently evaluated the methodological quality and psychometric properties of the instruments and graded the level of evidence for each measurement property. Disagreements were resolved through discussion with a third researcher.

The COSMIN Risk of Bias checklist was applied, covering ten domains, including content validity, structural validity, and internal consistency [12]. For each domain, the overall rating was determined according to the lowest score assigned to any item within that domain. The rating options were "very good" "adequate" "doubtful" "inadequate" and "not applicable".

3. Results

3.1. Literature search results

A total of 4,327 records were identified through database searches, including 2,683 English-language publications and 1,644 Chinese-language publications. After the screening process, 42 studies were

ultimately included in the review, comprising 38 English-language and 4 Chinese-language studies. The literature selection process is illustrated in **Figure 1**.

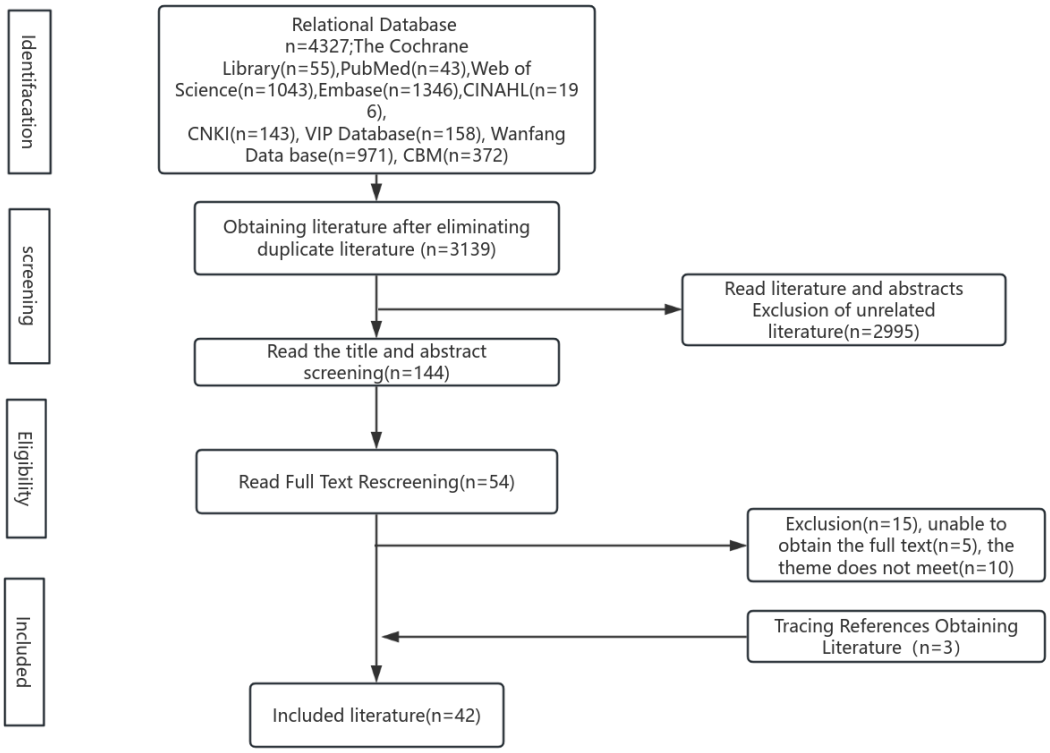


Figure 1. Flow chart of literature screening.

3.2. Characteristics and content summary of included studies

Among the included studies, 24 focused on instrument development and 18 on instrument validation. A total of 24 patient safety culture assessment instruments were identified, including 13 generic instruments and 11 setting-specific instruments [7,8,11,13–33]. Generic instruments were developed for use among all staff within comprehensive healthcare institutions, whereas setting-specific instruments targeted particular populations or healthcare settings. Of the setting-specific instruments, eight were designed for specific institutions or departments, including medical offices, nursing homes, community pharmacies, ambulatory surgery centers, radiology departments, dental hospitals, maternal and child healthcare institutions, and obstetric units [11,24–28,31,32]. The remaining three instruments were developed for specific populations, including healthcare administrators, medical students, and parents of pediatric patients [29,30,33]. The instruments were developed or validated in multiple countries, including the United States, the United Kingdom, Germany, the Netherlands, Indonesia, and Malaysia [7,11,13–15,18,19,21,24–27,29,32]. Six instruments were either developed by Chinese scholars or underwent Chinese translation and cross-cultural adaptation [17,20,22,23,31,33]. All included instruments were multidimensional scales administered through self-report questionnaires. Regarding the timeline of development, 11 instruments were developed between 1998 and 2010, 10 between 2011 and 2020, and 3 between 2021 and 2025. The basic characteristics of the included studies are presented in **Table 1**.

Table 1. Basic characteristics of patient safety culture assessment tools

Tool name	Author(s)	Country	Year	Target population	Dimensions / items
VA PSCS (Department of Veterans Affairs Patient Safety Culture Survey) [13]	Shiner,B. et al.	USA	1998	Department of Veterans Affairs staff	14 dimensions / 65 items
HSOPSC 1.0 (Hospital Survey on Patient Safety Culture) [7]	Westat.et al.	USA	2004	Hospital staff	12 dimensions / 51 items
TSCS (Teamwork and Safety Climate Survey questionnaire) [14]	Allen, Hutchinson et al.	UK	2006	Healthcare institution staff	5 dimensions / 22 items
SAQ (Safety Attitudes Questionnaire) [8]; AQ-SF [15]	Sexton, J.B. et al.	USA	2006	Hospital staff	6 domains / 60 items
PSCHO (Patient Safety Climate in Healthcare Organizations) [16]; PSCHO-SF [17]	Sara Singer et al.	USA	2007	Healthcare institution staff	9 dimensions / 38 items
NHSOPSC (Nursing Home Survey on Patient Safety Culture) [18]	Westat et al.	USA	2008	Nursing home staff	12 dimensions / 42 items
MOSOPSC (Medical Office Survey on Patient Safety Culture) [19]	Westat et al.	USA	2008	Medical office staff	10 dimensions / 38 items
MaPSaF (Manchester Patient Safety Framework) [20]	Arker, D. et al.	UK	2009	Healthcare and medical staff	9 dimensions / items not reported
PSCAS (Patient Safety Culture Assessment Scale) [21]	Chen, Fanglei et al.	China	2009	Hospital nursing staff	5 dimensions / 24 items
APSQ (Attitudes to Patient Safety questionnaire) [22]	Carruthers et al.	UK	2009	Medical students	9 dimensions / 26 items
CAS (cultural assessment survey) [23]	Kenneth Milne J. et al.	UK	2010	Obstetricians and nurses	6 subscales / 124 items
SCOPE (safety culture questionnaire for general practice) [24]	Zwart, D.L. et al.	Netherlands	2011	Healthcare personnel	8 dimensions / 46 items
HSOPS_M (Hospital Surveyon Patient Safety Culture for hospital Management) [25]	Antje Hammer et al.	Germany	2011	Senior hospital management	12 dimensions / 43 items
CPSOPSC (Community Pharmacy Survey on Patient Safety Culture) [11]	Westat et al.	USA	2012	Community pharmacy staff	11 dimensions / 36 items
SCOPE-PC **(safety culture questionnaire for** Primary Care) [26]	Verbakel, N.J. et al.	Netherlands	2013	Primary healthcare personnel	7 dimensions / 41 items
PSCQ (Patient Safety Culture Questionnaire) [27]	Jiang, He et al.	China	2013	Hospital nursing staff	8 dimensions / 36 items
ASCOPSC (Ambulatory Surgery Center Survey on Patient Safety Culture) [28]	Westat et al.	USA	2015	Ambulatory surgery center staff	8 dimensions / 27 items
PSCS-MCHI (patient safety culture scale for maternal and child health institutions) [29]	Yuanyuan Wang et al.	China	2018	Maternal and child healthcare staff	10 dimensions / 37 items
HSOPSC 2.0 (Hospital Survey on Patient Safety Culture) [30]	Westat et al.	USA	2019	Hospital staff	10 dimensions / 40 items
PSCSCHI (Patient Safety Culture Scale of Community-Level Healthcare Institutions) [31]	Lu, Chuntao et al.	China	2019	Primary healthcare institution staff	7 dimensions / 32 items

PVHSOPSC (Parental Version of Hospital Survey on Patient Safety Culture) [32]	Zeng, Xin et al.	China	2019	Parents of pediatric patients	4 dimensions / 14 items
PSCS-PC (Patient Safety Culture Scale for Chinese Primary Health Care Institution) [33]	Siyu Cheng et al.	China	2021	Primary healthcare institution staff	7 dimensions / 32 items
DOSOPSC (Dental Office Survey on Patient Safety Culture) [22]	Kusuma Arbianti et al.	Indonesia	2023	Dental hospital staff	10 dimensions / 35 items
SAQMI (Safety Attitude Quest- ionnaire for the medical imaging) [34]	Ravi Chanthriga Eturajulu et al.	Malaysia	2023	Hospital radiology department staff	5 dimensions / 22 items

3.3. High-frequency dimensions of patient safety culture assessments and variability across instruments

Among the included instruments, the most frequently assessed dimensions were teamwork (18 occurrences), communication openness (16 occurrences), organizational learning and continuous improvement (15 occurrences), event reporting (14 occurrences), staffing and work pressure (12 occurrences), and patient involvement (9 occurrences). In the past five years, several newly introduced dimensions have emerged, including openness of communication with parents, parents' overall perceptions of safety, patient involvement in safety, overall commitment to quality, open communication, patient safety improvement, quality commitment, safety and teamwork climate, working conditions, patient care tracking/follow-up, and standardization of office workflows. In contrast, dimensions related to negative emotions, such as shame and fear of blame, have become less prevalent in recent instruments.

From a cross-national perspective, patient safety culture assessment instruments developed in Europe and the United States such as the HSOPS, SAQ, and PSCHO tend to emphasize management support, organizational learning, and a non-punitive culture, reflecting a strong focus on systematic improvement within healthcare systems [7,8,16]. The MaPSaF instrument places particular emphasis on commitment to quality, aligning with European healthcare quality accreditation frameworks [20]. In contrast, patient safety culture assessment instruments developed in China place greater emphasis on perceived punitive responses, resource allocation at the primary care level, and patient involvement, reflecting the complexity of doctor-patient relationships and constraints in primary healthcare resources. Notably, the maternal and child healthcare instrument PSCS-MCHI incorporates dimensions related to defensive medical practices, highlighting characteristics of clinical behavior in high-risk healthcare environments [29]. In developing countries, such as Indonesia, assessment instruments like DOSOPS focus on staff training and work pressure, reflecting challenges related to workforce shortages and occupational burnout [22].

From an institutional perspective, instruments developed for comprehensive hospitals, such as the HSOPS and SAQ, emphasize core dimensions including teamwork, handoffs and transitions, and interdepartmental collaboration. In contrast, instruments designed for primary care or community-based settings, such as the SCOPE-PC and PSCS-PC, focus on resource allocation, open communication, and patient safety training, reflecting the practical challenges of workforce and equipment shortages in primary healthcare settings [7,8,26,33]. Instruments developed for specialized institutions, including maternal and child healthcare facilities and dental hospitals, place greater emphasis on patient involvement and patient follow-up [22,29]. From the perspective of role-related power differentials, instruments targeting healthcare professionals such as the HSOPS and SAQ tend to emphasize work pressure, management support, and trust in technology

[7,8]. Instruments developed for medical students, such as the APSQ, include dimensions related to acceptance of patient safety training and attributions of error, aligning with competency development and educational objectives [30]. In contrast, instruments designed for patients or family members, such as the parent-version questionnaire, simplify dimensional structures and avoid technical terminology, thereby enhancing feasibility and usability [32].

3.4. Methodological quality and psychometric evaluation of patient safety culture assessment instruments

Regarding item development, nine instruments relied solely on literature review. Eleven instruments, including HSOPSC 2.0, incorporated interviews with target respondents [8,11,13,14,16,19–29]. Twelve instruments, such as SCOPE, employed the Delphi method, while eight instruments, including PSCS-MCHI, used all three methods in combination. With respect to sampling methods, sixteen instruments applied convenience sampling [7,11,15,17,19–34].

The methodological quality of instrument development was evaluated using the COSMIN Risk of Bias (RoB) checklist. For structural validity, thirteen instruments, including the SAQ, conducted both confirmatory and exploratory factor analyses, and were rated as very good in methodological quality [7,8,14,25–27,29–34]. Five instruments, such as PSCHO, performed exploratory factor analysis only and were rated as adequate [16,18,24,27,32]. For internal consistency, COSMIN recommends that each dimension be unidimensional and that Cronbach's alpha be calculated for each dimension. Among the included instruments, 15 instruments tested unidimensionality and reported Cronbach's alpha for each dimension, receiving a methodological quality rating of very good [7,16,18,19,25,27,29,30–34].

Regarding test-retest reliability, five instruments, including HSOPSC 1.0, calculated test-retest reliability using the Pearson correlation coefficient while accounting for systematic error, and were rated as very good [7,19,25,29,30]. Eight instruments, such as DOSOPS-C, calculated Pearson correlation coefficients without accounting for systematic error, resulting in a methodological quality rating of doubtful [14,18,21,22,26,27,32,33]. The psychometric properties of the instruments were further graded using the updated criteria for good measurement properties. Among the 13 instruments that assessed structural validity, seven instruments, including HSOPSC 1.0, met all criteria and were rated as sufficient [7,8,11,26,27,29,30]. For internal consistency, six instruments, including MOSOPSC, achieved a rating of sufficient [18,19,29,31–33]. Among the 14 instruments that assessed test-retest reliability, 11 instruments, such as DOSOPS-C, did not report intraclass correlation coefficients (ICCs) and were therefore rated as indeterminate [14,18,21–27,31–33]. Detailed information is provided in **Table 2**.

Table 2. Evaluation of the methodological and measurement properties of the PSC evaluation tool development study

Tool	Item development method	Sample			Structural validity		Internal consistency		Test-retest reliability	
		Sampling method	Sample size	Sample characteristics	MQ	QM	MQ	QM	MQ	QM
VA PSCS [13]	Literature review	Convenience sampling	28	Department of Veterans Affairs staff	-	-	-	-	Ade quate	Suff icient

HSOPSC 1.0 [7]	Literature review + Interviews with target population	Convenience sampling	50513	Hospital staff	Very good	Suffi cient	Very good	Indete rminate (0.62–0.85)	Very good	Sufficient
TSCS [14]	Literature review	Random sampling	897	Patient-contact healthcare staff	Very good	Insuff icient	Probl ematic	Indete rminate (> 0.69)	Probl ematic	Indete rminate
SAQ [8]	Literature review	Random sampling	16184	Clinical staff	Very good	Suffi cient	-	-	-	-
PSCHO [16]	Literature review	Random sampling	42249	Hospital staff	Ade quate	Indete rminate	Very good	Indete rminate	-	-
NHS OPSC [18]	Literature review + Interviews + Delphi method	Convenience sampling	306	Nursing home staff	Ade quate	Indete rminate	Very good	Suffi cient (0.94)	Probl ematic	Indete rminate
MOS OPSC [19]	Literature review + Interviews + Delphi method	Convenience sampling	4100	Medical office staff	Very good	Suffi cient	Very good	Sufficient	Very good	Sufficient
MaPSaF [20]	Literature review + Interviews	-	-	Primary healthcare organization staff	-	-	-	-	-	-
Patient Safety Culture Questio nnaire [21]	Literature review + Delphi method	Convenience sampling	236	Nurses	Very good	Indete rminate	Very good	Suffi cient (0.8861)	Prob lematic	Indete rminate
APSQ [22]	Literature review	Convenience sampling	721	Medical students and their supervisors	Very good	Indete rminate	Proble matic	Indete rminate (0.73)	-	-
CAS [23]	Literature review + Interviews + Delphi method	Convenience sampling	350	Obstetricians and nurses	-	-	-	-	-	-
SCOPE [24]	Literature review + Delphi method	Convenience sampling	331	Healthcare workers	Ade quate	Indete rminate	Very good	Indete rminate (0.64–0.85)	Ade quate	Indete rminate
HSOPS_M [25]	Literature review	Convenience sampling	551	Hospital management personnel	Very good	Indete rminate	Very good	Indete rminate (0.61–0.87)	Very good	Indete rminate
CPSO PSC [11]	Literature review + Interviews + Delphi method	Convenience sampling	630	Pharmacy staff	-	-	Proble matic	Indete rminate (0.89)	Ade quate	Suffi cient
SCOPE-PC [26]	Literature review	Random sampling	615	Primary healthcare personnel	Very good	Suffi cient	Very good	Indete rminate (0.58–0.86)	Probl ematic	Indete rminate

Patient Safety Culture Questionnaire [27]	Literature review + Interviews + Delphi method	Random sampling	580	Nursing staff	Adequate	Indeterminate	Very good	Indeterminate (0.658–0.890)	Problematic	Indeterminate
ASC OPSC [28]	Literature review + Interviews + Delphi method	Convenience sampling	59 ASCs	Ambulatory surgery center staff	-	-	-	-	-	-
PSCS-MCHI [29]	Literature review + Interviews + Delphi method	Convenience sampling	1256	Maternal and child healthcare staff	Very good	Sufficient	Very good	Indeterminate (0.89)	Very good	Sufficient
HSOP SC2.0 [30]	Literature review + Interviews + Delphi method	Convenience sampling	1300	Nurses	Very good	Sufficient	Very good	Indeterminate (0.68–0.93)	Very good	Sufficient
Primary Healthcare Patient Safety Culture Scale [31]	Literature review + Delphi method	Random sampling	343	Primary healthcare institution staff	Very good	Insufficient	Very good	Sufficient (0.940)	Inadequate	Indeterminate
Parent Version Hospital Safety Culture Questionnaire [32]	Literature review + Delphi method	Convenience sampling	562	Parents of pediatric patients	Adequate	Indeterminate	Very good	Sufficient (0.893)	Problematic	Indeterminate
PSCS-PC [33]	Literature review + Focus group discussions + Delphi method	Random sampling	369	Healthcare staff	Very good	Insufficient	Very good	Sufficient (0.940)	Problematic	Indeterminate
DOSOPSC [22]	Literature review	Convenience sampling	123	Dental hospital staff	-	-	Problematic	Indeterminate (> 0.7)	Problematic	Indeterminate
SAQ-MI [34]	Literature review	Convenience sampling	300	Hospital radiology department staff	Very good	Sufficient	Very good	Indeterminate (0.921)	-	-

Note:

QM: Quality of measurement properties; refers to the quality of the measurement attributes.

MQ: Methodological quality; refers to the methodological rigor of the tool development and validation process.

"–" indicates information not reported.

4. Discussion

4.1. General characteristics of patient safety culture assessment instruments

Healthcare institutions of different types and levels vary in management models and work practices;

therefore, patient safety culture assessment instruments need to be developed and adapted according to the specific characteristics of healthcare services in each setting. Among all instruments, those developed for hospital environments are the most numerous. Of the 24 instruments included in this study, ten were specifically developed for hospital settings [7,16,18,20–22,25,29,30,32]. Among them, the HSOPSC has been the most widely applied and has been used in multiple countries to assess hospital safety culture [7]. It has been validated across different languages and cultural contexts, demonstrating good stability. The SAQ measures patient safety culture through healthcare professionals' safety attitudes and perceptions and has also been validated for use in community hospitals, showing satisfactory psychometric properties [8,36].

In terms of assessed domains, 11 instruments included ten or more dimensions, covering areas such as communication, teamwork, organizational support, and event reporting [7,11,16–18,19–21,29,30]. Core dimensions were highly consistent across instruments, with teamwork, communication openness, and organizational learning occurring in 15 or more instruments, indicating that safety culture fundamentally depends on collaboration, transparency, and continuous improvement mechanisms. Content analysis further revealed cross-national differences: instruments developed in Europe and the United States are generally oriented toward market-driven and systematized improvements, emphasizing open communication and individual accountability, whereas instruments developed in East Asian countries, including China, tend to prioritize collective coordination and risk avoidance, often reflecting local healthcare policies and the push for localized tool development. Regarding scoring methods, the APSQ uses a 7-point Likert scale, while the remaining 23 instruments employ a 5-point Likert scale, all based on self-report [22]. Several instruments, including the SAQ, VA PSCS, HSOPS_M, SCOPE-PC, and CAS, contain more than 40 items, which can lead to lengthy assessment times [8,13,23–25]. Some instruments have been simplified or updated to improve feasibility, such as the SAQ-SF and PSCHO-SF [15,17]. Future efforts should aim to maintain comprehensive coverage of assessment domains while enhancing brevity to improve efficiency.

4.2. Trends toward simplification and differentiation in the development of patient safety culture assessment instruments

Among the instruments developed under the Surveys on Patient Safety Culture ® (SOPS®) initiative led by the U.S. Agency for Healthcare Research and Quality (AHRQ), five instruments HSOPSC, NHSOPSC, MOSOPSC, CPSOPSC, and ASCOPSC represent the most widely applied patient safety culture assessment tools internationally and have undergone localization in multiple countries. Notably, the HSOPSC was revised in 2019, reducing the original 12 dimensions and 51 items to 10 dimensions and 40 items in version 2.0, while retaining psychometric properties comparable to the original version, with Cronbach's α coefficients ranging from 0.67 to 0.89 [7,30]. In China, Yin et al conducted a cross-cultural adaptation of the HSOPSC 2.0 in 2023 [9]. After merging two dimensions, the instrument still demonstrated strong psychometric properties (Cronbach's $\alpha = 0.952$; test-retest reliability = 0.924). In addition, due to differences in work environments across healthcare institutions and departments, researchers in various countries have adapted existing generic instruments to specific populations or settings, resulting in specialized assessment tools. For example, Ravi et al. developed the SAQ MI based on the SAQ to address potential biases in specialized clinical environments, achieving a Cronbach's α of 0.921 [16]. The proliferation of specialized instruments, however, may hinder cross-institutional and cross-population comparability, limiting the ability to evaluate patient safety culture at a system-wide level or establish national benchmarks. Therefore, a hybrid

development model combining core modules with optional specialty- or institution-specific modules is recommended, allowing differentiation while maintaining comparability of essential dimensions.

4.3. Methodological quality and psychometric properties of patient safety culture assessment instruments require further exploration and refinement

Evaluation based on the COSMIN Risk of Bias checklist and the updated criteria for good measurement properties indicates that the development and validation processes of existing patient safety culture assessment instruments remain insufficiently rigorous. Some instruments relied solely on literature review during the item development phase, which may compromise the comprehensiveness and applicability of the tools. Future studies should integrate multiple data sources such as literature review, semi-structured interviews, and expert consultation to ensure thorough item construction. Over one-third (9/24) of instruments, including the APSQ and PSCHO, relied exclusively on literature review in the initial item development phase, without direct interviews or focus group discussions with target populations, such as healthcare professionals, patients, or administrators [16,22]. This single-method approach may fail to capture the unique understanding and core concerns of specific cultural contexts, institutional types, or populations (e.g., primary healthcare institutions in China, medical students, parents of pediatric patients), potentially resulting in item content that does not reflect participants' actual experiences and undermining both face and content validity. Future instrument development should rigorously follow COSMIN guidelines, employing an integrated approach that combines literature review, semi-structured interviews/focus groups with target populations, and expert consultation (e.g., Delphi method) to systematically construct conceptual frameworks and generate item pools, thereby ensuring that the assessment content accurately reflects the patient safety culture in the target environment and strengthens content validity. During validation, some instruments exhibited unclear factor interpretations. For example, in the APSQ, certain factors such as team functioning demonstrated cross-loadings, indicating that even instruments using both exploratory and confirmatory factor analyses (EFA and CFA) may have ambiguities in factor definitions or insufficient discrimination among constructs, which can compromise interpretability and diagnostic value. Future studies should prioritize CFA to test pre-specified models or combine EFA and CFA in a cross-validation approach during the exploratory phase. Furthermore, methodological quality regarding instrument stability was limited. Among the included instruments, only the HSOPSC 2.0 and VA PSCS achieved a sufficient rating for test-retest reliability; other instruments either did not report test-retest reliability or provided unclear interpretations [13,30]. It is recommended that stability assessments be conducted following the COSMIN-RoB checklist to ensure structural consistency. In summary, future research should ensure a rigorous, multi-stage instrument development and validation process guided by COSMIN standards, particularly for the development of localized instruments in China. Large-scale validation across different levels and types of healthcare institutions is necessary to establish reliable normative data and to explore the relationship between assessment results and clinical safety outcomes, such as adverse event rates.

5. Conclusion

This study systematically identified a total of 24 PSC assessment instruments and synthesized their characteristics, providing recommendations for future research:

(1) Development of concise yet comprehensive instruments that fully reflect the diversity of healthcare

environments is warranted. Further rigorous studies such as stepped-wedge cluster randomized trials or interrupted time series analyses are encouraged to evaluate the causal effects of integrated safety improvement programs that incorporate PSC assessment as a diagnostic and monitoring tool on safety culture perception, safety-related behaviors, and clinical safety outcomes.

(2) Future instrument development should be guided by robust theoretical frameworks and sound methodological principles to ensure accurate quantification of patient safety culture. This will provide reliable data to support the construction of safety culture, the design of interventions, and the formulation of management policies.

(3) Chinese researchers are encouraged to develop more precise, culturally adapted PSC instruments under the guidance of the COSMIN-RoB checklist, and to validate these instruments across different levels of healthcare institutions to establish normative data.

This study has several limitations. First, the original literature primarily focused on instrument development and validation rather than intervention applications, resulting in a limited quantity and variable quality of effectiveness evidence, most of which were observational or descriptive. Second, although the COSMIN-RoB checklist was used for methodological quality assessment, some items in COSMIN-RoB are inherently subjective, which may introduce potential bias in the evaluation results.

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References

[1] Cox S, Petersen J, Lund G, et al., 1991, The Structure of Employee Attitudes to Safety: A European Example. Work and Stress, 5(2): 93–106.

[2] Sammer C, Lykens K, Singh K, et al., 2010, What Is Patient Safety Culture? A Review of the Literature. Journal of Nursing Scholarship, 42(2): 156–165.

[3] World Health Organization, 2021, Global Patient Safety Action Plan 2021–2030: Towards Eliminating Avoidable Harm in Health Care. Geneva: WHO Press.

[4] Hessels A, Paliwal M, Weaver S, et al., 2019, Impact of Patient Safety Culture on Missed Nursing Care and Adverse Patient Events. Journal of Nursing Care Quality.

[5] Hafezi A, Babaii A, Aghaie B, et al., 2022, The Relationship Between Patient Safety Culture and Patient Safety Competency With Adverse Events: A Multicenter Cross-Sectional Study. BMC Nursing.

[6] Qin S, Chen D, Ban B, et al., 2015, The Analysis of Patient Safety Culture Assessment and Safety Culture Building Strategies at Home and Abroad. Chinese Hospitals, (4): 43–45.

[7] Sorra J, Gray L, Streagle S, et al., 2018, AHRQ Hospital Survey on Patient Safety Culture: User's Guide. Rockville, MD: Agency for Healthcare Research and Quality.

[8] Sexton J, Helmreich R, Neilands T, et al., 2006, The Safety Attitudes Questionnaire: Psychometric Properties, Benchmarking Data, and Emerging Research. BMC Health Services Research, 6: 44.

[9] Yin W, Shang L, Li S, et al., 2023, Translation and Validation of the Hospital Survey on Patient Safety Culture Version 2.0. Journal of Nursing Science, 38(8): 67–71.

[10] Tricco A, Lillie E, Zarin W, et al., 2018, PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Annals of Internal Medicine, 169(7): 467–473.

[11] Franklin M, Sorra J, 2018, Community Pharmacy Survey on Patient Safety Culture: User's Guide. Rockville, MD: Agency for Healthcare Research and Quality.

[12] Mokkink L, De Vet H, Prinsen C, et al., 2018, COSMIN Risk of Bias Checklist for Systematic Reviews of Patient-Reported Outcome Measures. Quality of Life Research, 27(5): 1171–1179.

[13] Sorra J, Gray L, Famolaro T, et al., 2018, AHRQ Medical Office Survey on Patient Safety Culture: User's Guide. Rockville, MD: Agency for Healthcare Research and Quality.

[14] Sorra J, Gray L, Famolaro T, et al., 2022, AHRQ Nursing Home Survey on Patient Safety Culture: User's Guide. Rockville, MD: Agency for Healthcare Research and Quality.

[15] Smith S, Sorra J, Franklin M, et al., 2018, Ambulatory Surgery Center Survey on Patient Safety Culture: User's Guide. Rockville, MD: Agency for Healthcare Research and Quality.

[16] Eturajulu R, Tan M, Zakaria M, et al., 2025, Development of the Modified Safety Attitude Questionnaire for the Medical Imaging Department. Singapore Medical Journal, 66(1): 33–40.

[17] Arbianti K, Amalia R, Hendrartini J, et al., 2023, Patient Safety Culture Analysis in Dental Hospital Using Dental Office Survey on Patient Safety Culture Questionnaire: A Cross-Cultural Adaptation and Validation Study. Journal of Patient Safety, 19(7): 429–438.

[18] Hammer A, Ernstmann N, Ommen O, et al., 2011, Psychometric Properties of the Hospital Survey on Patient Safety Culture for Hospital Management. BMC Health Services Research, 11: 165.

[19] Carruthers S, Lawton R, Sandars J, et al., 2009, Attitudes to Patient Safety Amongst Medical Students and Tutors: Developing a Reliable and Valid Measure. Medical Teacher, 31: e370–e376.

[20] Wang Y, Han H, Qiu L, et al., 2019, Development of a Patient Safety Culture Scale for Maternal and Child Health Institutions in China: A Cross-Sectional Validation Study. BMJ Open, 9(9): e025607.

[21] Milne K, Bendaly N, Bendaly L, et al., 2010, A Measurement Tool to Assess Culture Change Regarding Patient Safety in Hospital Obstetrical Units. Journal of Obstetrics and Gynaecology Canada, 32(6): 590–597.

[22] Zeng X, Li M, Chen X, et al., 2019, Revision and Evaluation of Reliability and Validity of the Parental Version of Hospital Survey on Patient Safety Culture. Chinese Journal of Modern Nursing, 25(5): 555–559.

[23] Shiner B, Ronconi J, McKnight S, et al., 2016, Test-Retest Reliability of the VA National Center for Patient Safety Culture Questionnaire. Journal of Evaluation in Clinical Practice, 22(6): 985–989.

[24] Hutchinson A, Cooper K, Dean J, et al., 2006, Use of a Safety Climate Questionnaire in UK Health Care: Factor Structure, Reliability and Usability. Quality and Safety in Health Care, 15(5): 347–353.

[25] Lee W, Wung H, Liao H, et al., 2010, Hospital Safety Culture in Taiwan: A Nationwide Survey Using Chinese Version Safety Attitude Questionnaire. BMC Health Services Research, 10: 1–8.

[26] Singer S, Meterko M, Baker L, et al., 2007, Workforce Perceptions of Hospital Safety Culture: Development and Validation of the Patient Safety Climate in Healthcare Organizations Survey. Health Services Research, 42(5): 1999–2021.

[27] Benzer J, Meterko M, Singer S, 2017, The Patient Safety Climate in Healthcare Organizations Survey: Short-Form

Development. Journal of Evaluation in Clinical Practice, 23: 853–859.

[28] Parker D, 2009, Managing Risk in Healthcare: Understanding Your Safety Culture Using the Manchester Patient Safety Framework. Journal of Nursing Management, 17(2): 218–222.

[29] Chen F, Zhou L, 2009, Patient Safety Culture Assessment Scale: Design and Establishment. Military Nursing, 26(1): 1–4.

[30] Zwart D, Langelaan M, Van De Vooren R, et al., 2011, Patient Safety Culture Measurement in General Practice: Clinimetric Properties of 'SCOPE'. BMC Family Practice, 12: 125.

[31] Verbakel N, Zwart D, Langelaan M, et al., 2013, Measuring Safety Culture in Dutch Primary Care: Psychometric Characteristics of the SCOPE-PC Questionnaire. BMC Health Services Research, 13: 923.

[32] He J, Xu L, 2013, Development and Reliability and Validity Testing of Patient Safety Culture Questionnaire. Journal of Nursing Administration, 13(6): 386–388.

[33] Sorra J, Yount N, Famolaro T, et al., 2019, AHRQ Hospital Survey on Patient Safety Culture Version 2.0: User's Guide. Rockville, MD: Agency for Healthcare Research and Quality.

[34] Lu C, 2019, Development and Psychometric Evaluation of Patient Safety Culture Scale of Community-Level Healthcare Institutions in China, thesis, Huazhong University of Science and Technology.

[35] Cheng S, Hu Y, Pfaff H, et al., 2021, The Patient Safety Culture Scale for Chinese Primary Health Care Institutions: Development, Validity and Reliability. Journal of Patient Safety, 17(2): 114–121.

[36] Suter E, Hyman M, Oelke N, 2007, Measuring Key Integration Outcomes: A Case Study of a Large Urban Health Center. Health Care Management Review, 32(3): 226–238.

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Application and Effect Evaluation of Typical Critical Situation Simulation Teaching in Operating Room in Stratified Training of Nurses

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Abstract: *Objective*: To explore the application effect of typical critical situation simulation teaching in the operating room in the stratified training of nurses, and to provide practical basis for optimizing the training system of operating room nurses and improving their clinical emergency response capacity. *Methods*: A total of 50 operating room nurses in a tertiary hospital were selected and divided into N0~N1 grade (junior group), N2 grade (middle group) and N3–N4 grade (senior group) according to their professional titles, working years and post capabilities. A 6-month stratified training with typical critical situation simulation was implemented. Before and after the training, theoretical assessment, operational skill scoring, emergency response capacity scale and professional identity scale were used to evaluate the effect, and training satisfaction was collected simultaneously. *Results*: After training, the scores of theoretical knowledge, operational skills and emergency response capacity of nurses in the three groups were significantly higher than those before training ($p < 0.05$), and the improvement range of team cooperation capacity in the senior group was better than that in the junior group ($p < 0.05$); the score of professional identity increased significantly ($p < 0.05$), and the total training satisfaction reached 95.0%. *Conclusion*: The stratified teaching with typical critical situation simulation in the operating room can effectively improve the professional competence and professional identity of nurses at all levels, adapt to the needs of standardized training, and is worthy of popularization and application.

Keywords: Operating room; Critical situation; Simulation teaching; Stratified training of nurses; Application

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1. Introduction

The operating room is an important place for emergency treatment, rescue and therapy of patients, characterized by frequent emergencies, heavy tasks and a large workload. The main critical situations include sudden changes in vital signs, anesthetic accidents, and massive intraoperative hemorrhage. Nurses' psychological quality, professional competence and emergency response level have a direct impact on the success rate of surgery and the level of medical care. With the improvement of medical standards and

people's health awareness, the public has put forward higher requirements for the quality and ability of operating room nursing staff [1]. However, in the traditional training process, nurses mainly receive theoretical knowledge and observe standardized skill demonstration procedures, lacking opportunities for practical operation and practice. Once an emergency occurs, it is difficult to ensure the standardization of disposal methods, which cannot meet the needs of operating room nursing work [2].

Under the concept of hierarchical nursing management, implementing stratified training according to the differences in nurses' abilities have become the key to improving training efficiency. There are significant gaps in knowledge reserve, operational skills and emergency experience among nurses at different levels: junior nurses need to consolidate basic emergency skills, middle nurses need to strengthen their ability to handle complex situations, and senior nurses need to improve their team command and guidance capabilities [3]. The one-size-fits-all training model is prone to resource waste and poor effect, and it is difficult to adapt to stratified needs.

Scenario simulation teaching constructs and restores real critical scenarios with the help of real nursing cases, realizing the combination of theoretical explanation and practical operation, and making up for the lack of practical operation opportunities in traditional training [4]. At present, the OSCE model and standardized patient simulation have shown good application effects in operating room training, but the scenarios selected in current research are relatively single, and different types of critical cases have not been transformed into training resources [5,6]. Based on this, this study follows the concept of hierarchical management, constructs a hierarchical scenario simulation training system, and further promotes the scientific and standardized development of the training model for operating room nurses.

2. Relevant theoretical basis

2.1. Stratified training theory

Stratified training theory originates from the concept of teaching students in accordance with their aptitude, which requires following the principle of differentiation, and formulating hierarchical training content, implementation methods and assessment standards according to personnel's job responsibilities, basic levels and improvement goals, so as to promote the improvement of personnel's overall work ability and level. Stratification based on the professional age of operating room nurses: N0–N1 grade nurses (working ≤ 3 years) are in the adaptation period and need to master basic emergency procedures and skills; N2 grade nurses (working 3–7 years) are in the growth period and need to improve their ability of independent disposal and cooperation in complex situations; N3–N4 grade nurses (working ≥ 8 years) are in the mature period and must have the abilities of emergency command, teaching guidance and decision-making [3]. Stratified training can avoid the problem of unbalanced difficulty of content and improve the pertinence and effectiveness of training.

2.2. Situated learning theory

Situated learning theory emphasizes carrying out learning activities in combination with reality-close scenarios, and using situational interaction to help learners construct knowledge and skill systems and realize the improvement of knowledge and skill levels. Typical critical cases are selected for operating room scenarios, and immersive and experiential scenarios are created by using real operating room environments, equipment, instruments and standardized patients, allowing nurses to experience the whole process of

emergency treatment [7]. Compared with lecture-based training methods, this model can give play to nurses' subjective initiative, promote them to apply knowledge in practice, and improve their psychological quality and team cooperation ability [8,9].

2.3. Ebbinghaus forgetting curve theory

This theory points out that memory decreases with time, forgetting rapidly at first and then slowing down gradually, and reviewing according to a certain cycle can improve memory effect. This study integrates it into training design: junior nurses focus on repeated practical operation of basic skills, middle nurses strengthen interval review of complex situations, and senior nurses deepen knowledge transfer through case discussion, consolidating training effects with scientific review planning and ensuring the long-term retention of skills [3].

3. Research objects and methods

3.1. Research objects

A total of 50 operating room nurses in a tertiary hospital from July to December 2025 were selected. Inclusion criteria: holding a nurse practitioner certificate, working in the operating room for ≥ 1 year, voluntarily participating and cooperating with the assessment. Exclusion criteria: further study/internship nurses, those with training absence ≥ 10%, and those who have participated in similar training in the past. According to the Guidelines for Hierarchical Management of Operating Room Nurses, the nurses were divided into groups combined with professional titles, working years and ability assessment: 17 nurses in the junior group (N0–N1 grade), aged 22–29 years (25.7 ± 3.5) years, with working years of 1–2 years (2.0 ± 0.2) years; 26 nurses in the middle group (N2 grade), aged 23–34 years (28.6 ± 5.4) years, with working years of 3–7 years (5.6 ± 2.4) years; 7 nurses in the senior group (N3–N4 grade), aged 30–40 years (35.2 ± 4.8) years, with working years of 8–14 years (12.1 ± 2.4) years. There was no statistically significant difference in general data among the three groups ($p > 0.05$), with comparability.

3.2. Research methods

3.2.1. Training preparation

(1) Setting up a training team

Composed of operating room head nurses, quality control specialists of the nursing department, attending anesthesiologists and senior specialist nurses. The head nurse overall plans the implementation of the plan, the anesthesiologist explains the pathological mechanism and key points of anesthetic cooperation, and the specialist nurses are responsible for drill guidance and assessment. The team clarifies goals and standards after unified training to ensure training standardization.

(2) Constructing a gradient case database

Six types of typical critical situations were sorted out: massive intraoperative hemorrhage, anesthetic accidents, instrument-related events, sudden changes in vital signs, intraoperative infection and emergency treatment for special populations [4,10]. Each case includes case data, trigger points, disposal procedures and division of labor, and the difficulty is designed according to stratified needs: the junior group is for basic scenarios with a single trigger point, the middle group for comprehensive scenarios with multiple trigger points, and the senior group for complex command scenarios with unknown trigger points.

(3) Preparing simulation resources

A simulated operating room was created relying on the nursing simulation training center, equipped with operating tables, defibrillators, first-aid drugs, simulated instruments, standardized patients (SP) and other resources. SPs were professionally trained to simulate critical symptoms and emotions, and video recording equipment was prepared to record drills for review and analysis simultaneously.

3.2.2. Training implementation

The training cycle was 6 months, adopting the mode of "theoretical teaching + scenario simulation + review and summary + reinforcement and consolidation", 4 times a month, 2.5 hours each time (0.5 hours for theory, 1.5 hours for drill, 0.5 hours for review), and hierarchical differentiated training was implemented.

(1) Junior group

The core goal is to master basic emergency procedures and the use of first-aid resources, and improve initial response ability. Theories explain scenario identification, disposal principles and drug usage; basic scenarios such as massive hemorrhage in a single part and mild anaphylaxis to anesthesia are selected for division of labor drills in groups of 4–5 people, with on-site error correction by the team; the review focuses on operational standardization and process integrity, and deficiencies are clarified through video recording; basic skill operation is conducted once a week and scenario re-performance once a month, combining the Ebbinghaus curve to consolidate memory [3,11].

(2) Middle group

The core goal is to train the ability to respond to and cooperate in handling complex situational problems. The theoretical part analyzes and evaluates comprehensive scenarios and shares team communication skills. Comprehensive scenarios such as massive hemorrhage in multiple parts and instrument failure combined with infection are selected, and surgical operation teams are formed with 5–6 people invited, requiring rapid scenario assessment and decision-making, with team members giving prompts at key links; the review analyzes deficiencies in scenario decision-making and cooperation level, and summarizes optimization plans; case variant drills are adopted to improve flexible response ability.

(3) Senior group

The core goal is to strengthen command, decision-making and teaching guidance capabilities. Theories explain emergency decision-making thinking and team management skills; complex scenarios such as multiple organ failure and anesthetic accidents combined with instrument failure are selected, with senior nurses serving as chief commanders in groups of 6–7 people to overall plan division of labor and decision-making; two-way evaluation is adopted for the review, and senior nurses share experience simultaneously; they are arranged to serve as instructors for the junior group to deepen abilities through teaching.

3.2.3. Evaluation indicators and methods

(1) Theoretical assessment

A self-made test paper with good reliability and validity (Cronbach's $\alpha = 0.86$) was used for assessment before and after training, covering scenario identification, disposal principles and other contents, with a full score of 100 points and an assessment time of 60 minutes.

(2) Operational skill assessment

Defibrillation, preparation and infusion of first-aid drugs were assessed before and after training, scored according to unified standards (50 points for each item, 100 points in total), covering operational standardization, process integrity and other dimensions.

(3) Emergency response capacity

A self-made scale (Cronbach's α = 0.89) was used for scoring, including 5 dimensions and 20 items of scenario identification, decision-making, operation, cooperation and psychological quality, with Likert 5-level scoring (full score of 100 points).

(4) Professional identity

The Nurse Professional Identity Scale (Cronbach's α = 0.83) was used, with 20 items and Likert 5-level scoring (20–100 points), and the higher the score, the stronger the identity.

(5) Training satisfaction

A self-made questionnaire was used to investigate from 4 dimensions of content, method, teaching staff and effect (10 items with Likert 5-level scoring), and open suggestions were collected simultaneously. Total satisfaction = (number of very satisfied + satisfied cases) / total number of cases × 100%.

3.2.4. Statistical methods

SPSS 26.0 was used to process the data. Measurement data were expressed as ($\overline{x} \pm s$), with paired *t*-test within groups and one-way analysis of variance between groups; count data were expressed as rate (%), with χ^2 test. $p < 0.05$ indicated a statistically significant difference.

4. Research results

4.1. Comparison of ability scores of the three groups before and after training

There was no statistically significant difference in the scores of theoretical knowledge, operational skills and emergency response capacity among the three groups before training ($p > 0.05$); after training, all scores of the three groups increased significantly ($p < 0.05$), and the scores of emergency cooperation and command dimensions in the senior group were higher than those in the middle group, and those in the middle group were higher than those in the junior group, with statistically significant differences among groups ($p < 0.05$).

4.2. Comparison of professional identity scores of the three groups before and after training

There was no statistically significant difference in the total score of professional identity among the three groups before training ($p > 0.05$); after training, all scores of the three groups increased significantly ($p < 0.05$), with no statistically significant difference among groups ($p > 0.05$). Specific data: junior group (62.3 ± 5.8) points vs (78.6 ± 6.2) points ($t = 12.35$, $p < 0.001$); middle group (65.7 ± 5.2) points vs (81.2 ± 5.9) points ($t = 13.17$, $p < 0.001$); senior group (68.9 ± 4.7) points vs (83.5 ± 5.3) points ($t = 12.89$, $p < 0.001$).

4.3. Training satisfaction results

Among the 50 nurses, 33 were very satisfied (66.0%), 15 were satisfied (30.0%), and 2 were general (4.0%), with a total satisfaction of 96.0%. The top four recognized advantages were: scenario simulation close to clinical practice (90.0%), strong pertinence of stratified training (86.0%), improved emergency confidence

(82.0%), and review helping improvement (78.0%). Suggestions were concentrated on increasing drill frequency (8 nurses), enriching case types (5 nurses), and extending the command drill time for the senior group (3 nurses).

5. Discussion

After the application and effect test of the training model, it was found that the typical critical situation simulation teaching in the operating room makes up for the lack of practical training in the traditional training system and has a significant promoting effect on improving nurses' abilities. Under the traditional theoretical training system, nurses can only passively learn knowledge and skills, lacking real operation opportunities and difficult to accumulate practical experience [12]. By constructing and restoring typical critical scenarios and setting assessment content combining theory with practice, nurses' enthusiasm for analyzing and solving problems is mobilized. After basic skill training, junior nurses have a further understanding of skill standards and accumulate practical experience; middle nurses have trained their team cooperation and problem-solving abilities through comprehensive situational problem disposal training; senior nurses have improved their coordination and decision-making abilities and deepened their understanding of professional norms [10]. The introduction of standardized patients enhances the authenticity of scenario simulation, provides nurses with repeated training opportunities, and gradually strengthens their psychological quality. This is consistent with the research conclusion of Cui Haiwei, whose training with the OSCE model confirmed that scenario simulation can improve nurses' professional and emergency abilities and reduce the probability of untimely clinical cooperation [5,6].

At the same time, the stratified training model follows the principle of differentiated design, and formulates targeted training goals and content according to the differences in basic abilities and experience of junior, middle and senior nurses, promoting mutual help among nurses of different seniorities, creating a training atmosphere of "seniors guiding juniors, middle nurses promoting excellence", and mobilizing the overall enthusiasm for learning and development. This is consistent with the research results of Zhang Yin et al, that modular stratified training can improve both individual ability and overall team level simultaneously [13].

According to the satisfaction feedback, the training model needs to be improved in four aspects: first, junior nurses have rapid short-term forgetting, so it is necessary to increase the opportunities for basic skill drills and optimize the review cycle combined with the Ebbinghaus curve; second, the case scenarios need to be enriched, and it is necessary to link with multidisciplinary clinical scenarios and continuously develop critical scenarios to improve nurses' ability to deal with complex situations; third, extend the command drill time for the senior group and add special training for teaching guidance; fourth, introduce a virtual simulated surgery system to improve the authenticity of scenario simulation relying on 3D visualization and real-time feedback [3,14]. In addition, it is necessary to establish a long-term evaluation mechanism to track the transformation of training effects through clinical follow-up and emergency event review ; combine the Kirkpatrick evaluation model to construct a comprehensive evaluation system from four dimensions of reaction, learning, behavior and results, providing a scientific basis for model optimization [15].

6. Conclusion

In conclusion, stratified teaching combined with typical critical situation simulation in the operating room

significantly enhances professional competence and professional identity among nurses at all levels. This approach effectively meets the demands of standardized training and is therefore worthy of widespread application.

Disclosure statement

The author declares no conflict of interest.

References

[1] Su Y, Wang S, Gong M, et al., 2024, Application of Interactive Teaching Based on Problem-Solving Model Combined with Scenario Simulation Training in the Training of Operating Room Specialist Nurses. Nursing of Integrated Traditional Chinese and Western Medicine, 10(12): 193–195.

[2] Fang Z, Zhao W, Miao X, et al., 2024, Investigation and Analysis of Training Needs of Nurses in Interventional Operating Room. Chinese Journal of Nursing Education, 21(12): 1482–1489.

[3] Bi C, Tang J, 2024, Effect of Teaching Model Based on Ebbinghaus Forgetting Curve Theory in the Training of N0–N1 Grade Obstetric Nurses. China Continuing Medical Education, 16(22): 141–145.

[4] Zhang Y, Li Y, Wu X, et al., 2024, Construction of a Team Training Case Database for Operating Room Nurses Based on Clinical Crises. Journal of Nursing, 31(21): 22–26.

[5] Cui H, 2024, Application of OSCE Model Based on Scenario Cases in the Training and Assessment of Operating Room Nurses. Famous Doctors, 2024(16): 183–185.

[6] Fan R, Wang Q, Huang P, et al., 2024, Application of Standardized Patient Scenario Simulation in Skill Training of Junior Operating Room Nurses. Medicine and Pharmacy of Yunnan, 45(03): 101–103.

[7] Li Y, Wang Y, 2022, Application Effect of Combined Teaching Method of Standardized Cases and Scenario Simulation in Nursing Staff Participating in Standardized Training in the Operating Room. China Standardization, 2022(22): 255–257.

[8] Ruan X, Feng Y, Chen J, et al., 2023, Design and Application of a Comprehensive Training Program for Pain Management with High-Fidelity Scenario Simulation. Chinese Journal of Nursing Education, 20(02): 158–163.

[9] Xu L, Guo Y, Sun T, 2020, Application Effect of Scenario Simulation Case Teaching Method in the Standardized Training of Nurses. China Continuing Medical Education, 12(13): 34–37.

[10] Wang Y, Zhang Z, Li S, et al., 2024, Application of Scenario Simulation Teaching Based on OSCE in the Training of Operating Room Specialist Nurses. Chinese Clinical Nursing, 16(01): 37–40.

[11] Zheng J, Hu Y, Luo P, et al., 2024, Application of Three-Step Teaching Method in Skill Training of Operating Room Intern Nurses. Journal of Traditional Chinese Medicine Management, 32(15): 76–78.

[12] Fei L, Gao B, Li Q, et al., 2024, Comparison of Application Effects of Different Teaching Models in the Standardized Training of Operating Room Nurses. Nursing of Integrated Traditional Chinese and Western Medicine, 10(08): 190–192.

[13] Zhang Y, Chen H, 2024, Application Effect of Modular Training in the Training of New Operating Room Nurses. Chinese Journal of Health Preservation and Health Care, 42(09): 160–162 + 166.

[14] Pan Y, Zhang Y, Luo X, et al., 2024, Application of Work Record Micro-Videos in the Training of Operating Room Nurses. Continuing Medical Education, 38(07): 74–77.

[15] Huang S, Liu F, 2023, Application Research of Scenario Simulation Teaching Method Combined with Kirkpatrick

Model Evaluation Method in CLABSI Prevention and Control Training. Modern Medicine and Health, 39(13): 2318–2321 + 2340.

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Evaluation of the Implementation Effectiveness of a Standardized Nursing Protocol for Ambulatory Chemotherapy Pump Infusion in Home-Based Care Settings

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Abstract: ***Objective*:** To explore the implementation effect of a standardized nursing process for continuous infusion via home chemotherapy pumps in day chemotherapy patients, and to provide a reference for improving nursing quality. ***Methods*:** We studied 316 patients who got FOLFOX chemotherapy at our hospital's Day Chemotherapy Center between January and June 2025. We used a before-and-after design. Patients treated from January to March 2025 were the control group and got standard home nursing care for their chemotherapy pump. Patients treated from April to June 2025 were the experimental group. They received the standardized nursing process on top of the usual care. ***Results*:** In the experimental group, 94.30% (149/158) of patients got their chemotherapy on time, compared to 84.18% (133/158) in the control group. This difference was significant (χ^2=8.62, P<0.05). The experimental group also had higher nursing satisfaction scores [94.4 (89.0, 100.0)] and a higher satisfaction rate (98.10%) than the control group [88.8 (80.0, 100.0), 86.71%], and the difference was significant (Z=5.16, P<0.05). Adverse events were low in both groups: 3.8% (6/158) in the experimental group and 7.0% (11/158) in the control group, but this difference was not statistically significant (P>0.05). ***Conclusion*:** The application of the standardized nursing process in the management of continuous infusion via home chemotherapy pumps for day chemotherapy patients can significantly improve the on-time drug infusion rate and patient satisfaction, ensure the safety of home chemotherapy, and thus have clinical promotion value.

Keywords: Portable chemotherapy pump; Home chemotherapy; Standard operating procedure; Nursing quality; Day chemotherapy; 5-Fluorouracil

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1. Introduction

Gastrointestinal tumors are a group of heterogenous malignancies that occur in the digestive tract, such as esophageal cancer, gastric cancer, hepatocellular carcinoma, pancreatic cancer, colorectal cancer, etc. These malignancies collectively account for over 25% of all cancer incidences and approximately 35% of global cancer-related mortality rates [1]. According to data released in 2020, gastrointestinal malignancies comprised 38.8% of newly diagnosed cancer cases in China [2].

Chemotherapy has always been a key treatment for patients with advanced disease or metastasis after surgery [3]. In recent years, China has made significant improvements in the diagnosis and treatment of tumor diseases. Daytime chemotherapy has gradually become an important choice for the treatment of patients with gastrointestinal tumors. This treatment model can effectively shorten the hospitalization time of patients and reasonably reduce the economic burden of treatment [4]. The chemotherapy pump used at home occupies a very important position in the development of daytime chemotherapy. Whether the nursing staff can manage the relevant nursing process in place will be directly related to whether the effect of chemotherapy can reach the expectation, and will also affect the safety of patients in the treatment process. Can be guaranteed [5]. For such diseases as gastrointestinal tumors, chemotherapy is still one of the most important treatment methods, and FOLFOX regimen (oxaliplatin + calcium folinate + fluorouracil) is also a commonly used chemotherapy regimen in clinical practice [6]. 5-FU itself is a time-dependent drug. Only through continuous and stable infusion operation, the drug concentration in the patient's blood can be maintained in a stable state, so that the therapeutic effect of this drug can be brought to the best level [7]. In the actual diagnosis and treatment of the hospital, portable micro-infusion pumps are often used in the continuous chemotherapy infusion of patients at home [8]. In addition, 5-FU is also a cycle-specific drug, which has a relatively fast metabolic rate in the body and a relatively short half-life.

To get the best effect, current guidelines recommend keeping its plasma levels steady through extended infusion. This approach helps expose S-phase tumor cells more effectively and improves cytoreduction [9].

After patients return home to carry out infusion therapy, various problems are easy to appear one after another ; on the one hand, the home environment, the operating habits of the accompanying staff, and the patient's own compliance and other multiple conditions are likely to disrupt the original smooth infusion process [10]. The first problem that needs to be paid attention to is the disconnection between the content of hospital education and the actual operation at home. When some patients lack the ability to operate the chemotherapy pump independently, such problems will be more prominent. Patients may inadvertently pull the indwelling catheter if they do some ordinary physical activities daily. Once the catheter falls off and loosens, it will not only cause extravasation of chemotherapy liquid and damage the surrounding body tissue, but also directly interrupt the whole infusion work [11]. This kind of accidental fluctuation will make the blood concentration of 5-FU in patients rise and fall, which can not only weaken the pharmacological effect of the drug relying on time dependence, but also aggravate the psychological anxiety of patients themselves, and even lead to contradictions and differences between patients and caregivers [12]. In addition, the winding and knotting of the infusion pipeline, the fluctuation of the ambient temperature, or the failure of the relevant personnel to follow the standard steps, will also disrupt the original infusion rhythm, resulting in the early termination or delayed termination of the infusion, which can adversely affect the chemotherapy from the two levels of efficacy and treatment safety [13].

SOP is a standardized way of doing things. It lays out the steps and quality requirements clearly, so

everyone can work consistently and avoid mistakes. In healthcare, SOPs have been used in ECMO, surgical coordination, and nursing management, and they have indeed improved efficiency and care quality [14].

Quite a few studies have looked at nursing care for portable chemotherapy pumps. But for day-chemotherapy patients who need continuous 5-FU infusion at home, there really aren't any practical, ready-to-use SOPs. Without one, the whole infusion process has no standardized management, and it's hard to keep risks under control. That's a real challenge in clinical nursing, and it's exactly what this study set out to address.

So we developed an SOP specifically for home-based chemotherapy pump care, tried it out in clinical practice, and got good results. The outcomes are presented below.

2. Materials and methods

2.1. Study design

We used a before-and-after controlled design. Patients admitted between January and March 2025 were the control group. They received standard care. Patients admitted between April and June 2025 were the experimental group. They got the SOP on top of standard care.

2.2. Research subjects

We enrolled 316 cancer patients in total. All of them received FOLFOX chemotherapy at our hospital's daytime chemotherapy center between January 2025 and June 2025. They were discharged with a Baxter Infusor elastomeric pump for home infusion.

2.2.1. Inclusion criteria

(1) Pathologically confirmed diagnosis of [gastric cancer (ICD-10: C16), colorectal cancer (ICD-10: C18-C21), or esophageal cancer (ICD-10: C15)]; meeting the chemotherapy indications outlined in the Guidelines for the Diagnosis and Treatment of Gastrointestinal Cancer in China; and having initiated continuous home infusion therapy using an elastomeric portable chemotherapy pump.

(2) Successful establishment of a central venous catheter (PICC or port), with no catheter-related contraindications such as occlusion, damage, or infection.

(3) Aged ≥ 18 years, fully conscious, and possessing normal communication and comprehension abilities.

(4) First-time use of an elastomeric portable chemotherapy pump, with no prior operational or in-home usage experience.

2.2.2. Exclusion criteria

(1) Concurrent severe dysfunction of major organ systems (e.g., cardiac, hepatic, renal, hematopoietic) or presence of chemotherapy contraindications precluding tolerance to continuous chemotherapy.

(2) Diagnosis of psychiatric disorders, cognitive impairment, or language communication barriers that hinder cooperation with nursing procedures, data collection, or follow-up.

(3) The living environment of some patients at home can not meet the conditions required for the normal operation of the elastic portable chemotherapy pump.

(4) Subjects who had adverse events such as extravasation of chemotherapeutic drugs, catheter-related infections, or catheter shedding in the three months before entering the observation phase of this study

also need to be excluded.

2.2.3. Statistical Sample Estimation

Sample size estimation followed the dual-proportion equivalence formula: . With parameters set at (two-tailed,) and a power of 80%, calculations focused on home-based delayed drug infusion rates. Based on the pre-test survey data previously carried out by our hospital, we made a pre-conceived assumption that after the implementation of SOP interventions, the baseline infusion delay rate of 15 % could be reduced to 5 %. It can be calculated by the formula that each group needs to receive at least 142 subjects. Considering that there will be problems such as case shedding and data loss during the follow-up period of the study, the study set aside an additional 10 % of the sample loss space. The final research plan determined that 158 subjects were included in each group, and a total of 316 samples were collected.

2.3. Intervention methods

2.3.1. Control group

The patients in the control group were treated with portable chemotherapy infusion pump at home routine nursing management ; after the docking of the portable chemotherapy infusion pump and the central venous catheter in the daytime chemotherapy center, the nursing staff of the department will carry out routine health education work, and explain the basic operation principle of the chemotherapy pump in detail to the ears of patients and accompanying family members. The related education content also includes various precautions for home use, which will involve the protection method of chemotherapy pump, catheter fixation operation, key points of position control during infusion, and health guidance content for high incidence of adverse reactions of chemotherapy.

2.3.2. Experimental group

The experimental group will be based on the original routine nursing of the control group, and then add the SOP standardized nursing management plan ; first of all, the standardized nursing procedures (SOP) implemented in this study are divided into five core implementation links. When each link is implemented on the ground, it is necessary to strictly follow the relevant guidelines of aseptic operation and the existing clinical nursing norms to promote. The specific operation content can be explained below.

(1) **Assessment**

Nursing staff need to check the patient's personal information, the name of the drug used, the dosage of the drug, the overall infusion time and the flow rate of the drug one by one ; at the same time, it is also necessary to check whether the remaining liquid volume in the chemotherapy pump can be consistent with the content of the doctor's advice, and the pipeline should be fully flushed to ensure that no bubbles will remain inside the pipeline. During the whole verification process, we should pay attention to the patient's venous access, and confirm that the infusion port or PICC pipeline is in a state of patency and no leakage, and there is no redness, pain or abnormal exudation at the puncture site.

(2) **Connection and fixation**

When carrying out the operation, it is necessary to follow the relevant specifications of aseptic operation, and use chlorhexidine or povidone iodine cotton sheet to wipe the infusion joint, and the duration of

wiping operation should be maintained at more than 15 seconds. After that, the chemotherapy pump pipeline is firmly connected to the patient's venous pathway. The operator can install the chemotherapy pump into the protective sleeve and fix it at the waist or shoulder of the patient, so as to avoid the pipeline being pulled and bent. Then the flow rate regulator is accurately debugged, and the anti-reflux clamp valve is adjusted to an open state. After the nursing staff completed the one-to-one home guidance and education, the nurses on duty needed to sign the observation sticker to confirm that the whole operation had been completed.

(3) **Health education**

Nursing staff need to explain the precautions during the home to the patient in detail ; on the one hand, the patient is advised not to carry out strenuous activities and carry heavy objects, which can easily cause the catheter to fall off ; on the other hand, the protection method of chemotherapy pump during bathing and bed rest is explained in detail, and the self-examination method of chemotherapy pump and catheter is demonstrated on the spot, so as to guide patients to pay attention to the abnormal changes of puncture position at any time. The nursing staff should also explain the abnormal manifestations that need urgent medical treatment clearly, sort out the corresponding disposal process of the emergency situation at the same time, leave the patients with all-weather consultation telephone and paper guidance instructions, and assist the patients to access the home intelligent follow-up system. This system contains the actual operation video of chemotherapy pump, the key points of basic nursing at home, and the online reporting function of abnormal situation. It is convenient for patients to consult relevant knowledge at any time and seek medical assistance in time when they encounter difficulties.

(4) **Infusion completion and disconnection**

When carrying out the extubation operation, the medical staff should first confirm that the liquid in the drug storage bag of the pump body has been completely infused, and the actual total dosage can be consistent with the requirements of the doctor's advice ; subsequently, the roller clamp was closed and the infusion pipeline was separated, and 10 mL of normal saline was used to flush the catheter in a pulsed manner [15]. The speed of flushing the catheter should be controlled at about 3–5 mL per second as far as possible [16]. Once you confirm the catheter is open and there's no resistance, lock it with 100 U/mL heparinized saline, again using a pulsatile positive-pressure technique [17]. Follow the rule of "clamp before needle removal". Pull the non-coring needle straight out, apply pressure until bleeding stops, and cover the site with a sterile dressing. Check that the needle tip is intact, then dispose of it according to standard protocols.

(5) Waste disposal

Medical staff need to wear disposable latex gloves and protective goggles during these operations. Put used needles into sharps containers right away. Tubing and pump parts that touched chemotherapy drugs go into leak-proof yellow medical waste bags. Seal the bags securely, then put them into designated chemotherapy waste containers for disposal. After all operations, wash your hands thoroughly following hand hygiene protocols.

2.4. Evaluation method

2.4.1. Medication on-time infusion rate

We used medication on-time infusion rate as the main outcome, and also looked at infusion time accuracy.

Through on-site checks, we recorded how much the actual infusion time differed from the scheduled time for patients in both groups. Based on the pharmacokinetic properties of 5-FU [18] and the 2024 edition of the Clinical Application Guidelines for Novel Antitumor Drugs [19], we set a deviation of 30 minutes or less as the standard for on-time infusion. This level of deviation does not noticeably affect blood drug concentration stability and still ensures chemotherapy effectiveness. We then calculated the on-time rate (deviation ≤ 30 min) and the off-time rate (deviation > 30 min), paying special attention to how the SOP intervention affected infusion accuracy.

2.4.2. Evaluation of home-based chemotherapy safety

We looked at three categories of adverse events.

(1) Catheter migration

The catheter tip moves 1 cm or more from where it should be, and needs to be adjusted or replaced [20].

(2) Drug extravasation

Chemo drugs leak out of the blood vessel during infusion, causing redness, swelling, and pain at the site [21].

(3) Catheter-related bloodstream infection (CRBSI)

Meeting the standard diagnosis for hospital-acquired infections, with the same bacteria found in both the blood and the catheter tip, and the patient has fever (38.5 ℃ or higher) or other signs of infection [22].

(4) Minor local redness at the puncture site

The red area is no more than 2 cm across, with no pain or fluid leaking out, and does not need special treatment—it is considered a minor event [23].

2.4.3. Patient satisfaction

We used patient satisfaction as a secondary outcome, measured with a self-designed nursing satisfaction scale. The scale has 10 items, each scored from 1 to 10, so total scores range from 10 to 100. Higher scores mean greater satisfaction. The scale showed good reliability and validity, with a Cronbach's α of 0.87 and a content validity index of 0.92.

We used the Shapiro-Wilk test to check the data distribution. The results showed that the total satisfaction scores were not normally distributed ($P < 0.05$). So we used the Wilcoxon rank-sum test to compare the two groups.

To make the results easier to understand clinically, we also calculated the satisfaction rate. The satisfaction rate was defined as (number of "highly satisfied" patients + number of "satisfied" patients) divided by the total number of patients, multiplied by 100%. We set the cutoffs as follows: scores of 90 or above were "highly satisfied", 70 to 89 were "satisfied", 60 to 69 were "neutral" and below 60 was "unsatisfied".

When the catheter pump was removed, nurses gave the questionnaire to patients, helped them fill it out, and collected the forms right away. Then they tallied the satisfaction data based on the completed scales.

2.5. Data collection and quality control

We reviewed patient records to collect demographic and clinical information from both groups, including gender, age, tumor type, number of chemotherapy cycles, and type of venous access.

When the pump was connected, the nurse in charge wrote down the start time and the expected

completion time (48 hours later) on the pump itself [24,25]. When the patient came back to have the pump removed, we checked the time written on the pump, asked the patient when it actually finished, and looked to see if any medication was left in the pump. If the difference between the actual and expected completion times was 30 minutes or less, we counted it as punctual. Then we calculated the punctual infusion rate based on that.

After the pump was removed, specialized nurses handed out the nursing satisfaction questionnaires. Patients filled them out on the spot, nurses collected them right away, and then they tallied the results.

When patients came back for follow-up, we asked about their home care experience and also did an on-site check. Based on that, we recorded any adverse events—such as problems at the puncture site, catheter issues, or drug leakage. We described these events for safety monitoring without doing further statistical analysis. Two researchers independently went through all the data and organized it. We used the Kappa statistic to see how much they agreed; a Kappa of 0.85 or higher meant good agreement. If they disagreed on anything, a third researcher made the final call.

2.6. Statistical methods

We analyzed the data using SPSS 26.0. For continuous data, we used mean ± standard deviation and compared groups with the t-test. For categorical data, we used counts (percentages) and the χ^2 test. The significance level was set at $\alpha=0.05$, so $P<0.05$ was considered statistically significant. Because the total score of the Patient Care Satisfaction Scale did not follow a normal distribution (tested by the Shapiro-Wilk test), we compared groups using the Wilcoxon rank-sum test and reported results as median (interquartile range) [M(P25,P75)]. All statistical tests were two-sided, and $P<0.05$ was taken as significant.

3. Results

3.1. Comparison of on-time drug infusion rate

In the experimental group, 94.30% (149/158) of patients got their chemotherapy infusion on time at home, compared to 84.18% (133/158) in the control group. The experimental group demonstrated a statistically significant higher rate of timely infusion than the control group ($\chi^2 = 8.62$, $P < 0.05$). See **Table 1**.

Table 1. Comparison of on-time and non-on-time drug infusion rates between the two groups

Group	Total cases (n)	On-time infusion (n)	On-time infusion rate (%)	Non-on-time infusion (n)	Non-on-time infusion rate (%)	χ^2	P
Experimental group	158	149	94.30	9	5.70	8.62	<0.05
Control group	158	133	84.18	25	15.82		

3.2. Comparison of patient satisfaction

The data of patient satisfaction did not meet the test standard of normal distribution ($P < 0.05$). After the rank sum test was used to carry out the comparative analysis between the groups, it was found that the nursing satisfaction level of the experimental group was significantly higher than that of the control group ($P < 0.05$). See **Table 2**.

Table 2. Comparison of patient satisfaction between the two groups

Group	Total cases (n)	Total scale score [M (P25, P75)]	Very satisfied (n)	Satisfied (n)	General (n)	Dissatisfied (n)	Satisfaction rate (%)	Z	P
Experimental group	158	94.4 (89.0, 100.0)	102	53	2	1	98.10	5.16	<0.05
Control group	158	88.8 (80.0, 100.0)	78	59	17	4	86.71		

3.3. Comparison of adverse events

There were 6 cases of adverse events in the experimental group, accounting for 3.8% of the total number of the group, including 2 cases of mild catheter displacement and 4 cases of mild swelling at the puncture site. There were 11 cases of adverse events in the control group, with an incidence of 7.0%, including 2 cases of small amount of liquid extravasation, 4 cases of catheter displacement and 5 cases of redness and swelling at the puncture site. There were no cases of catheter-related bloodstream infection in both groups. The overall incidence of adverse events in the two groups was at a low level. After statistical comparison, the difference between the groups was not statistically significant ($\chi^2 = 1.58$, $P > 0.05$). On the one hand, the results may be related to the small sample size selected in this study. The limited sample size will restrict the ability of the data to detect the real differences between groups to a certain extent. On the other hand, the basic conditions of the subjects enrolled are not much different. The baseline data of each group also achieved a balanced ratio, which will also make it difficult for statistics to detect significant differences between groups.

After all patients with adverse events were treated in a timely manner, the related symptoms were improved, and no severe adverse related complications occurred throughout the course. See **Table 3**.

Table 3. Comparison of the incidence of adverse events between the two groups

Group	Total cases (n)	Number of adverse events (n)	Incidence of adverse events (%)	χ^2	P
Experimental group	158	6	3.80	1.58	>0.05
Control group	158	11	7.00		

4. Discussion

4.1. The implementation of SOP standardized nursing program can effectively improve the on-time infusion rate of patients, and can also play a corresponding role in ensuring the safety and overall treatment effect of home chemotherapy

From the data obtained from this study, it can be seen that the proportion of drug infusion on time in the

experimental group implementing the SOP nursing program will be significantly better than that in the control group of routine nursing. This means standardized nursing protocols can really improve timing accuracy for home-based 5-FU infusion.

5-FU is a time-dependent drug, so its effectiveness against tumors really depends on how long you can keep blood levels in the right range [26]. Once the infusion time is deviated, it will directly interfere with the actual dose of the drug acting on the tumor lesion, which will adversely affect the therapeutic effect of the overall chemotherapy [27].

In the past, most of the published related studies have only explored the chemotherapy pump infusion nursing of hospitalized patients. On the one hand, we have not yet been able to form a set of standardized step-by-step operation procedures that can be implemented in clinical practice to guide outpatients to complete the pump body infusion at the home stage. On the other hand, the lack of such procedures will bring many practical problems. Patients are prone to inadequate implementation of steps when operating at home, and it is difficult to obtain adequate nursing supervision during the whole infusion process [28].

The SOP constructed in this study can build a closed-loop management system covering the whole process of infusion. This system will take into account the clinical operation content of medical staff and the home self-care behavior of patients. In the process of in-hospital nursing, the program will reduce the occurrence of various nursing errors from the root through double verification and evaluation, standardized pipeline connection and fixed operation mode [29] ; in the scene of home management, this scheme can also rely on systematic health education and intelligent follow-up system to help patients better complete self-care work.

This complete set of nursing operation process can effectively avoid the infusion interruption, infusion time deviation and other conditions caused by improper operation and catheter abnormality [30]. This improvement can significantly improve the qualified rate of on-time infusion of drugs in patients [31], and can further consolidate the overall safety guarantee basis of home chemotherapy mode.

4.2. SOP improves patient compliance and satisfaction with home-based chemotherapy nursing services

The data obtained in this study can also be intuitively reflected. The evaluation results of nursing satisfaction in the experimental group using SOP nursing program will be significantly better than those in the control group using routine nursing ($P < 0.05$). From this result, it can be seen that the standardized operation process can optimize the home medical experience of patients with daytime chemotherapy, which can not only improve the satisfaction of patients with various nursing services, but also help patients better comply with the whole set of chemotherapy diagnosis and treatment plan.

In the past, most of the traditional nursing care only relied on oral explanation to complete health education. The related propaganda content often has the problem of repeated repetition, and the arrangement of knowledge points is also scattered. Under such propaganda and education conditions, it is difficult for patients to fully understand the key contents of home care. When there is a lack of clear step-by-step operation norms, patients are prone to irregular operation behaviors, which in turn induces various infusion-related adverse problems, and also aggravates the patient's inner irritability and anxiety [32].

The SOP developed by us can properly resolve the various drawbacks mentioned above from a number of specific measures ; the first is to unify and standardize the guidance template used in health education.

The second is to open a supporting follow-up communication channel. The third is to paste the observation reminder stickers in the prominent position of the chemotherapy pump. These landing methods can bring clear and easy-to-implement home care guidance to patients, and can also help patients learn self-protection and home self-examination methods quickly.

Compared with the traditional way of education relying solely on oral advice, this new nursing mode can reduce the vague and general guidance content, and also reduce the probability of patients forgetting the nursing points [10]. The patient's home medical experience can therefore be truly improved. Even if they have left the hospital, they can feel the professional medical support that continues to follow up. This stable help can enhance the patient's own sense of security, alleviate their various concerns about sudden accidents, and then reduce many nursing-related problems that could have been avoided.

In summary, this systematic and standardized patient guidance model can effectively improve the patient's treatment compliance and nursing satisfaction ; at the same time, the model can also form a virtuous cycle relationship. After patients get a better medical experience, they will be more active in cooperating with the follow-up diagnosis and treatment work, which in turn can steadily improve the quality of nursing and further optimize the final chemotherapy effect.

4.3. The SOP helps fill a gap in specialist management and improves the standardized nursing system for home-based infusion in daytime chemotherapy

This study independently developed and validated a set of SOP specifications for home-based continuous chemotherapy pump infusion ; the operation standard can effectively fill the research gap in the special management of home infusion for daytime chemotherapy patients. On the one hand, it can provide a set of practical and available nursing work mode for clinical nursing staff, so that the nursing work related to home chemotherapy can become more standardized and unified. On the other hand, it can also help clinical nursing get rid of the traditional nursing mode which is scattered in the past and relies solely on personal experience, and promote the nursing work to gradually move towards a systematic and standardized standardized management system.

The SOP developed in this study has fully covered the entire process of nursing work, from the patient's venous access verification work to the final medical waste disposal link ; each step of the whole process is set with a clear implementation standard and corresponding emergency treatment plan. The key point is that this set of SOP can build a complete closed-loop management system, which can effectively link the standardized operation in the hospital with the home follow-up and continuous quality control after discharge. This can not only provide specific and verifiable operation basis for nursing staff, but also make up for all kinds of weak links in the current home chemotherapy nursing management from the actual clinical work level.

This study completed the application verification of the SOP in a single-center clinical environment, and the construction process of the whole scheme also adopted a scientific and standardized step-by-step research method. First, the difficulty of starting this set of operation process is low, and it has a relatively perfect quality control system ; second, it can be adapted to different levels and different types of medical institutions. Thanks to the simple and clear overall design, the SOP has a very good promotion value and clinical reuse space, and can be widely used in hospitals at all levels. In the follow-up research work, researchers can also refine and optimize the scheme according to different tumor types and different types of infusion drugs, and can also complete the upgrade iteration with the intelligent nursing system, so that the

operation system has more abundant digital service functions.

In general, the SOP constructed in this study can effectively fill the gaps in the special nursing management of 5-FU home continuous infusion at this stage ; on the one hand, it can provide a set of practical reference templates for the optimization and improvement of domestic home chemotherapy nursing standards by relying on standardized process design, closed-loop management mode and perfect quality control system. On the other hand, it can also effectively improve the professional level of daytime chemotherapy nursing. It can provide a certain practical reference value for the standardized management of clinical tumor nursing.

5. Conclusion

The relevant results of this study can be found that the application of home continuous chemotherapy pump infusion SOP for patients with daytime chemotherapy will play a very positive intervention effect ; it can not only effectively improve the patient's on-time infusion rate of drugs, improve the overall nursing satisfaction, but also effectively enhance the overall safety of the home chemotherapy mode. The relevant conclusions obtained in this study can provide a reliable and practical clinical reference for the standardized management of home care for such patient groups.

The reason why this SOP has high clinical application value is mainly reflected in many aspects ; first, it can effectively guarantee the overall treatment effect of 5-FU chemotherapy. Second, it can steadily improve the quality of care for home chemotherapy. Third, it can effectively protect the patient's home treatment safety. Fourth, it can also provide a clear, standardized and directly referenced standardized working model for nursing staff in daytime chemotherapy positions.

For patients with gastrointestinal tumors receiving daytime chemotherapy, this study developed and verified a set of full-process SOP suitable for continuous infusion of 5-FU home pump for the first time. With the help of this standardized operation scheme, we can integrate the nursing work of home chemotherapy into the standardized and unified, whole-process closed-loop management mode, and effectively realize the standardization and homogenization control of home chemotherapy nursing.

The difficulty of implementing this standardized operation process is relatively low, and it can be applied to hospitals of different sizes at all levels. This also makes it have a very considerable application prospect in clinical scenarios.

It needs to be objectively explained that there are still some deficiencies in this study ; first, this study is a single-center clinical trial. The corresponding research results can not be directly extended to other clinical scenarios for the time being. The differences in the operation level of nursing staff and the patient's own compliance may also have a certain impact on the results of this research data. Second, the follow-up time set by the study is relatively limited, and there is no corresponding observation and evaluation of the long-term chemotherapy effect and recurrence of adverse events.

Follow-up studies can carry out multi-center, large-sample randomized controlled trials, while the overall follow-up period is appropriately extended ; on the one hand, it can further explore the actual impact of this SOP on the long-term treatment effect of patients. On the other hand, it can also develop a more personalized SOP version, which can make the nursing work of home chemotherapy more refined and efficient, and further improve the overall clinical nursing quality.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Singh A, 2024, Global Burden of Five Major Types of Gastrointestinal Cancer. Przeglad Gastroenterologiczny, 19(3): 236–254.

[2] Qiu H, Cao S, Xu R, 2021, Cancer Incidence, Mortality, and Burden in China: A Time-Trend Analysis and Comparison with the United States and United Kingdom Based on the Global Epidemiological Data Released in 2020. Cancer Communications, 41(10): 1037–1048.

[3] Wang Y, Yang Y, 2025, Exploration of Integrated Traditional Chinese and Western Medicine Treatment Regimens for Elderly Patients with Advanced Malignant Tumors. Journal of Beijing University of Chinese Medicine, 48(9): 1185–1190.

[4] Zhang H, Lu Y, Yu W, et al., 2020, Exploration and Practice of Day Chemotherapy Model in Cancer Specialty Hospitals. Chinese Nursing Management, 20(1): 7–10.

[5] Zhang X, Zhang J, Shu Y, et al., 2019, Effect of Chemotherapy Diary on Gastrointestinal Tumor Patients with Home Chemotherapy Pumps. Journal of Nursing of the Chinese People's Liberation Army, 36(12): 57–60.

[6] Shao X, Li W, Hu H, et al., 2024, Efficacy and Safety of Laparoscopic Radical Gastrectomy After Neoadjuvant Chemotherapy Combined with Immunotherapy and Targeted Therapy. National Medical Journal of China, 104(16): 1397–1402.

[7] Zhou S, 2013, Nursing Care of 5-Fluorouracil Chemotherapy with Portable Chemotherapy Pump Combined With PICC. Contemporary Nurse, 2013(6): 89–90.

[8] Gao H, 2014, Nursing Care of Gastrointestinal Tumor Patients with Deep Vein Catheterization Combined with Continuous Chemotherapy via Chemotherapy Pump. General Nursing, 12(18): 1702–1703.

[9] Shi S, Yang L, Yang S, 2023, Application of Mobile Nursing Platform in Patients with Port-a-Cath Receiving Continuous Infusion of 5-FU via Portable Pumps for Home Chemotherapy. Journal of Qiqihar Medical University, 44(11): 1088–1092.

[10] Jang H, Kim S, Kim D, et al., 2022, "It's a Part of the Patient": The Experiences of Patients with Cancer Undergoing Home-Based Chemotherapy from Patients' and Nurses' Perspectives. Asia-Pacific Journal of Oncology Nursing, 9(8): 100072.

[11] Yang L, 2016, Analysis of Causes of Time Error in Fluorouracil Infusion via Chemotherapy Pump and Nursing Countermeasures. Tianjin Nursing, 24(4): 317–318.

[12] Mao X, Jin L, Shi C, et al., 2020, Study on the Effect of High-Quality Nursing on the Quality of Life of Malignant Tumor Patients Undergoing Chemotherapy. Chinese Journal of Clinical Oncology and Rehabilitation, 27(10): 1203–1206.

[13] Li C, Hu B, Zeng M, 2008, Analysis of Factors Related to the Flow Rate of Fluorouracil Chemotherapy via Portable Infusion Pumps. Chinese Nursing Research, 22(35): 3259–3260.

[14] Li T, Gao X, 2017, Evaluation of the Effect of Video Teaching and Training on Standard Operating Procedures for Surgical Instrument Management. Chinese Journal of Infection Control, 16(9): 870–872.

[15] Goossens G, 2015, Flushing and Locking of Venous Catheters: Available Evidence and Evidence Deficit. Nursing Research and Practice, 2015: 985686.

[16] Xu B, Geng C, 2015, Guidelines for Infusion Access Safety in Tumor Treatment. Beijing: Peking Union Medical

College Press.

[17] Gorski L, Hadaway L, Hagle M, et al., 2021, Infusion Therapy Standards of Practice, 8th Edition. Journal of Infusion Nursing, 44(Suppl 1): S1–S224.

[18] Zhang K, Wang P, Tian T, 2019, Application and Nursing of Portable Chemotherapy Pump Combined with PICC in Chemotherapy for Gastrointestinal Tumor Patients. Chinese Community Physicians, 35(27): 164 + 166.

[19] Guiding Principles for the Clinical Application of New Antineoplastic Drugs, 2025, Clinical Education of General Practice, 23(3): 197 + 206.

[20] Zheng X, Zhang H, Yu W, et al., 2023, Multidisciplinary Expert Consensus on Implantation and Management of Venous Port-a-Cath (2023 Edition). Chinese Journal of General Surgery, 32(6): 799–814.

[21] Wu C, Fu J, Feng P, et al., 2012, Risk Factors and Possible Mechanisms of Intravenous Port Catheter Migration. European Journal of Vascular and Endovascular Surgery, 44(1): 82–87.

[22] Xu B, Chen C, Yan B, et al., 2024, Distribution Characteristics and Risk Factors of Pathogenic Bacteria in Port-a-Cath Associated Catheter-Related Bloodstream Infection in Patients with Malignant Tumors. Journal of Pathogen Biology, 19(7): 846–849 + 854.

[23] Yang N, Luo Z, Lin C, et al., 2016, Study on the Treatment Plan for Patients with Puncture Site Infection After Peripherally Inserted Central Catheterization. Chinese Journal of Nosocomiology, 26(21): 4925–4927.

[24] Cui J, He T, Cai Y, et al., 2018, Relationship Between the Detection of Fluorouracil Concentration in Blood and the Efficacy and Prognosis of Patients with Advanced Colorectal Cancer. Chinese Journal of Laboratory Medicine, 41(6): 450–455.

[25] Tong J, 2018, Application and Nursing Experience of Portable Microinfusion Pumps in Chemotherapy for Elderly Patients with Malignant Tumors. Electronic Journal of Practical Clinical Nursing Science, 3(36): 38.

[26] Shereen N, Salman D, 2019, Delivering Chemotherapy at Home: How Much Do We Know? British Journal of Community Nursing, 24(10): 482–484.

[27] Algethami A, Alshamrani M, Alharbi A, et al., 2021, Evaluation of Handling, Storage, and Disposal Practices of Oral Anticancer Medications Among Cancer Patients and Their Caregivers at Home Setting. Journal of Oncology Pharmacy Practice, 27(1): 20–25.

[28] Ye H, Wu Y, Hong L, et al., 2012, Analysis of Factors Related to the Flow Rate of Portable Chemotherapy Pumps and Nursing Countermeasures. International Medicine and Health Guidance News, 18(23): 3487–3489.

[29] Qian Y, 2011, Analysis of Causes of Abnormal Flow Rate in Clinical Application of Portable Infusion Pumps and Nursing Countermeasures. Zhejiang Medical Education, 10(3): 30–31 + 36.

[30] Gao Y, Jin A, Jin X, 2018, Analysis of the Effect of PICC Catheterization Combined with Fully Automatic Chemotherapy Pump for Continuous Chemotherapy in Patients with Colorectal Cancer. Zhejiang Medical Education, 17(4): 36–38 + 53.

[31] Wang Q, Li X, Pan F, 2021, Application of Family Information-Based 4C Model in Patients with Colon Cancer Undergoing Continuous Chemotherapy via Portable Chemotherapy Pump Combined With PICC. Journal of Qilu Nursing, 27(14): 14–17.

[32] Wang L, 2023, Application of Portable Chemotherapy Pump Combined with High-Quality Nursing in Gastrointestinal Tumor Patients Undergoing Chemotherapy. Forum of Basic Medical Education, 27(24): 83–85 + 116.

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A Scoping Review of Risk Prediction Models for Oral Mucosal Pressure Injury in ICU Patients with Oral Tracheal Intubation

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Abstract: *Objective*: To conduct a comprehensive review of risk prediction models for oral mucosal pressure injury in ICU patients with oral tracheal intubation, aiming to provide a reference for the development and clinical application selection of risk prediction models in the future. *Methods*: Using the scope review methodology framework, this study searched PubMed, Web of Science, Embase, Cochrane Library, China Biomedical Literature Database, CNKI and Wanfang from database construction until December 31. Two researchers independently screened and extracted data for aggregated analysis. *Results*: Seven studies were finally included. The subjects were mainly ICU patients with oral tracheal intubation. Logistic regression model was used as the model construction method, and nomogram was used as the model presentation. The three most frequently occurring predictors were tracheal intubation indwelling time, APACHEII score, and dental pad usage. *Conclusion*: The included models had good overall predictive power. However, to establish models with a low risk of bias, good predictive performance, and strong operability, a high overall risk of bias needed to be addressed to provide some guidance for clinical practice.

Keywords: ICU; Pressure injury of oral mucosa; Predictive model; Risk assessment; Scope review

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1. Introduction

With the continuous development of critical care medicine and mechanical ventilation techniques in recent years, oral tracheal intubation has become the most commonly used and effective method for establishing artificial airways in critically ill patients in ICUs, accounting for more than 96% of all tracheal intubated patients [1]. While maintaining airway patency and providing life support, this also increases the risk of oral mucosal pressure injury (OMPI) to some extent. Studies have shown an increase in OMPI among patients with oral tracheal intubation in the ICU.

The incidence rate is as high as 31.3% to 55.6%, mostly occurring 2 to 13 days after intubation [2–6]. It is the most common device-related pressure injury and also the most common among all mucosal pressure injuries caused by invasive catheters [7]. Due to the critical condition and poor resistance of ICU patients, the occurrence of OMPI is not only difficult to heal spontaneously and prone to recurrence, but in severe cases, it may cause infection, ulceration, etc., increasing patients' pain, causing dysphagia, increasing medical expenses, prolonging the hospital stay, and may even result in doctor–patient disputes [2]. It is reported that about 20% of traditional site pressure injuries can be detected at stage 1, while only 5% of OMPI can be detected by medical staff in the early stage of injury [8]. Therefore, early identification of OMPI predictors and timely intervention are of great significance for reducing the incidence of OMPI, alleviating patients' pain, improving prognosis and enhancing patients' quality of life. Although there have been oral mucosal pressure injury risk prediction models at home and abroad in recent years, there is heterogeneity in the predictors and model performance of the prediction models in each study, and there is no review on the risk prediction models for oral mucosal pressure injury in ICU patients with oral tracheal intubation [4,9]. Therefore, this study provides a comprehensive review of the construction, application, performance, and influencing factors of predictive models in relevant domestic and international studies. It analyzes the problems and deficiencies in this research field, aiming to provide references for the development and application selection of models in the future, as well as for clinical nursing work and subsequent research.

2. Data and methods

2.1. Clarify the research question

(1) What are the existing models for predicting the risk of oral mucosal pressure injury in ICU patients with oral tracheal intubation, and what are the predictive factors involved?

(2) How is the performance of the existing models? Has internal or external validation been carried out?

(3) What are the shortcomings of the current research and what implications does it have for future research?

2.2. Literature search strategies

A systematic search was conducted from database inception to 31 December 2025, across these databases: Web of Science, Cochrane Library, Embase, China Biomedical Literature Database, CNKI, VIP, Wanfang and other databases until Decdember 31, 2025, using a combination of subject terms and free terms. The English search terms included "Mouth Mucosa/Oral Mucosa/Buccal Mucosa", "Pressure Ulcer/Pressure Injuries/Pressure Sores", "predict/score/algorithm/equa/assess/calculate/identif*", "prognos/probabil/risk factors", and "ICU/Intensive Care Units". For example, in Chinese databases, the search formula is :(Mucosa + mucosal pressure injury + oral + oral mucosal pressure injury) AND (transoral tracheal intubation + ICU + critical care + critical patient + critical care unit + critical care) AND (risk prediction model + risk assessment + risk factor + influencing factor + nomogram + prediction + prevention). For the PubMed database, the search strategy is as follows:

#1 ("Mouth Mucosa"[Mesh]) OR (((Buccal Mucosa[Title/Abstract]) OR (Oral Mucosa[Title/Abstract])) OR (Mucosa, Mouth[Title/Abstract]))

#2 ("Pressure Ulcer"[Mesh]) OR ((Pressure Injuries[Title/Abstract]) OR (Pressure Sores[Title/Abstract]))

#3 ("predict"[Mesh]) OR ((algorithm[Title/Abstract]) OR (assess[Title/Abstract])OR(prognos [Title/Abstract]) OR (risk factors[Title/Abstract]))
#4 #1 AND #2AND #3

2.3. Criteria for literature inclusion and exclusion

2.3.1. Inclusion criteria

(1) Patients aged ≥ 18 years admitted to the ICU;
(2) The study type was original research, including cross-sectional studies, case-control studies, cohort studies, etc.
(3) The content of the study is to construct and (validate a risk prediction model for oral mucosal pressure injury in ICU patients with oral tracheal intubation.

2.3.2. Exclusion criteria

(1) Inability to obtain the full text, repeated publication, etc.;
(2) Secondary studies, such as reviews, systematic reviews, and master's theses;
(3) Failure to describe the content and methods of the prediction model;
(4) Not in Chinese or English

2.4. Literature screening and data extraction

The retrieved bibliographic records were imported into EndNote X9 software to remove duplicate references. Two researchers independently carried out the initial screening according to the inclusion criteria by reading the titles and abstracts. Then, they read the full text for re-screening. If there were differences of opinion during the screening process, a third researcher was consulted to resolve them. In this study, a standardized table for extracting data from risk prediction models, developed by Moons et al., was used [10]. The extracts included the author, publication year, country, type of study design, number of model builders and validators, incidence rate, model construction method, model predictor, model performance, etc.

2.5. Inclusion of literature risk of bias and suitability assessment

Two researchers used the Predictive Model Bias Risk Assessment tool (PROBAST) to assess the risk of bias and suitability of the included literature [11].

3. Results

3.1. Literature screening results and basic characteristics of the included literature

A preliminary search yielded 1,163 relevant literatures. After removing duplicate literatures, 1,032 literatures were obtained. After checking for duplicates, and in accordance with the literature inclusion and arrangement standards, as well as reading the titles, abstracts, and full texts, 7 literatures were finally included [4,9,12–16]. They were published between 2020 and 2025, including 6 from China and 1 from South Korea [4,9,12–16]. One retrospective case-control study[15], five prospective cohort studies, and one cross-sectional study; Two multicenter studies and six single-center studies [4,9,12–16].

3.2. Evaluation of literature quality

The risk of bias was evaluated based on PROBAST in terms of the study subjects, predictors, outcomes, and model analysis. The included models had a high risk of bias, which might be related to the study design, variable handling, variable selection, statistical analysis methods of predictors, improper handling of or non - mention of missing data, and validation methods. The suitability of the models' subjects, predictors, and outcomes was evaluated, and most of the models had good overall suitability. The specific evaluation results are shown in **Table 1**.

Table 1. Evaluation of risk of bias and suitability of included models

Inclusion model	Risk of bias				Applicability			Overall	
	Subjects of Study	Predictors	Outcomes	Analysis	Research subjects	Predictors	Outcomes	Risk of bias	Appli cability
Choi, 2020 [4]	low	low	low	high	low	low	low	high	low
Gu, 2024 [9]	low	low	low	high	low	low	low	high	low
JIA, 2024 [12]	low	Not clear	low	high	low	low	low	high	low
Zhang, 2024 [13]	low	Not clear	low	high	low	low	low	high	low
Lee, 2024 [14]	low	low	low	high	low	low	low	high	low
Zhang, 2025 [15]	high	Not clear	high	high	high	low	low	high	low
Wang, 2024 [16]	low	low	Not clear	high	low	low	low	high	high

3.3. Construction and validation of a risk prediction model for oral mucosal pressure injury in ICU patients with oral tracheal intubation

3.3.1. Basic features included in the model

The study population of the model was mainly concentrated on ICU patients with oral tracheal intubation, including 2 multicenter studies and 5 single - center studies, with a total sample size ranging from 27 to 1521 cases.; The model construction methods can be divided into two categories. Five models were constructed using Logistic regression, one model using a machine learning algorithm, and one model using Cox regression [4,9,12–16]. Six models are presented as nomograms, and only one model is presented as an equation [4,9,12–16]. The model details are shown in **Table 2**.

Table 2. Model construction

Included studies	Publication Year (year)	Country	Research Design	Model construction number (Example)	Number of validators (example)	Incidence rate (%, model building/ validation)	Model-building methods
Choi [4]	2020	Korea	Prospective Cohort study	27	—	A: 32.5 B: 13.4	Logistic regression model Gaussian Bayes algorithm
Gu Tiantian [9]	2024	China	Prospective cohort study	335	143	14.03/16.78	Logistic regression model
Jia [12]	2024	China	Prospective cohort study	1037	484	41.7/25.9	Cox regression model
Zhang Shuguang [13]	2024	China	Prospective cohort study	373	160	19.3/19.38	Logistic regression model

Li Min [14]	2024	China	Prospective cohort study	400	152	17.2/19.7	Logistic regression model
Zhang Ying [15]	2025	China	Case-control studies	209	—	25.3	Logistic regression model
Wang [16]	2025	China	Cross-sectional study	640	275	44.7/41.8	Logistic regression model

Note: A: Lower oral mucosa; B: Upper oral mucosa

3.3.2. Predictors of the model

The number of predictors included in the study was 3 to 7. The majority of the model presentation methods were visual nomograms, and only one was a risk score formula constructed based on the regression coefficients of each factor. The model prediction content and presentation methods are shown in **Table 3**. For the subsequent analysis, the predictors were aggregated into six categories: general information, laboratory test indicators, tracheal intubation-related factors, drug factors, vital signs and scores, and other factors. Among them, the most frequently occurring factors were tracheal intubation indwelling time (n = 5), serum albumin (n = 4), and dental pad use (n = 3). The classification of predictors is shown in **Table 4**.

Table 3. Model prediction content and performance

Included in the study	Model predictors	Model presentation
Choi [4]	A: Dental pads/airway use, commercial ETT stent use, steroid use B: Commercial ETT stent use, vasopressors, hematocrit, serum albumin	The risk score formula was derived based on the regression coefficients of each factor
Gu [9]	Daily oral care frequency, tracheal intubation duration, tracheal tube material, whether dental pads are used, daily oral aspiration frequency, RASS score, history of diabetes	Nomogram
Jia [12]	Antibiotic use, duration of nutritional therapy, restlessness, hypotension, albumin levels	Nomogram
Zhang [13]	Gender, APACHEII score, hemoglobin, serum albumin, prone position ventilation, use of vasoconstrictor drugs, time of indwelling tracheal intubation	Nomogram
Li [14]	APACHEII score, RASS score, age, serum albumin level, dental pad + gauze + oropharyngeal tube, senior physician, artificial airway indwelling time	Nomogram
Zhang [15]	Prone position ventilation, application of vasoconstrictor drugs, inability to express chief complaint during catheterization, APACHEII score, indwelling time of tracheal intubation	Nomogram
Wang [16]	APACHEII score, modified Beck oral score, oxygenation index, sedation, prone ventilation, duration of tracheal catheter indwelling, frequency of tracheal catheter fixation	Nomogram

Table 4. Classification of risk predictors for the model unit: units

	Items	Number of models included	Project	Number of models included
General information	Age	1	Steroid use	1
	Gender	1	Antibiotic use	1
Laboratory test indicators	Serum albumin	4	Vital signs and scores Use of sedative drugs	1
	Hematocrit	1	Hypotension	1

	Hemoglobin	1		Oxygenation index	1
Factors related to tracheal intubation	Tracheal intubation indwelling time	5		APACHEII score	4
	Pad use	3		Modified beck oral score	1
	For commercial tracheal intubation use	2		RASS score	1
	Number of oral aspirations per day	1	Other factors	Duration of nutritional therapy	1
	Number of oral care sessions per day	1		Prone position ventilation	2
	Tracheal tube fixation frequency	1		Restlessness	1
	Inability to express the chief complaint during catheterization	1		History of diabetes	1
Drug factors	Vasoconstrictor drug use	2		Tracheal intubation operator	1

3.3.3. Model performance and validation

All seven models were validated [12–14,16]. Four of them had both internal and external validation, while three had only internal validation [4,9,15]. In terms of model performance, all seven studies reported area under the receiver operating characteristic curve (AUC) ranging from 0.680 to 0.918, with six of them having an AUC of 0.7 or above, indicating good model discrimination [4,9,12–16]. Five studies reported calibration metrics using the Hosmer-Lemeshow goodness-of-fit test, all with $p > 0.05$, suggesting good calibration ability of the model. The model details are shown in **Table 5**.

Table 5. Validation and performance of the model

Included studies	Validation methods	Validation Results	Model performance			
			Degree of discrimination	Calibration degree	Specificity	Sensitivity
Choi [4]	Inside	A: AUC = 0.60 B: the AUC = 0.85	A: AUC = 0.68 B: the AUC = 0.82	A: Hosmer-Lemeshow goodness-of-fit test $p = 0.130$ B: Hosmer-Lemeshow goodness of fit test $p = 0.399$	A: 0.76. B: 0.89	A: 0.85, B: 0.6
Gu [9]	"Internal	AUC = 0 .908	AUC = 0.93	Hosmer-Lemeshow goodness-of-fit test $p = 0.164$	0.894	0.833
Jia [12]	Inside, outside	C index = 0.77	The C index = 0.77	—	—	—
Zhang [13]	Inside, outside	AUC = 0.875	AUC = 0.87	Hosmer-Lemeshow goodness-of-fit test $p = 0.651$	0.738	0.875
Min [14]	Inside, outside	AUC = 0.956	AUC = 0.913	Hosmer-Lemeshow goodness-of-fit test $p = 0.427$	0.841	0.888
Zhang [15]	Inside	—	AUC = 0.881	—	—	—
Wang [16]	Inside, outside	AUC = 0.936	AUC = 0.918	Hosmer-Lemeshow goodness-of-fit test $p = 0.795$	0.861	0.829

4. Discussion

4.1.1. Focusing on the predictors of oral mucosal pressure injury (OMPI) in ICU patients with oral tracheal intubation can provide reference for improving the prognosis of ICU patients

This study summarized the risk prediction models of oral mucosal pressure injury in ICU patients with orotracheal intubation at home and abroad. It was found that the common risk predictors were the indwelling time of tracheal intubation, APACHEII score, serum albumin value, pad usage, vasoconstrictor drug use, etc. Due to the different materials and types of dental pads, the effects of using dental pads on oral mucosal pressure injury in patients vary. Two studies have shown that the use of dental pads is a risk factor for oral mucosal pressure injury, which is consistent with most previous studies [4,14,17–19]. Other studies have shown that the use of dental pads is a protective factor [9]. This suggests that healthcare workers should exercise caution when choosing the type of dental pad and determining whether to use it for patients based on their dental and oral conditions. The higher the patient's APACHE II score, the higher the risk of oral MMPI. Four studies have shown that a high APACHE II score is a risk factor for OMPI [13–16]. This is because the higher the APACHE II score, the more severe the patient's condition, with insufficient tissue perfusion, hemodynamic instability, and increased hypoxia. All of these can lead to increased hypoxia, dryness, and fragility of the oral mucosa. Nursing staff should pay more attention to the APACHE II score of patients. For those with a higher score, the mucosal tissue at the compression site should be closely evaluated during the indwelling of the artificial airway, and preventive protective measures should be implemented.

Patients with oral tracheal intubation may suffer from varying degrees of malnutrition because of their critical condition and inability to eat orally [20]. For example, low serum albumin levels can alter osmotic pressure, leading to tissue edema, perfusion impairment, and a decline in the body's tissue repair ability [21]. For such patients, admission screening and assessment should be carried out, and continuous monitoring should be conducted. For patients with low serum albumin levels who undergo oral tracheal intubation, effective nutritional intervention should be given in a timely manner.

4.1.2. The risk prediction model for oral mucosal pressure injury needs to be further optimized

The seven risk prediction models included in this study performed well overall, but the overall risk of bias was high. The main reasons are as follows:

(1) In terms of predictive factors, healthcare workers responsible for collecting and evaluating these factors lacked unified training. Moreover, predictive factors like scale score assessment were prone to interference and bias

(2) In terms of sample size calculation, only one model met the model construction criterion that the number of cases of clinical outcome events divided by the number of candidate predictive factors is greater than or equal to 20. The remaining models all had insufficient sample sizes and may have had bias.

(3) In statistical analysis, there is a lack of detailed handling reports on some complex data issues (such as deletion, competition risk, controlled sampling, etc.), which increases the risk of biasMost models use univariate analysis to screen predictors, converting continuous variables into categorical variables in the early stages of model construction.In addition, most predictive models have incomplete performance evaluations and are single - center studies.

Based on the shortcomings of existing models, it is suggested that future studies focus on the following

aspects for optimization and improvement:

(1) Existing studies do not evaluate predictors well. In the future, more factors can be included, such as edema, types of oral care fluid, and oral bacterial culture conditions, etc. This can enable more comprehensive predictions and provide guidance for clinical practice.

(2) Most of the existing OMPI risk prediction models use traditional logistic analysis methods. In contrast, machine learning can better define the complex relationship between predictors and outcomes through a large number of mathematical operations. This approach aligns with the comprehensive and complex characteristics of actual clinical work and holds a significant advantage in disease prediction [22]. Therefore, in the future, the utilization of machine learning algorithms to enhance the accuracy of model predictions will be considered.

(3) Most existing models do not separately study the upper and lower regions of the OMPI. Further detailed studies can be conducted in the future to achieve better regional prevention in clinical practice.

(4) In future model development and validation, try to expand sample sources and quantities as much as possible, enhance large-sample multi-center validation, and promote better clinical promotion and application of risk prediction models.

5. Summary

Currently, an increasing number of scholars are focusing on and identifying the risk of oral mucosal pressure injury in patients with orotracheal intubation in the ICU. This study analyzed the seven included models, summarized their basic characteristics, and examined the aspects of the current research that can still be further optimized and improved. It is suggested that future researchers could further conduct large-sample, multi-center validation on the basis of the existing model, promote and apply it after clinical practice, improve the accuracy of the model, and enable medical staff to identify the high-risk population of oral mucosal pressure injury in the ICU at an early stage and intervene. At the same time, artificial intelligence technology could be considered in future research. For example, machine learning algorithms can be used to build models and present them visually. In this way, medical staff can estimate risks more intuitively and reduce their workload.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Feng Y, Shi D, Huang J, 2012, Research Progress on Different Fixation Methods in Transoral Tracheal Intubation. China Practical Nursing Journal, 28(z2): 143.

[2] Amrani G, Gefen A, 2020, Which Endotracheal Tube Location Minimises the Device-Related Pressure Ulcer Risk: The Centre or a Corner of the Mouth? International Wound Journal, 17(2): 268–276.

[3] Kim S, Nah H, Kim J, et al., 2021, Relationships Between Oral-Mucosal Pressure Ulcers, Mechanical Conditions, and Individual Susceptibility in Intubated Patients Under Intensive Care: A PCR-Based Observational Study. Biological Research for Nursing, 23(4): 557–567.

[4] Choi B, Kim M, Kim S, 2020, Risk Prediction Models for the Development of Oral-Mucosal Pressure Injuries in Intubated Patients in Intensive Care Units: A Prospective Observational Study. J Tissue Viability, 29(4): 252–257.

[5] Wang B, Jiang X, Shi G, et al., 2024, Analysis of Characteristics and Influencing Factors of Oral Mucosal Pressure Injury in Elderly ICU Patients with Tracheal Intubation. Chinese Journal of Geriatric Stomatology, 22(04): 200–204 + 229.

[6] Coyer F, Stotts N, Blackman V, 2014, A Prospective Window into Medical Device-Related Pressure Ulcers in Intensive Care. International Wound Journal, 11(6): 656–664.

[7] Barakat-Johnson M, Barnett C, Wand T, et al., 2017, Medical Device-Related Pressure Injuries: An Exploratory Descriptive Study in an Acute Tertiary Hospital in Australia. J Tissue Viability, 26(4): 246–253.

[8] Nan R, Pei J, Zhang Y, et al., 2020, Research Progress on Nursing Care for Mucosal Pressure Injuries. Journal of PLA Nursing, 37(12): 62–64.

[9] Gu T, Huang G, Zhang P, et al., 2024, Construction and Validation of a Risk Prediction Model for Oral Mucosal Pressure Injury in Patients with Orotracheal Intubation. Journal of Nursing, 39(20): 64–68.

[10] Moons K, de Groot J, Bouwmeester W, et al., 2014, Critical Appraisal and Data Extraction for Systematic Reviews of Prediction Modelling Studies: The CHARMS Checklist. PLoS Medicine, 11(10): e1001744.

[11] Chen X, Zhang Y, Zhuang Y, et al., 2020, PROBAST: Assessment of Bias Risk in Diagnostic or Prognostic Multivariate Predictive Model Studies. China Journal of Evidence-Based Medicine, 20(06): 737–744.

[12] Jia L, Deng Y, Xu Y, et al., 2024, Development and Validation of a Nomogram for Oral Mucosal Membrane Pressure Injuries in ICU Patients: A Prospective Cohort Study. Journal of Clinical Nursing, 33(10): 4112–4123.

[13] Zhang S, Jiang H, Hou J, et al., 2024, Construction of a Risk Prediction Model for Oral Mucosal Pressure Injury in Elderly Patients Undergoing Endotracheal Intubation via the Mouth in the ICU. Nursing Research, 38(20): 3592–3597.

[14] Li M, Tang L, Yao Q, et al., 2024, Construction and Validation of a Predictive Model for Oral Mucosal Pressure Injury Risk in Patients Undergoing Endotracheal Intubation via the Mouth. Nursing and Rehabilitation, 23(06): 1–8.

[15] Zhang Y, Pan Y, Huang Y, et al., 2025, Risk Factor Analysis and Risk Prediction Model Construction for Oral Mucosal Pressure Injury in Patients Undergoing Endotracheal Intubation via the Mouth in the Emergency Intensive Care Unit. Journal of Practical Clinical Medicine, 29(3): 75–79 + 83.

[16] Wang Z, He X, Tao Z, et al., 2024, Construction of a Line Graph Model for the Risk of Oral Mucosal Pressure Injury in ICU Patients with Tracheal Intubation. Chinese Journal of Modern Nursing, 30(13): 1764–1770.

[17] Kim C, Kim M, Kang M, et al., 2019, Oral Mucosa Pressure Ulcers in Intensive Care Unit Patients: A Preliminary Observational Study of Incidence and Risk Factors. J Tissue Viability, 28(1): 27–34.

[18] Hampson J, Green C, Stewart J, et al., 2018, Impact of the Introduction of an Endotracheal Tube Attachment Device on the Incidence and Severity of Oral Pressure Injuries in the Intensive Care Unit: A Retrospective

Observational Study. BMC Nursing, 17: 4.

[19] Zhang Q, Song C, Zou Q, et al., 2020, Observation on the Efficacy of Modified Transoral Tracheal Intubation Fixation Method for Instrument-Induced Pressure Injuries of the Oral and Facial Neck in ICU Patients. Chinese General Practice, 18(08): 1421–1424.

[20] Ren X, Chen J, 2019, Prevention and Nursing Care of Tongue Pressure Ulcers in Patients Undergoing Transoral Endotracheal Intubation. General Nursing, 17(15): 1841–1843.

[21] Serra R, Caroleo S, Buffone G, et al., 2014, Low Serum Albumin Level as an Independent Risk Factor for the Onset of Pressure Ulcers in Intensive Care Unit Patients. International Wound Journal, 11(5): 550–553.

[22] Liu Y, Yang X, Li L, 2021, Advances in the Application of Machine Learning for Disease Prediction. Journal of Nursing Science, 28(07): 30–34.

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Preliminary Clinical Observations on the Treatment of 20 Cases of Severe Immune-Mediated Diseases Using the Combined Immune-Inflammation Adsorption System (CIAS)

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Abstract: *Objective*: To investigate the short-term efficacy and safety of the Combined Immune-Inflammation Adsorption System (CIAS) in the treatment of severe immune-mediated diseases. *Methods*: A retrospective analysis was conducted on the clinical data of 20 patients with severe immune-mediated diseases treated at our hospital using CIAS, which involved a series connection of the Kangbail® Protein A Immunoadsorption Column and the Kangseitong® Hemoperfusion Device. Changes in key laboratory indicators and clinical symptoms before and after treatment were compared. Results: A total of 68 treatment sessions were completed across the 20 patients. The mean reduction in IgG levels after a single treatment was (46.2 ± 11.3)% ($p < 0.01$). In patients with lupus nephritis, anti-ds-DNA antibody titers decreased by (68.4 ± 15.2)%, and 24-hour urine protein levels decreased from (4.8 ± 2.1) g/day to (1.2 ± 0.7) g/day ($p < 0.01$); Antibody levels in patients with anti-glomerular basement membrane disease decreased significantly, with 3 cases (75%) becoming independent of dialysis; in the group of highly sensitized patients prior to kidney transplantation, the positive rate of reactive antibodies (PRA) decreased from (76.5 ± 18.3)% to (21.4 ± 12.6)% ($p < 0.01$), and all patients successfully underwent transplantation. Post-treatment, both IL-6 and TNF-α levels decreased by more than 50% ($p < 0.05$). The overall clinical remission rate was 85% (17/20), including 6/7 cases of lupus nephritis, 3/4 cases of anti-GBM disease, 3/4 cases of ANCA-associated vasculitis, and 5/5 cases of highly sensitized pre-transplant patients. The incidence of treatment-related adverse reactions was 14.7% (10/68 sessions), primarily consisting of mild hypotension, bleeding at the puncture site, and mild allergic reactions. All symptoms resolved after symptomatic treatment, and no serious complications occurred. *Conclusion*: CIAS demonstrates definite short-term efficacy in severe immune-mediated diseases, with good safety and manageable adverse reactions, and can serve as a rescue treatment option for patients who have not responded well to conventional drug therapy.

Keywords: Immuno-inflammation adsorption system; Protein A immunoadsorption; Severe immune-mediated diseases; Hemodialysis; Lupus nephritis; Desensitization for kidney transplantation

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1. Introduction

Ethical Approval: This study is a retrospective case analysis and has been reviewed and approved by the Ethics Committee of Shaanxi Provincial People's Hospital (Approval No.: 2024R168). As the treatment constitutes routine clinical practice and the data were analyzed anonymously, informed consent from patients was waived.

Severe lupus nephritis, anti-glomerular basement membrane disease, ANCA-associated vasculitis, and other severe immune-mediated diseases are common critical conditions in nephrology. Patients often present with severe immune dysregulation and intense inflammatory responses. Conventional treatment with corticosteroids and immunosuppressants not only takes time to take effect but is also frequently interrupted due to severe side effects, resulting in persistently high clinical mortality rates [1,2]. Hemodialysis is an emerging technology in modern clinical practice, commonly referred to as renal replacement therapy (RRT). It directly removes circulating immune complexes, pathogenic autoantibodies, and inflammatory mediators from the circulation and has become a crucial adjunctive treatment for critically ill patients in our department [3].

The Combined Immune-Inflammation Adsorption System (CIAS) is a novel combined blood purification technology that has emerged in recent years. By using a Protein A immunoadsorption column in series with a broad-spectrum adsorption perfusor, it simultaneously achieves the dual therapeutic goals of specific autoantibody removal and non-specific inflammatory mediator adsorption [4,5]. Building on previous clinical experience, this article presents a retrospective analysis of 20 cases of severe autoimmune diseases treated with CIAS in the Department of Nephrology at Shaanxi Provincial People's Hospital from January 2024 to December 2025. The aim is to preliminarily evaluate the short-term efficacy and safety of this technology and provide real-world evidence to support future prospective controlled studies.

2. Materials and methods

2.1. General characteristics

The study included 20 patients with severe autoimmune diseases who underwent CIAS treatment at the Hemodialysis Center of the Department of Nephrology, Shaanxi Provincial People's Hospital, from January 2024 to December 2025. Among them, 8 were male and 12 were female; Ages ranged from 18 to 65 years, with a mean age of (38.6 ± 12.5) years. Disease types included 7 cases of severe/critical lupus nephritis, 4 cases of anti-glomerular basement membrane (GBM) disease, 5 cases of high sensitization prior to kidney transplantation (PRA ≥ 50%), and 4 cases of ANCA-associated vasculitis with renal involvement.

2.1.1. Inclusion criteria

(1) Met the established diagnostic criteria for lupus nephritis, anti-GBM disease, ANCA-associated vasculitis, and other relevant conditions [6,7];

(2) Serological evidence of high-titer autoantibodies or the presence of significant systemic inflammatory response;

(3) Inadequate response to standard treatment with adequate doses of corticosteroids and immunosuppressants, or inability to tolerate medication due to severe adverse reactions.

2.1.2. Exclusion criteria

(1) Patients with concurrent severe active infections, such as sepsis, severe pneumonia, or active

tuberculosis;

(2) Patients with concurrent malignant tumors, end-stage liver disease, multi-organ failure (SOFA score ≥ 12), or a projected survival of < 3 months;

(3) Patients who have received rituximab, bortezomib, plasma exchange, or other immunoadsorption therapies within 30 days prior to treatment.

2.2. Methods

All CIAS treatments were performed by a dedicated medical team at the Hemodialysis Center. The treatment system utilized a series combination of the Kangbail® Protein A Immunoadsorption Column and the Kangseitong® disposable hemoperfusion device, both manufactured by Zhuhai Lizhu. Extracorporeal circulation was established using a CRRT machine or a blood cell separator, and line priming was strictly performed in accordance with the department's standardized procedures.

Anticoagulation regimens:

(1) Unfractionated heparin

Initial dose of 2000–3000 U administered by intravenous push, followed by a maintenance dose of 5–10 U/(kg·h) via continuous infusion. ACT is monitored every 30 minutes to maintain a level of 1.5–2.5 times the baseline.

(2) Low-molecular-weight heparin

For patients at high risk of bleeding, use 0.4 mL of nadroparin to prime the tubing, with an additional 0.2 mL administered every 2 hours during treatment, or adjust dynamically based on thromboelastography.

(3) Parameter settings

Blood flow rate 100–150 mL/min; single treatment duration 120–180 min. Treatment frequency is individualized based on clinical condition and immune markers, typically once daily or every other day, with 3–5 sessions constituting one course of treatment.

2.3. Observation parameters

(1) Laboratory parameters

Measurement of immunoglobulin G (IgG) before and after treatment; autoantibodies: antinuclear antibodies (ANA), anti-ds-DNA, anti-glomerular basement membrane antibodies (anti-GBM), anti-neutrophil cytoplasmic antibodies (ANCA); plasma renin activity (PRA);Renal function: (serum creatinine (Scr), blood urea nitrogen (BUN); 24-hour urine protein quantification; inflammatory markers: interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α).

(2) Clinical efficacy indicators

Determine the clinical remission rate according to standardized criteria; record renal function recovery and discontinuation of dialysis.

(3) Safety indicators

Record adverse reactions such as hypotension, allergic reactions, and puncture site bleeding, along with management outcomes. Incidence rate = Number of adverse reaction events / Total number of treatment sessions (68) × 100%.

2.4. Definition of clinical remission

(1) Lupus nephritis

A decrease in urinary protein of ≥ 50% and stable or improved serum creatinine (decrease of ≥ 20% from baseline or return to normal).

(2) Anti-GBM disease/ANCA vasculitis

Discontinuation of dialysis (no dialysis required for 4 consecutive weeks and eGFR ≥ 15 mL/min/1.73 m^2) or a decrease in serum creatinine (Scr) of ≥ 50%.

(3) Pre-transplant in highly sensitized patients

PRA reduced to < 50% and successful kidney transplantation.

(4) Other

Significant improvement in symptoms, with a ≥ 30% reduction in corticosteroid dosage.

2.5. Statistical methods

Data were analyzed using SPSS 22.0 software. Continuous variables are expressed as mean ± standard deviation ($\overline{x} \pm s$). Paired *t*-tests were used for intra-group comparisons; categorical variables are expressed as percentages (%). A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of changes in laboratory parameters before and after treatment

A total of 68 CIAS treatments were administered to 20 patients, and all patients completed the treatment course as planned. Laboratory test results showed that, compared with pre-treatment levels, IgG levels in the 20 patients decreased significantly, with a reduction ranging from 32% to 65% and an average decrease of (46.2 ± 11.3)% ($p < 0.01$); IL-6 decreased from (42.3 ± 15.6) pg/mL to (18.5 ± 7.2) pg/mL, representing a reduction of (56.3 ± 14.2)% ($p < 0.05$);TNF-α decreased from (38.7 ± 12.4) pg/mL to (16.2 ± 6.1) pg/mL, representing a reduction of (58.1 ± 13.6)% ($p < 0.05$); in 7 patients with lupus nephritis, anti-ds-DNA titers decreased by (68.4 ± 15.2)% ($p < 0.01$), 24-hour urine protein decreased from (4.8 ± 2.1) g/day to (1.2 ± 0.7) g/day ($p < 0.01$), and serum creatinine (Scr) decreased from (156.4 ± 72.3) μmol/L to (98.6 ± 41.2) μmol/L ($p < 0.05$); In 4 patients with anti-GBM disease, antibody levels decreased by an average of (73.6 ± 14.2)%, with 2 patients becoming seronegative; in 4 patients with ANCA-associated vasculitis, ANCA titers decreased by an average of (58.3 ± 20.5)% ($p < 0.01$), with 2 patients becoming seronegative; Among the 5 patients with high sensitization (PRA ≥ 50%) prior to kidney transplantation, the mean PRA decreased by (55.1 ± 15.7)% ($p < 0.01$). See **Table 1** for details.

Table 1. Comparison of changes in laboratory parameters before and after treatment ($\overline{x} \pm s$)

Disease type	Laboratory parameters	Pre-treatment	Post-treatment	Decrease (%)	*t*-value	*p*-value
Total cohort (n = 20)	IgG (g/L)	18.6 ± 5.2	10.0 ± 3.1	46.2 ± 11.3	7.39	< 0.01
	IL-6 (pg/mL)	42.3 ± 15.6	18.5 ± 7.2	56.3 ± 14.2	6.63	< 0.05
	TNF-α (pg/mL)	38.7 ± 12.4	16.2 ± 6.1	58.1 ± 13.6	7.96	< 0.05

Lupus nephritis (n = 7)	Anti-ds-DNA (IU/mL)	124.5 ± 38.6	39.3 ± 15.4	68.4 ± 15.2	6.14	< 0.01
	24-hour urine protein quantification (g/day)	4.8 ± 2.1	1.2 ± 0.7	75.0 ± 12.5	4.87	< 0.01
	Scr (μmol/L)	156.4 ± 72.3	98.6 ± 41.2	36.9 ± 18.4	2.03	< 0.05
Anti-GBM disease (n = 4)	Anti-GBM antibodies (RU/mL)	156.8 ± 42.5	41.2 ± 15.3	73.6 ± 14.2	5.74	< 0.01
High sensitization before kidney transplantation (PRA ≥ 50%) (n = 5)	PRA (%)	76.5 ± 18.3	21.4 ± 12.6	55.1 ± 15.7	5.98	< 0.01
ANCA vasculitis (n = 4)	ANCA titer (U/mL)	112.5 ± 38.6	46.8 ± 16.4	58.3 ± 20.5	3.37	< 0.01

3.2. Evaluation of clinical efficacy after four weeks of treatment

Overall clinical remission rate: 85% (17/20). After four weeks of treatment, 17 of the 20 patients regained renal function and were weaned off dialysis, resulting in a remission rate of 85%. Among them, 6 of the 7 patients with lupus nephritis achieved significant remission, yielding a remission rate of 85.7%; Among the 4 patients with anti-GBM disease, 3 achieved remission, resulting in a remission rate of 75%; among the 4 patients with ANCA vasculitis, 3 achieved remission, resulting in a remission rate of 75%; all 5 patients with high sensitization prior to kidney transplantation successfully underwent the procedure, resulting in a remission rate of 100%.

3.3. Evaluation of treatment safety

A total of 10 adverse events occurred in 7 patients, with an incidence rate of 14.7% (10/68). These included 5 cases of mild hypotension (7.35%), 3 cases of bleeding at the puncture site (4.41%), and 2 cases of mild allergic reactions (2.94%). After targeted clinical management, symptoms improved significantly, and no serious safety incidents occurred (see **Table 2**).

Table 2. Results of treatment safety evaluation

Type of adverse reaction	Occurrences	Incidence (%)	Clinical manifestations	Management	Outcome
Mild hypotension	5	7.35	Dizziness, mild drop in blood pressure (90–100/60–70 mmHg)	Rapid fluid resuscitation, reduction of cardiac output	Resolved within 10 minutes, no recurrence
Bleeding at the puncture site	3	4.41	Minor bleeding at the puncture site, subcutaneous bruising	Apply local pressure for 10–15 minutes	Bleeding stops; bruising gradually resolves
Mild allergic reaction	2	2.94	Skin itching, scattered rash	Administered antihistamines for symptomatic treatment	Symptoms resolved within 30 minutes; no worsening

4. Discussion

The core pathophysiological mechanisms of severe autoimmune diseases include the excessive release of pathogenic IgG-class autoantibodies and inflammatory mediators. Although traditional plasma exchange can remove pathogenic substances, it has limitations such as limited plasma resources, the risk of allergic reactions, and loss of coagulation factors [8]. The CIAS model adopted in this study utilizes protein A to specifically adsorb IgG with high affinity, while simultaneously adsorbing medium- and large-molecule

inflammatory mediators via a perfusion device, thereby achieving dual-target clearance of "antibodies and inflammation."

Results showed that a single CIAS session reduced IgG levels by 46.2%, an effect comparable to that reported in the literature for simple immunoadsorption, while avoiding the blood-borne risks associated with plasma exchange. Clinical studies have confirmed that CIAS can rapidly control renal inflammation in lupus nephritis and significantly reduce proteinuria and creatinine levels; for patients with rapidly progressive kidney injury, it can rapidly clear pathogenic antibodies, creating an opportunity to preserve renal function and reduce dependence on dialysis [9,10]; for highly sensitized patients awaiting kidney transplantation, it can effectively reduce PRA and improve transplant success rates. The overall remission rate in this group was 85%, indicating that CIAS has clear short-term therapeutic value.

This study also found that the combined immuno-inflammatory adsorption system (CIAS) treatment for severe immune-mediated diseases has a low incidence of adverse reactions, primarily consisting of mild, transient reactions, with no serious adverse events, making its clinical application safe and controllable. From a health economics perspective, CIAS does not require allogeneic plasma, thereby reducing the risk of bloodborne infections and allergies; although the cost of consumables is relatively high, it can shorten hospital stays, reduce the dosage of immunosuppressants, and improve transplant success rates. However, as this study was a single-center, retrospective observational study with a limited sample size and no parallel control group, selection bias exists. Furthermore, the study only assessed short-term efficacy and safety, lacking long-term follow-up data; cost data were not systematically collected, and no quantitative ICER analysis was conducted. Treatment frequency, duration, and anticoagulation regimens were adjusted on an individualized basis, and no unified standardized protocol was established. Treatment frequency, duration, and anticoagulation regimens were adjusted on an individual basis, and a unified standardized protocol was not established. Consequently, the impact on long-term renal function, recurrence rates, and survival rates cannot be assessed. Therefore, the study conclusions have certain limitations. Future studies will further expand the sample size and conduct multicenter, prospective randomized controlled trials to provide further validation.

5. Conclusion

In summary, this single-center retrospective study demonstrated that the Combined Immune-Inflammation Adsorption System (CIAS) exerts reliable short-term therapeutic effects on multiple types of severe immune-mediated renal diseases. By specifically removing pathogenic autoantibodies and nonspecifically eliminating circulating inflammatory mediators, CIAS effectively reduced systemic inflammatory levels, alleviated renal tissue damage, decreased proteinuria, and improved renal function in patients with lupus nephritis, anti-GBM disease, ANCA-associated vasculitis, and pre-transplant hypersensitization. Moreover, CIAS treatment presented a low incidence of mild and reversible adverse reactions, confirming favorable clinical safety and controllable treatment risks. Compared with traditional plasma exchange and single immunoadsorption, CIAS avoids allogeneic plasma transfusion and related blood transfusion complications, providing a superior alternative rescue strategy for patients with poor response to conventional hormone and immunosuppressant regimens. Nevertheless, restricted by the small sample size, single-center design, retrospective nature and lack of unified standardized treatment protocols and long-term follow-up data, the long-term clinical

efficacy and economic benefits of CIAS remain to be further verified. Large-sample, multicenter, prospective controlled studies are urgently required to optimize the treatment scheme and promote the standardized clinical application of CIAS.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Ding Y, Yang Z, Zhang L, et al., 2026, Clinical Analysis of the Combined Use of Immunosuppressants and Glucocorticoids in the Treatment of Severe Pneumonia Complicating Pediatric Immune-Mediated Kidney Diseases. Journal of Rare and Rare Diseases, 33(03): 138–141.

[2] Alnaimat F, AbuHelal A, Elmusa R, et al., 2026, Immune Rehabilitation After Renal Transplantation in Autoimmune Diseases: Balancing Immunosuppression and Risk of Complications. Autoimmunity Reviews, 25(4): 104031.

[3] Zhang L, Guo Y, Huang H, et al., 2025, The Role of Continuous Blood Purification Techniques in the Treatment of Patients with Acute Kidney Injury Due to Sepsis. China Medical Device Information, 31(17): 144–146.

[4] Chen M, Wu G, Niu H, et al., 2025, A Study on the Role and Mechanism of Hemoperfusion for Inflammatory Adsorption in the Treatment of Sepsis-Induced Cardiomyopathy. Journal of Lingnan Emergency Medicine, 30(06): 636–639.

[5] Zheng N, An Z, Liu H, et al., 2019, Effects of Uridqing Granules Combined with Combined Artificial Kidney on Lipid Metabolism, Inflammatory Response, and Cellular Immune Function in Patients with Diabetic Nephropathy Undergoing Maintenance Hemodialysis. Journal of Modern Integrated Traditional and Western Medicine, 28(20): 2208–2211.

[6] Cheng J, 2025, Establishment of an Evaluation System for the Efficacy of Integrated Traditional Chinese and Western Medicine in Lupus Nephritis, thesis, Yunnan University of Traditional Chinese Medicine.

[7] Zhao Y, Gao Y, Zhu R, et al., 2025, A Case of Anti-GBM Disease Complicated by IgA Nephropathy. Zhejiang Clinical Medicine, 27(12): 1873–1875.

[8] Kaur M, Chittipolu S, Marathi R, et al., 2026, A Rare Diagnostic Crossroad: ANCA Vasculitis with C3 Glomerulopathy. The American Journal of the Medical Sciences, 371(Suppl 1): S94–S95.

[9] Chen Q, Yan Z, Liu L, et al., 2026, Analysis of the Efficacy of Rituximab Combined with Mycophenolate Mofetil in the Treatment of Lupus Nephritis. Chinese Journal of Modern Drug Application, 20(09): 82–85.

[10] Zeng Y, Hou C, Wu W, et al., 2025, Analysis of the Efficacy of Immunoadsorption in the Treatment of Pediatric Neuroimmunological Diseases. Chinese Journal of Neuroimmunology and Neurology, 32(04): 307–312.

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Application of the "Qi, Acid, Bacteria" Concept in Functional Gastrointestinal Disorders (FGIDs)

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Abstract: Functional gastrointestinal disorders (FGIDs) refer to a group of diseases characterized by a series of gastrointestinal symptoms without apparent organic lesions, leading to pathological changes in areas such as the oropharynx, stomach, intestines, anus, and biliary tract. In recent years, the incidence of FGIDs has been increasing annually, with over 40% prevalence globally. However, there is currently no unified standard for treatment both domestically and internationally. This paper defines "Qi" as the spleen-stomach "qi" in traditional Chinese medicine (TCM), where the spleen governs transformation and transportation, and the stomach governs reception and digestion, working together to digest food and absorb nutrients, akin to the gastrointestinal digestive and absorptive functions in Western medicine. "Acid" refers to gastric acid, and "bacteria" denotes the gastrointestinal microbiota. Through modern pharmacological research on TCM herbs combined with traditional TCM concepts, the regulation of gastric acid and gastrointestinal microbiota using relevant herbs has shown efficacy in controlling FGIDs. This paper summarizes and analyzes the "Qi, Acid, Bacteria" theory and provides clinical case examples to demonstrate its effectiveness, suggesting that this approach can offer new insights into the clinical treatment of FGIDs.

Keywords: Functional gastrointestinal disorders; Integrated traditional Chinese and Western medicine; Qi, acid, microbiota theory

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1. Introduction

Functional gastrointestinal disorders (FGIDs) are diseases characterized by a series of gastrointestinal symptoms without apparent organic lesions. Initially, patients may experience gastrointestinal symptoms such as oropharyngeal, gastric, intestinal, anal, and biliary tract lesions, which can be named based on the signs and severity of different FGIDs patients. As FGIDs progress, some patients may develop systemic symptoms like headaches and dizziness, or even neurological symptoms such as anxiety and insomnia. If mental disorders occur in FGIDs patients, it is essential to actively identify any organic lesions for accurate diagnosis.

In today's society, with rapid economic development and fast-paced lifestyles, changes in dietary

preferences and structures have increased the risk of FGIDs, with a global prevalence exceeding 40% [1]. However, there is currently no unified standard for treatment both domestically and internationally. The integration of traditional Chinese and Western medicine theories can provide treatment ideas for such diseases.

2. Application of "Qi"

According to basic TCM theory, the spleen and stomach are the sources of "qi" production. TCM scholars believe that the spleen governs transformation and transportation, while the stomach governs reception and digestion. If the spleen and stomach are healthy, the body can smoothly digest food and absorb nutrients. If the spleen is damaged but the "qi" is abundant, it can distribute nutrients to the heart and lungs, which then convert them into body fluids and blood. Therefore, nutrients, body fluids, and blood can all transform into "qi", known as the ""qi" of food and grain" in TCM, which circulates throughout the body's meridians and is the source of Zang-fu organ ""qi"". Thus, the spleen and stomach can produce "qi". If the spleen and stomach's transformative and distributive functions are disrupted, affecting the absorption of food nutrients, it can lead to a deficiency of food "qi" and hinder its production.

The spleen "qi" ascends, and the spleen prefers dryness and dislikes dampness. Spleen "qi" descent may be related to the following pathogenic mechanisms: for instance, spleen "qi" deficiency leading to weak ascending function, resulting in spleen "qi" descent. It is recommended to use "qi"-tonifying and spleen-strengthening formulas, such as Buzhong Yiqi Decoction or Sijunzi Decoction, with common herbs like *astragalus* and ginseng. Another example is dampness obstructing the spleen, also leading to weak ascending function or even descent. It is recommended to use spleen-strengthening and dampness-eliminating formulas, such as Huoxiang Zhengqi San or Pingwei San, with common herbs like *Agastache*, tangerine peel, and *Atractylodes*. Spleen "qi" should ascend, while stomach "qi" should descend. If the stomach loses its descending function, it can cause symptoms like abdominal distension, pain, dullness, and constipation. If stomach "qi" rebels upwards, it can cause symptoms like hiccups, belching, nausea, and vomiting. Tian Lin and other scholars, based on spleen-stomach theory, deeply explored the impact of spleen-stomach "qi" movement on bodily health and integrated TCM knowledge related to spleen-stomach "qi" movement and gastrointestinal motility to discuss treatment plans targeting the spleen and stomach meridians [2]. For example, they administered seven herbs with spleen-stomach "qi"-regulating functions to guinea pig stomachs in experiments, stimulating gastric smooth muscle contraction. They found that all seven herbs had significant prokinetic effects, enhancing spleen-stomach transformative function with excellent results.

The stomach prefers moisture and dislikes dryness, so it is essential to maintain sufficient body fluids in the stomach for food reception and digestion. When treating stomach diseases (FGIDs), it is crucial to protect stomach fluids. Herbs like *Adenophora* and *Ophiopogon*, which belong to the stomach meridian, are clinically used for their stomach-nourishing and fluid-generating effects, often showing significant efficacy in treating FGIDs symptoms like dry mouth, dry throat, and constipation.

3. Regulation of "acid"

The human stomach wall contains two types of secretory cells: one secretes digestive enzymes, and the other secretes gastric acid. Gastric acid (0.2–0.4% hydrochloric acid) in gastric juice can activate pepsinogen,

increasing pepsin production, and create an acidic environment for pepsin to function, killing bacteria introduced with food into the stomach. Additionally, the presence of gastric acid in the small intestine can increase intestinal fluid and pancreatic juice production, facilitating the absorption of substances like calcium and iron. It also enhances the stomach's ability to decompose muscle fibers and connective tissue in food, denaturing proteins and improving digestion. Gastric acid can also act on antral cells to reduce gastrin secretion. Gastric acid plays a crucial role in the entire digestive system. However, excessive gastric acid secretion, influenced by various factors, can cause symptoms like acid reflux, heartburn, retrosternal burning pain, and epigastric pain. Clinically, herbs like arca shell, cuttlebone, thunberg fritillary bulb, coptis, and evodia are commonly used to regulate gastric acid balance. Arca shell contains weakly alkaline $CaCO_3$, which can effectively neutralize excess gastric acid, significantly inhibit pepsin activity, and protect the gastric mucosa [3]. The mucilage can form a thin protective layer on the gastric and duodenal mucosa surfaces, accelerating granulation tissue growth and shortening ulcer healing time [4]. Chen Weiwen et al. conducted preliminary pharmacological experiments using a chronic hypergastrinemic and hyperacid secretory model and found that a self-made TCM decoction (mainly containing evodia and coptis) significantly inhibited excessive gastric acid secretion in the model, with a 50% reduction in gastric acid flow compared to the control group [5].

4. Regulation of "bacteria"

In a healthy state, the intestines contain a large number of microorganisms, primarily beneficial bacteria, with a constant proportion of various bacterial groups that mutually depend and restrain each other, maintaining a dynamic balance. Clinical practice shows that there are approximately 400–500 types of intestinal bacteria, which can be classified as exogenous or indigenous based on their origin, with indigenous bacteria being the beneficial bacteria in the intestines [6]. Under normal gastrointestinal function, intestinal bacteria exert biological barrier effects, such as anti-aging and immune functions, while promoting bodily metabolism. After gastrointestinal lesions occur, the intestinal environment becomes disrupted, and antibiotic use can inhibit the proliferation of some gastrointestinal bacteria while allowing others to proliferate rapidly, leading to bacterial imbalance and aggravating gastrointestinal lesions. Additionally, bacterial imbalance can damage the intestinal mucosa's biological barrier, affecting the prognosis of gastrointestinal diseases [7]. Multiple studies have proven the significant value of TCM in regulating intestinal bacteria, eliminating harmful bacteria, and protecting beneficial bacteria. Further analysis of TCM's protective effect on beneficial bacteria has revealed that polysaccharide components, TCM compound preparations, and TCM extracts can all protect beneficial bacteria [8]. Wang Haoran found in his research on the effect of TCM on beneficial bacteria growth that various traditional TCM herbs can stimulate the proliferation of *Lactobacillus paracasei*, such as herbs with blood-regulating or tonifying effects, without affecting the proportion of beneficial bacteria in the gastrointestinal tract [9]. Currently, many studies indicate that many TCM herbs and gastrointestinal beneficial bacteria mutually promote each other. On one hand, TCM herbs can promote the growth and proliferation of beneficial bacteria while providing a favorable environment and nutrients. On the other hand, gastrointestinal beneficial bacteria can further assist in the metabolism, decomposition, and absorption of TCM herbs, helping them exert their pharmacological effects. Representative herbs include hawthorn, medicated leaven, chicken gizzard lining, and malt.

5. Clinical cases

5.1. Example of clinical case 1

Ms. Xu, aged 38, first visited our hospital on July 8, 2019. She had been experiencing recurrent upper abdominal distension for one year, accompanied by acid reflux and heartburn after consuming sweet potatoes, a recent decrease in appetite, poor sleep quality, and loose stools. Observation of her tongue and pulse revealed a pale tongue, thick coating, thin pulse, and tooth marks on the sides of the tongue. Gastroscopy indicated chronic non-atrophic gastritis; the breath test (carbon-14) was negative. Western medicine diagnosis: chronic atrophic gastritis; Traditional Chinese Medicine (TCM) diagnosis: fullness and distension, with a pattern of spleen and stomach deficiency. Treatment aimed to replenish "qi", strengthen the spleen, and promote "qi" circulation to alleviate fullness. The modified Xiangsha Liujunzi Decoction was prescribed as the main formula, consisting of 15 g of *Codonopsis pilosula* (Taizishen), 15 g of *Poria cocos*, 15 g of stir-fried *Atractylodes macrocephala*, 15 g of *Pinellia ternata* (prepared with ginger), 15 g of *Citri reticulatae pericarpium*, 15 g of *Cyperus rotundus*, 15 g of *Citrus aurantium*, 15 g of *Magnolia officinalis*, 15 g of *Areca catechu* peel, 10 g of *Coptis chinensis*, 20 g of *Arca subcrenata* shell, 15 g of *Thunberg fritillary* bulb, and 10 g of prepared *Glycyrrhiza uralensis*. Seven doses were prescribed, decocted in water, with one dose taken daily divided into three servings. The patient was advised to abstain from spicy, greasy, and stimulating foods. On the second visit on July 17, 2019, the symptoms of fullness had significantly subsided, but the patient was hesitant to eat more, and the stools had become formed. However, she reported light sleep and easy awakening. The tongue was pale with tooth marks on the sides, a thin and greasy coating, and a thin pulse. To the previous formula, 30 g of *Polygonum multiflorum* (Yejiaoteng), 10 g of honey-processed *Polygala tenuifolia*, and 10 g of stir-fried *Crataegus pinnatifida* were added. Seven doses were prescribed, with the same decoction and administration method as before. On the third visit on July 24, 2019, there was no sensation of upper abdominal fullness, appetite had improved, and sleep had also improved. Both bowel movements and urination were normal. Observation of the tongue and pulse revealed a pale red tongue, thin yellow coating, thin pulse, and tooth marks on the sides of the tongue. Another seven doses were prescribed, and follow-up revealed the disappearance of all symptoms.

5.2. Example of clinical case 2

Patient Wang, female, aged 12, first visited on July 9, 2023, with a chief complaint of halitosis for one year, which had worsened in the past five days. There was no acid reflux or heartburn, normal appetite and sleep, loose stools, and normal urination. The tongue was red with a thin yellow and greasy coating, and the pulse was thin. TCM diagnosis: halitosis, with a pattern of spleen deficiency and damp-heat. Western medicine diagnosis: gastrointestinal dysfunction. Treatment aimed to replenish "qi", strengthen the spleen, clear heat, and resolve dampness. The modified Liujunzi Decoction was prescribed as the main formula, consisting of 20 g of *Poria cocos*, 20 g of stir-fried *Atractylodes macrocephala*, 10 g of *Eugenia caryophyllus*, 15 g of *Citri reticulatae pericarpium*, 20 g of *Coicis semen*, 10 g of *Foeniculum vulgare*, 9 g of *Pinellia ternata* (prepared), 10 g of *Magnolia officinalis* (prepared with ginger), 15 g of *Perilla frutescens* stem, 15 g of *Citrus aurantium*, 10 g of *Amomum tsao-ko*, 10 g of prepared *Glycyrrhiza uralensis*, 15 g of *Thunberg fritillary bulb*, 15 g of *Corydalis yanhusuo*, 10 g of *Dendrobium officinale*, 15 g of cleaned *Crataegus pinnatifida*, 15 g of *Prunus mume*, 10 g of *Mosla chinensis*, 15 g of *Ophiopogon japonicus*, and 20 g of *Codonopsis pilosula* (Taizishen). Seven doses were prescribed, decocted in water, with one dose taken daily divided into three

servings. On the second visit on July 16, 2023, the halitosis had significantly subsided, but the stools were slightly dry, and the tongue coating was thick and greasy. The previous formula was modified by replacing *Citri reticulatae pericarpium*, *Pinellia ternata* (prepared), *Perilla frutescens* stem, and *Corydalis yanhusuo* with 15 g of *Cassia obtusifolia*, 10 g of *Curcuma longa*, 15 g of *Rosa rugosa*, and 10 g of *Nelumbo nucifera* leaf. Seven doses were prescribed, with the same decoction and administration method as before. On the third visit on July 23, 2023, the halitosis had further improved, but the patient felt dry mouth. The tongue was pale red with a thin yellow coating, and the pulse was thin. The previous formula was modified by removing *Curcuma longa* and *Nelumbo nucifera* leaf and adding 10 g of *Rehmannia glutinosa* (raw) and 10 g of *Fructus Mori*. Another seven doses were prescribed. On the fourth visit on July 30, 2023, all symptoms had disappeared. Observing that the patient was slightly overweight, the previous formula was modified by removing *Coicis semen* and *Amomum tsao-ko* and adding 15 g each of *Gynostemma pentaphyllum* and *Bupleurum chinense*. Seven doses were prescribed to consolidate the therapeutic effect.

6. Conclusion

Numerous clinical cases abound. In summary, for the treatment of Functional Gastrointestinal Disorders (FGIDs), the beneficial integration of Western and Traditional Chinese Medicine concepts of "Qi, Acid, Bacteria" is key to constructing a harmonious gastrointestinal ecosystem and often yields significant clinical results. It is hoped that this article can provide a new approach to the treatment of functional gastrointestinal diseases.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Gastroenterologist Branch of Chinese Medical Doctor Association, Gastrointestinal Dynamics Group of Digestive Disease Branch of Chinese Medical Association, 2010, Investigation on the Current Status of Clinical Diagnosis and Treatment of Dyspepsia Symptoms in 17 Provinces and Cities in China. Chinese Journal of Practical Internal Medicine, 30(11): 989–991.

[2] Tian L, 2007, Discussion on the Prokinetic Mechanism of Seven Qi-Regulating Traditional Chinese Medicines Including Areca Catechu Peel, thesis, Nanjing Medical University.

[3] Tao M, Yan Y, Chen L, et al., 2017, Comparative Analysis of the Components of Arca Subcrenata Shell and Its Adulterants. Traditional Chinese Medicine and Clinical Pharmacology, 8(6): 5–9.

[4] Zhong G, 2016, Chinese Materia Medica. Beijing: China Press of Traditional Chinese Medicine: 318–319.

[5] Chen W, Wang G, Wu Q, et al., 1990, Chronic Hyperacidity Secretion Model in Rats and Pharmacological Experiments with Traditional Chinese Medicine. Journal of Guangzhou University of Traditional Chinese Medicine, 1990(03): 178–181.

[6] Guarner F, Malagelada J, 2003, Gut Flora in Health and Disease. Lancet, 361: 512–519.

[7] Huang Y, 2010, Detection of Gastrointestinal Flora and Gastrointestinal Mucosal Barrier. Chinese Journal of Practical Pediatrics, 25(07): 516–519.

[8] Zhou L, Dai G, 2020, Research Progress on the Treatment of Gastrointestinal Diseases with Traditional Chinese Medicine Based on Intestinal Flora. Smart Health, 6(08): 39–42.

[9] Wang H, 2020, Research on the Effects of Traditional Chinese Medicine on the Growth of Probiotics and the Design and Optimization of Traditional Chinese Medicine-Probiotic Compound Microecological Preparations, thesis, Jilin University.

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Research on the Correlation Between Dynamic Platelet Changes Combined with D-Dimer and Mortality Risk in Critically Ill Patients

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Abstract: *Objective*: To analyze the predictive value of dynamic platelet changes combined with D-dimer for the 28-day mortality risk in critically ill patients. *Methods*: A retrospective analysis was conducted on the clinical data of 500 critically ill patients admitted to the intensive care unit (ICU) of Shapingba District People's Hospital in Chongqing from August 2023 to August 2025. Data on the maximum relative decrease in platelet count within 72 hours of admission and peak D-dimer levels were collected to analyze their correlation. Patients were divided into a death group (171 cases) and a non-death group (329 cases) based on 28-day all-cause mortality. Confounding factors were adjusted for to confirm whether the maximum relative decrease in platelet count within 72 hours and peak D-dimer levels were independent risk factors for 28-day mortality in critically ill patients. Based on the confirmation, the optimal cut-off values for both were analyzed, and a dual-parameter rapid judgment table was constructed, followed by performance testing and value analysis. *Results*: The maximum decrease in platelet count within 72 hours and peak D-dimer levels in the 500 patients showed a moderate correlation ($r = 0.551$, $p = 0.012$). Multivariate logistic regression analysis revealed that age, serum lactate, APACHE II score, SOFA score, maximum decrease in platelet count within 72 hours, and peak D-dimer levels were independent risk factors for 28-day mortality in critically ill patients ($p < 0.05$). ROC curve analysis indicated that the optimal cut-off values for predicting 28-day mortality in critically ill patients were 20% for the maximum decrease in platelet count and 5 mg/L for peak D-dimer levels. The dual-parameter rapid judgment table constructed based on these values demonstrated good discrimination (AUROC = 0.852, 95% CI: 0.811–0.883) when tested using the Bootstrap method. The assessment time for 30 patients using the dual-parameter rapid judgment table was (41.05 ± 8.37) seconds, and the predicted 28-day mortality showed good consistency with actual mortality (Kappa value = 0.726, $p < 0.05$). Clinical retrospective analysis revealed that the use of the dual-parameter rapid judgment table could potentially avoid a mortality rate of 16.96%. *Conclusion*: The maximum relative decrease in platelet count within 72 hours and peak D-dimer levels are closely related to the 28-day mortality risk in critically ill patients. The dual-parameter rapid judgment table constructed by combining these two factors requires less assessment time and has high application value in predicting the 28-day mortality risk in critically ill patients, contributing to a reduction in mortality.

Keywords: Dynamic platelet changes; D-dimer; Intensive care unit; 28-day mortality; Dual-parameter rapid judgment

table

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1. Introduction

Patients in the intensive care unit (ICU) often face severe conditions such as pneumonia and sepsis, carrying a high risk of mortality. The rapid deterioration and variability of critically ill patients' conditions, along with the swift progression of multi-organ failure and a short therapeutic window, make early warning of mortality risk a core challenge in critical care medicine. Early and accurate identification of adverse prognosis risk in critically ill patients aids in clinical intervention and optimization of treatment strategies to reduce mortality risk. Coagulopathy, as a common pathophysiological process in critical illnesses such as sepsis, severe pneumonia, and trauma, is closely related to multi-organ failure and mortality in patients [1,2]. Increasing studies have found that decreased platelet count and elevated D-dimer levels are associated with adverse prognosis in critically ill patients [3]. However, some studies have also found that the dynamic trajectory of platelet consumption rate and D-dimer, compared to static values, can more accurately reflect the nature of microcirculatory disorders in patients [4,5]. To achieve rapid assessment of mortality risk in critically ill patients, this study will analyze the predictive value of dynamic platelet changes combined with D-dimer for the 28-day mortality risk in critically ill patients, optimizing patient coagulation management in the clinical ICU setting.

2. Materials and methods

2.1. General information

A retrospective analysis was conducted on the clinical data of 500 critically ill patients admitted to the Intensive Care Unit (ICU) of Shapingba District People's Hospital in Chongqing from August 2023 to August 2025. This was done to confirm whether the maximum relative decrease in platelet count and the peak D-dimer level were independent risk factors for 28-day mortality in critically ill patients and to construct a dual-parameter rapid assessment table. A random sample of 30 critically ill patients from August 2025 to March 2026 was selected to verify the consistency between the predicted results of the dual-parameter rapid assessment table and the actual mortality.

2.1.1. Inclusion criteria

(1) ICU stay of at least 72 hours;
(2) Age 18 years or older;
(3) Having at least three platelet count measurements and two D-dimer tests recorded within 72 hours after admission to the ICU.

2.1.2. Exclusion criteria

(1) Coexisting hematological malignancies or chronic liver failure;
(2) Death or voluntary discharge within 24 hours of admission;

(3) Missing clinical data relevant to this study.

2.2. Methods

(1) The maximum relative decrease in platelet count from three platelet measurements within 72 hours of admission was collected for the 500 critically ill patients, along with data on the peak D-dimer level. The correlation between the maximum decrease in platelet count and the peak D-dimer level was analyzed. After incorporating confounding adjustment factors and taking 28-day all-cause mortality as the endpoint event, patients were divided into a death group (171 cases) and a non-death group (329 cases). Confounding adjustment factors, as well as the maximum relative decrease in platelet count and the peak D-dimer level, were compared. Based on this, independent risk factors for 28-day mortality in critically ill patients were identified. Upon confirming that the maximum relative decrease in platelet count and the peak D-dimer level were independent risk factors for 28-day mortality in critically ill patients, a dual-parameter rapid assessment table was constructed, and its discriminatory performance was validated.

(2) The 28-day mortality rate of 30 critically ill patients was assessed using the dual-parameter rapid assessment table, and the consistency with the actual 28-day mortality of the patients was evaluated.

(3) All 28-day mortality cases among the 500 patients were screened out. The dual-parameter rapid assessment table was used to assess the risk of death, and the avoidable mortality rate was analyzed.

2.3. Observation indicators

(1) Endpoint outcome

28-day all-cause mortality during ICU stay.

(2) Platelet dynamics

Platelet count data at 24 hours, 48 hours, and 72 hours after admission were collected. The maximum relative decrease in platelet count at 72 hours was calculated as follows: |Minimum value within 72 hours - Baseline value / Baseline value.

(3) Coagulation and fibrinolysis indicators

These included the peak D-dimer level, as well as the baseline values of prothrombin time, activated partial thromboplastin time, and fibrinogen.

(4) Baseline confounding adjustment indicators

Age, gender, underlying diseases (hypertension, diabetes, coronary heart disease, stroke), serum lactate, albumin, duration of mechanical ventilation, APACHE II score, and SOFA score.

(5) Time required for operation

The time taken for 30 patients to complete the dual-parameter rapid assessment table was recorded.

(6) Avoidable mortality rate

If the dual-parameter rapid assessment table assessment result within 24 hours before death indicated a high risk, but no consultation or intervention was triggered in actual clinical practice, the case was classified as an avoidable death. The theoretical avoidable mortality rate was calculated as follows: Number of avoidable death cases / Total number of death cases × 100%.

2.4. Statistical methods

All statistical analyses of the data in this study were performed using SPSS 26.0 software. Measurement

data conforming to a normal distribution were expressed as (mean ± standard deviation), and comparisons between two groups were made using the independent samples *t*-test. Count data were expressed as the number of cases (percentage) [n(%)], and the χ^2 test was used for comparisons. The Pearson method was used to analyze correlations. Multivariate logistic regression analysis was used to identify factors influencing 28-day mortality. The Receiver Operating Characteristic (ROC) curve was plotted to obtain the optimal cutoff value, and the Bootstrap method was used to evaluate the discriminatory performance of the dual-parameter rapid assessment table. The Kappa consistency test was used to assess the consistency between clinical predictions of 28-day mortality and actual outcomes. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Correlation analysis between the maximum relative decrease in platelet count at 72 hours and the peak D-dimer level

The maximum relative decrease in platelet count at 72 hours in the 500 patients was (19.85 ± 4.19)%, and the peak D-dimer level was (6.26 ± 1.45) mg/L. Correlation analysis using the Pearson method showed that r = 0.551 and $p = 0.012 < 0.05$, indicating a moderate correlation (r = 0.30–0.65).

3.2. Comparative analysis of confounding adjustment factors, as well as the maximum relative decrease in platelet count and the peak D-dimer level, between the death group and the non-death group

As shown in **Table 1**, there were statistical differences in age, serum lactate, maximum relative decrease in platelet count at 72 hours, peak D-dimer level, duration of mechanical ventilation, APACHE II score, and SOFA score between the death group and the non-death group ($p < 0.05$).

Table 1. Comparative analysis of confounding adjustment factors, as well as the maximum relative decrease in platelet count and the peak D-dimer level, between the death group and the non-death group

Variable		Death group (n = 171)	Non-death group (n = 329)	χ^2/t	p
Age (years)		62.43 ± 7.67	57.61 ± 6.53	7.367	< 0.001
Gender [n(%)]	Male	82 (47.95)	169 (51.37)	0.525	0.469
	Female	89 (52.05)	160 (48.63)		
Hypertension [n(%)]	Yes	58 (33.92)	106 (32.22)	0.147	0.701
	No	113 (66.08)	223 (67.78)		
Diabetes [n(%)] No	Yes	38 (22.22)	71 (21.58)	0.027	0.869
	No	133 (77.78)	258 (78.42)		
Coronary heart disease [n(%)]	Yes	53 (30.99)	91 (27.66)	0.610	0.435
	No	118 (69.01)	238 (72.34)		
Stroke [n(%)] No	Yes	36 (21.05)	61 (18.54)	0.454	0.500
	No	135 (78.95)	268 (81.46)		
Serum lactate (mmol/L)		7.75 ± 1.83	3.49 ± 1.18	31.482	< 0.001
Albumin (g/L)		24.06 ± 6.77	25.19 ± 7.05	1.723	0.085
Maximum 72h platelet decrease (%)		24.45 ± 3.07	17.46 ± 2.24	29.033	< 0.001
Peak D-dimer (mg/L)		9.43 ± 2.11	4.61 ± 1.17	32.857	< 0.001

Prothrombin time (s)	13.46 ± 4.65	12.85 ± 3.77	1.581	0.114
Activated partial thromboplastin time (s)	35.85 ± 10.42	34.91 ± 9.67	1.217	0.224
Fibrinogen (g/L)	3.12 ± 1.08	2.98 ± 0.96	1.481	0.139
Duration of mechanical ventilation (d)	12.05 ± 3.11	8.66 ± 2.25	13.959	< 0.001
APACHE II score	19.31 ± 1.26	15.85 ± 1.09	31.891	< 0.001
SOFA score	10.61 ± 1.18	8.07 ± 0.96	25.898	< 0.001

3.3. Multifactorial logistic regression analysis of factors influencing 28-day mortality in critically Ill patients

Using 28-day mortality as the dependent variable (0 = no, 1 = yes), and age, serum lactate, maximum decrease in platelet count within 72 hours, peak D-dimer level, duration of mechanical ventilation, APACHE II score, and SOFA score (all using original values) as independent variables, a multifactorial logistic regression analysis was conducted. As shown in **Table 2**, age, serum lactate, APACHE II score, SOFA score, maximum decrease in platelet count within 72 hours, and peak D-dimer level were identified as independent risk factors for 28-day mortality in critically ill patients ($p < 0.05$).

Table 2. Multifactorial logistic regression analysis of factors influencing 28-day mortality in critically ill patients

Variable	β	SE	Wald	*p*	OR	95% CI
Age	0.979	0.362	7.295	0.007	2.661	1.308–5.414
Serum lactate	1.280	0.423	9.133	0.003	3.596	1.568–8.247
Maximum 72h platelet drop	1.380	0.407	11.511	0.001	3.975	1.791–8.822
Peak D-dimer	1.468	0.405	13.142	0.000	4.342	1.963–9.604
Duration of mechanical ventilation	0.443	0.411	1.163	0.281	1.558	0.696–3.488
APACHE II score	1.505	0.410	13.456	0.000	4.502	2.015–10.059
SOFA score	1.407	0.379	13.768	0.000	4.083	1.942–8.584

3.4. Construction of a dual-parameter rapid assessment table

The optimal cutoff values for predicting 28-day mortality in critically ill patients were determined through ROC curve analysis (**Figure 1**). The optimal cutoff value for the maximum decrease in platelet count within 72 hours was 20%, and for the peak D-dimer level, it was 5 mg/L. Based on these findings, a dual-parameter rapid assessment table (**Table 3**) was constructed, incorporating platelet count reduction score + D-dimer score, with a total score ranging from 0 to 2. A score of 0 indicates low risk (routine monitoring), a score of 1 indicates moderate risk (daily coagulation review), and a score of 2 indicates high risk (immediate clinical department consultation).

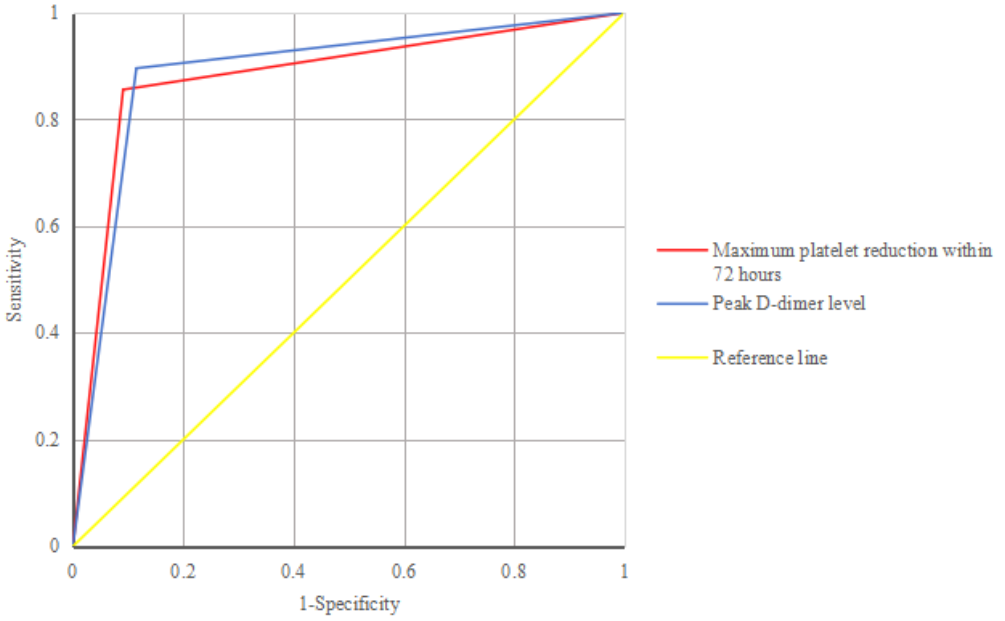


Figure 1. ROC Curve for Predicting 28-Day Mortality Risk in Critically Ill Patients Using the Maximum Platelet Reduction within 72 Hours and Peak D-Dimer Level.

Table 3. Two-parameter rapid judgment table

Predictive factor	Definition	Judgment
Maximum platelet reduction within 72 hours	≤ 20%: score 0 > 20%: score 1	Score 0: Low risk, routine monitoring; Score 1: Moderate risk, daily coagulation monitoring required; Score 2: High-risk, case requiring immediate clinical department consultation.
Peak D-dimer level	≤ 5mg/L: score 0 > 5mg/L: score 1	
Composite risk score	Maximum platelet reduction score within 72 hours + D-dimer peak value score (Total score ranged from 0 to 2)	

3.5. Performance evaluation and value analysis of the dual-parameter rapid assessment table

3.5.1. Bootstrap validation of discrimination efficacy

The dual-parameter rapid assessment table was validated through 300 bootstraps resampling, yielding an AUROC of 0.852 with a 95% confidence interval (CI) of 0.811 to 0.883, surpassing the preset threshold of 0.82. This indicates good discrimination and high stability of the table.

3.5.2. Consistency analysis between operational time and clinical prediction of 28-day mortality

The time required to assess 30 patients using the dual-parameter rapid assessment table was (41.05 ± 8.37) seconds. The predicted 28-day mortality outcomes using the table were compared with the actual 28-day mortality outcomes, and a Kappa consistency test revealed a Kappa value of 0.726 ($p < 0.05$), indicating good consistency.

3.5.3. Clinical retrospective analysis

Among 500 patients, 171 died within 28 days. Of these, 29 deaths could have been potentially avoided,

resulting in an avoidable mortality rate of 16.96%.

4. Discussion

Critically ill patients often experience intense stress, such as sepsis or severe trauma, which can easily trigger excessive activation of the systemic coagulation system [6]. This, in turn, leads to widespread microthrombus formation in systemic microvessels, causing microcirculatory obstruction and insufficient perfusion in multiple tissues throughout the body. This exacerbates multi-organ failure due to ischemia and hypoxia, significantly increasing the risk of death [7]. Therefore, coagulation function indicators hold significant value in assessing the mortality risk of critically ill patients.

Current research has identified that early dynamic changes in platelet count and D-dimer levels are more closely associated with the prognosis of critically ill patients than static values [8,9]. Therefore, quantifying the temporal synergistic effects of platelets and D-dimer and establishing a real-time mortality risk prediction model based on dynamic data could provide a decision-making window for anticoagulation therapy and platelet transfusion, which is of urgent clinical significance for achieving precise coagulation management in the intensive care unit. In this study, the maximum platelet reduction within 72 hours and the peak D-dimer level in 500 patients showed moderate correlation ($p < 0.05$). Early excessive consumption of platelets in critically ill patients leads to a decrease in their count, while secondary hyperfibrinolysis results in an increase in D-dimer levels. Both changes are mediated by coagulation dysfunction [9,10]. Although the pathological mechanisms underlying these changes are closely related, they are not completely synchronized, resulting in a moderate correlation between the two. This also suggests that their synergistic effect can complement information and more accurately predict mortality risk. After adjusting for confounding factors, the maximum platelet reduction within 72 hours and the peak D-dimer level remained independent risk factors for 28-day mortality in critically ill patients ($p < 0.05$), indicating their potential value in predicting mortality risk. After determining the optimal cutoff values for both indicators through ROC curve analysis, a dual-parameter rapid assessment table was constructed. The Bootstrap method confirmed its good discrimination (AUROC = 0.852, 95% CI: 0.811 to 0.883). The time required to assess 30 patients using the table was (41.05 ± 8.37) seconds, and the predicted 28-day mortality outcomes showed good consistency with the actual outcomes (Kappa value = 0.726, $p < 0.05$). Clinical retrospective analysis using the table revealed an avoidable mortality rate of 16.96%. This indicates that the dual-parameter rapid assessment table is not only easy to operate but also performs well in predicting the 28-day mortality risk of critically ill patients, which is of great significance for reducing mortality.

5. Conclusion

In summary, the maximum relative reduction in platelet count within 72 hours and the peak D-dimer level are closely associated with the 28-day mortality risk of critically ill patients. The dual-parameter rapid assessment table constructed based on these two indicators requires less operational time and has high application value in predicting the 28-day mortality risk of critically ill patients, contributing to a reduction in mortality. However, its long-term stability and generalization ability require further validation through multicenter, large-sample prospective studies in the future.

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References

[1] Tong Z, Tong M, Zhao C, et al., 2024, Platelet Count, Coagulation Function Indicators, Interleukin-6 Levels, and Their Clinical Significance in Elderly Patients with Severe Community-Acquired Pneumonia in the Intensive Care Unit. Journal of Trauma and Critical Care Medicine, 12(3): 140–144.

[2] Yin F, Liu Y, Shen X, 2022, Study on the Prognostic Factors of Severe Polytrauma Patients and the Establishment and Optimization of a Nomogram Model. Chinese General Practice, 25(20): 2498–2506.

[3] Guo J, Lu Y, Jiao B, 2022, Prognostic Value of D-Dimer, Platelet Count, and Prothrombin Time in Patients with Severe Pneumonia. Journal of Clinical and Pathological Research, 42(10): 2516–2521.

[4] Gao Y, Mei Q, Pan A, 2022, Dynamic Changes in Platelet Count Within One Week and Their Prognostic Value in Patients with Septic Shock. Chinese Journal of Critical Care Medicine, 34(10): 1055–1059.

[5] Zhang M, Zhou G, Wang Z, 2023, Clinical Significance of Dynamic Monitoring of Lac, cTnI, FBG, and D-D Levels in Patients with Sepsis. Journal of Molecular Diagnostics and Therapy, 15(3): 472–476.

[6] Chen S, Tong H, Qian J, 2023, Predictive Role of Lac, PLT, and Coagulation Function Tests in the Prognosis of TIC in Critically Ill Trauma Patients. Journal of Molecular Diagnostics and Therapy, 15(1): 9–13.

[7] Liang F, Wang Q, Lu S, et al., 2024, Levels and Significance of Serum NT-proBNP, D-Dimer, and Procalcitonin in Patients with Severe Pneumonia. Laboratory Medicine and Clinic, 21(22): 3270–3274.

[8] Chen C, Fang J, Chen Q, et al., 2022, Prognostic Value of Early Dynamic Changes in Platelet Count in Patients with Sepsis. Chinese Journal of Emergency Medicine, 31(5): 665–671.

[9] Chang J, Li C, Feng B, 2024, Dynamic Changes and Diagnostic Value of Serum FKN, Vasohibin-1, and D-Dimer in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. Journal of Clinical and Experimental Medicine, 23(14): 1501–1505.

[10] Li Z, Zhou M, Dong D, et al., 2024, Prognostic Significance of Early Dynamic Platelet Analysis in Patients with Severe Pneumonia. Chinese Journal of Lung Diseases, 17(3): 475–477.

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Analysis of the Application Value of Integrated Psychological Nursing Combined with Continuous Enteral Nutrition Nursing in Patients with Gastrointestinal Tumors Undergoing Chemotherapy

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Abstract: *Objective*: To evaluate the nursing effects of integrated psychological nursing combined with continuous enteral nutrition nursing in patients with gastrointestinal tumors undergoing chemotherapy. *Methods*: A total of 74 patients with gastrointestinal tumors admitted for chemotherapy from November 2023 to November 2025 were selected and equally divided into two groups using a randomization method. The experimental group received integrated psychological nursing combined with continuous enteral nutrition nursing, while the reference group received conventional nursing. Psychological scores, nutritional indicators, immune function indicators, and fatigue severity scores were compared between the two groups. *Results*: After nursing, the psychological scores and fatigue severity scores in the experimental group were lower than those in the reference group, while nutritional indicators and immune function indicators were higher in the experimental group ($p < 0.05$). *Conclusion*: Implementing integrated psychological nursing combined with continuous enteral nutrition nursing in patients with gastrointestinal tumors undergoing chemotherapy can improve their negative psychological states, adjust nutritional status, enhance immunity, and reduce fatigue severity.

Keywords: Integrated psychological nursing; Continuous enteral nutrition nursing; Gastrointestinal tumors; Chemotherapy

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1. Introduction

Gastrointestinal tumors, commonly including colorectal cancer and gastric cancer, are highly malignant and continuously damage the digestive system, leading to systemic symptoms [1]. Chemotherapy is a common

treatment for this disease, which can eliminate cancer cells, delay tumor progression, and thereby prolong patient survival. However, chemotherapy drugs can easily cause adverse reactions such as nausea, vomiting, or fatigue, increasing the psychological burden on patients and leading to negative emotions such as anxiety or depression. Therefore, integrated psychological nursing can be provided to these patients, employing multifaceted and diversified psychological nursing measures to improve their psychological states and meet their nursing needs at multiple levels, including psychological and spiritual aspects. Additionally, gastrointestinal reactions can affect patients' appetite, leading to issues such as malnutrition, necessitating the combination of enteral nutrition to deliver nutrients into the gastrointestinal tract and improve nutritional status [2]. Continuous enteral nutrition nursing involves scientifically administered enteral nutrition in a home environment, offering advantages of simplicity, efficiency, and safety. Based on this, this study selected 74 patients with gastrointestinal tumors to evaluate the intervention effects of integrated psychological nursing combined with continuous enteral nutrition nursing.

2. Materials and methods

2.1. General information

A total of 74 patients with gastrointestinal tumors who were admitted for chemotherapy between November 2023 and November 2025 were selected and randomly divided into two equal groups. The experimental group consisted of 37 patients, including 21 males and 16 females, aged between 32 and 75 years, with a mean age of (57.68 ± 4.19) years. The types of tumors were as follows: 14 cases of gastric cancer, 17 cases of colorectal cancer, and 6 cases of esophageal cancer. The reference group also consisted of 37 patients, including 22 males and 15 females, aged between 31 and 77 years, with a mean age of (57.81 ± 4.23) years. The types of tumors were as follows: 13 cases of gastric cancer, 17 cases of colorectal cancer, and 7 cases of esophageal cancer. Comparisons of data between the two groups showed $p > 0.05$.

2.1.1. Inclusion criteria

Clinically diagnosed with gastrointestinal tumors; meeting the indications for chemotherapy; having normal communication abilities; having relatively complete basic information; being fully informed about the study.

2.1.2. Exclusion criteria

Having other malignant tumors; having blood system diseases; having cognitive dysfunction; being allergic to chemotherapy drugs; having difficulty eating normally; having contraindications to enteral nutrition; withdrawing from the study midway.

2.2. Methods

The reference group received routine care: Nursing staff comprehensively explained chemotherapy knowledge to patients, including the mechanism of action of chemotherapy drugs, matters requiring cooperation during chemotherapy, and expected therapeutic effects. They assessed the patients' psychological states, patiently answered their inner doubts, and guided patients in deep breathing exercises to improve negative emotions. They demonstrated the key points of enteral nutrition operations, emphasized the precautions for home enteral nutrition, and provided targeted guidance for patients' nursing deficiencies. The experimental group received integrated psychological care + enteral nutrition continuation care.

2.2.1. Integrated psychological care

(1) Emotional support

Organize an emotional salon once a week in the outpatient department or community, inviting nursing staff, clinicians, and patients to participate together. Each session lasts 30 minutes, during which patients raise questions and express their doubts about chemotherapy or the disease, and healthcare professionals provide targeted answers. Successful cases share nursing experiences and discuss precautions for daily care to serve as role models. Patients are invited to join a WeChat group, with nursing staff serving as group administrators. Patients are encouraged to share their experiences and actively raise nursing questions in the group daily. Fellow patients can freely answer, and finally, the group administrator summarizes and answers the questions uniformly.

(2) Cognitive-behavioral intervention

Use ABC theory for nursing, where A represents the triggering event, B represents the patient's views and inner beliefs about the event, and C represents the behavioral and emotional responses to the event. Communicate face-to-face with patients to assess their views on chemotherapy, understand their daily nursing behaviors and emotional states, and deeply analyze the causes of negative emotions. Provide interventions such as language counseling or interest cultivation to correct their erroneous beliefs and behaviors. Each nursing session lasts 30 minutes and is conducted once a week.

(3) Relaxation training

Guide patients in mindfulness meditation training. In a home environment, play soft music, assume a comfortable posture, fully relax the body and mind, and imagine past pleasant experiences or unforgettable scenes, or look forward to future life. Use telephone follow-ups or WeChat private chats to conduct Morita therapy for patients, guiding them to face up to the tumor condition and side effects of chemotherapy, minimize rejection or avoidance behaviors, learn to accept the present, and coexist with the pathological state.

2.2.2. Enteral nutrition continuation care

(1) Nutritional status assessment

Based on nutritional assessment criteria, screen patients' current nutritional risks and reasonably formulate specific pathways for nutritional support, including tube feeding and oral enteral nutrition, according to their gastrointestinal function and nutrient requirements.

(2) Formulation of enteral nutrition plans

Nutritionists comprehensively assess patients' tolerance to enteral nutrition and reasonably determine the type of nutritional preparations and the dosage per meal. Continuously monitor patients' various nutritional indicators.

(3) Health education

Explain enteral nutrition knowledge during chemotherapy through various forms such as knowledge lectures, micro-video playback, and promotional brochures, including common nutritional preparations for enteral nutrition, the feasibility of plans, and nursing points for enteral nutrition. If oral medication is used, scientifically select the oral dosage and specific concentration of nutritional preparations. If tube feeding is used, demonstrate the scientific preparation method of nutritional preparations and the process of flushing the tube.

(4) Prevention of adverse reactions

For patients receiving nasal nutrition, effectively fix the nasointestinal tube. Before and after infusing nutritional preparations, flush the tube with warm water (20 mL) and then seal it. Flush the tube twice a week with sodium bicarbonate (20 mL) and assess the patency of the catheter. During the infusion of nutritional preparations, start with a slow speed and small dosage and gradually increase the infusion speed and dosage. Usually, the hourly infusion volume of the suspension is 10–20 mL, and the speed can be increased if there is no discomfort.

(5) Online follow-up

Establish a WeChat group and regularly explain enteral nutrition knowledge in the group every week, answer patients' doubts about enteral nutrition, and provide dietary guidance.

2.3. Observation indicators

(1) Psychological scores

The Self-Rating Anxiety Scale and Self-Rating Depression Scale were selected, with standard scores of 50 and 53, respectively. Anxiety and depression levels were positively scored.

(2) Fatigue level

The Cancer Fatigue Scale (CFS) was used, including physical fatigue (7 items), emotional fatigue (4 items), and cognitive fatigue (4 items). Each item was scored from 0 to 4, with a total score of 60. The fatigue level was positively scored.

(3) Nutritional indicators

Before nursing and 2 weeks after nursing, venous blood (5 mL, fasting) was collected. After centrifugation, the supernatant was taken to evaluate indicators such as hemoglobin (Hb), serum albumin (ALB), and serum total protein (TP) using an immunobiochemical analyzer.

(4) Immune function indicators

At the same time, venous blood (5 mL, fasting) was collected. After centrifugation, the plasma was separated to evaluate immunoglobulin G (IgG) and IgA using the enzyme-linked immunosorbent assay.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Measurement data were compared using *t*-tests, and count data were compared using χ^2 tests. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Comparison of psychological scores between the two groups

The psychological scores of the experimental group were lower after nursing, with $p < 0.05$ between the two groups. See **Table 1**.

Table 1. Comparison of psychological scores between the two groups [$\overline{x} \pm$ s, points]

Group	Number of cases	Anxiety		Depression	
		Before care	After care	Before care	After care
Experimental group	37	53.98 ± 4.15	23.59 ± 2.74	52.45 ± 4.78	27.19 ± 2.65
Reference group	37	53.81 ± 4.24	28.96 ± 2.91	52.41 ± 4.80	31.19 ± 2.71

t		0.174	8.172	0.036	6.419
p		0.862	0.000	0.971	0.000

3.2. Comparison of fatigue level between the two groups

The fatigue level score of the experimental group was lower after nursing, with a significant difference between the two groups ($p < 0.05$). See **Table 2**.

Table 2. Comparison of fatigue level between the two groups [$\overline{x} \pm s$, points]

Group	Number of cases	Physical Fatigue		Emotional fatigue		Cognitive fatigue	
		Before care	After care	Before care	After care	Before care	After care
Experimental group	37	17.65 ± 2.45	10.15 ± 1.57	10.53 ± 1.78	4.16 ± 1.05	9.87 ± 1.56	4.05 ± 1.13
Reference group	37	17.61 ± 2.49	14.16 ± 1.62	10.56 ± 1.81	6.19 ± 1.08	9.89 ± 1.61	6.17 ± 1.16
t		0.070	10.812	0.072	8.198	0.054	7.963
p		0.945	< 0.001	0.943	< 0.001	0.957	< 0.001

3.3. Comparison of nutritional indicators between the two groups

The nutritional indicators of the experimental group increased after nursing, with a significant difference between the two groups ($p < 0.05$). See **Table 3**.

Table 3. Comparison of nutritional indicators between the two groups [$\overline{x} \pm s$, g/L]

Group	**Number of cases**	**Hb**		**ALB**		**TP**	
		Before care	**After care**	**Before care**	**After care**	**Before care**	**After care**
Experimental group	37	10.85 ± 1.49	12.95 ± 1.56	36.11 ± 3.78	41.98 ± 3.74	65.27 ± 4.53	73.98 ± 4.14
Reference group	37	10.81 ± 1.53	10.98 ± 1.32	36.14 ± 3.82	37.05 ± 3.70	65.22 ± 4.58	67.15 ± 4.10
t		0.114	5.864	0.034	5.700	0.047	7.130
p		0.910	< 0.001	0.973	< 0.001	0.962	< 0.001

3.4. Comparison of immune function indicators between the two groups

The immune function indicators in the experimental group increased after nursing, with a significant inter-group difference ($p < 0.05$). See **Table 4**.

Table 4. Comparison of immune function indicators between the two groups [$\overline{x} \pm s$, mg/L]

Group	**Number of cases**	**IgG**		**IgA**	
		Before care	**After care**	**Before care**	**After care**
Experimental group	37	0.84 ± 0.16	1.53 ± 0.27	8.75 ± 1.36	11.56 ± 1.78
Reference group	37	0.81 ± 0.19	1.40 ± 0.25	8.77 ± 1.39	9.62 ± 1.70
t		0.735	2.149	0.063	4.794
p		0.465	0.035	0.950	< 0.001

4. Discussion

Gastrointestinal tumors are malignant tumors with a relatively high incidence rate. There are many types of this disease, and it progresses rapidly, which can have a long-term impact on the quality of life of patients [3].

Chemotherapy is a commonly used treatment method for patients with this disease. It can improve disease symptoms and reduce tumor size through standardized chemotherapy, thereby delaying tumor progression. However, due to disease-related and chemotherapy-related factors, patients with this disease generally experience negative psychological states, have obvious physiological stress responses, and are prone to accompanying symptoms such as malnutrition and cancer-related fatigue, which in turn affect disease outcomes [4]. Therefore, it is necessary to strengthen nursing interventions for patients undergoing chemotherapy for gastrointestinal tumors, alleviate their psychological burdens, and improve their nutritional status to ensure the effectiveness of chemotherapy.

Integrated psychological nursing is a relatively new nursing method that can utilize emotional support, cognitive-behavioral interventions, and other means to alleviate patients' negative psychological states, enabling them to face chemotherapy correctly and maintain a healthy psychological state [5]. Enteral nutrition continuation nursing involves providing scientific enteral nutrition guidance outside the hospital. It can comprehensively assess patients' nutritional risks and formulate targeted nutritional support plans to maintain their negative nitrogen balance and protect organ function [6]. Additionally, enteral nutrition can supplement patients with nutrients, improve gastrointestinal function, and thereby enhance immunity, which is conducive to controlling the disease.

The results showed that the psychological scores and fatigue level scores of the experimental group after nursing were lower than those of the reference group ($p < 0.05$). Integrated psychological nursing can use emotional support measures to convey positive energy to patients, enabling them to fully feel the understanding and care from healthcare workers, fellow patients, and family members. This can enhance their confidence in fighting the disease and improve treatment compliance [7]. Using WeChat groups to disseminate nursing knowledge to patients can provide long-term information support, enabling them to continuously learn new knowledge and correctly view their own diseases, thereby alleviating negative psychological states such as anxiety [8]. Based on ABC theory, cognitive-behavioral interventions for patients can help them analyze the causes of negative psychological states and correct their erroneous beliefs and behaviors. Morita therapy can improve patients' self-acceptance, enabling them to accept their own diseases, face their current situations calmly, alleviate their sense of powerlessness, and thereby relieve cancer-related fatigue symptoms [9]. The nutritional and immune function indicators of the experimental group after nursing were higher than those of the reference group ($p < 0.05$). Enteral nutrition continuation nursing can simultaneously provide nutritional support and outpatient nursing. It can use scientific enteral nutrition methods to improve patients' physiological functions, early identify and manage adverse reactions, thereby enhancing the effectiveness of enteral nutrition and improving patients' nutritional status and immune function [10].

5. Conclusion

In conclusion, implementing integrated psychological nursing combined with enteral nutrition continuation nursing for patients undergoing chemotherapy for gastrointestinal tumors can improve their psychological well-being, alleviate cancer-related fatigue, improve their nutritional status, and protect their immune function, demonstrating high nursing efficacy.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhu L, 2025, The Effect of Integrated Psychological Nursing Mode on Patients Undergoing Chemotherapy for Gastrointestinal Tumors. Contemporary Nursing, 6(9): 76–78.

[2] Zhang J, Li N, Zhu D, 2024, The Effect of Integrated Psychological Nursing Mode on Patients Undergoing Chemotherapy for Gastrointestinal Tumors. International Journal of Psychiatry, 51(6): 2002–2004.

[3] Tian M, Liu H, Wang J, 2022, Psychological Nursing Intervention Mode and Effect Evaluation for Improving Gastrointestinal Adverse Reactions in Tumor Chemotherapy Patients. Psychological Monthly, 17(12): 98–100 + 214.

[4] Qu Y, Liang Q, 2021, The Impact of Psychological Nursing and Personalized Nursing on the Psychology and Quality of Life of Patients After Chemotherapy for Gastrointestinal Tumors. Electronic Journal of Practical Clinical Nursing, 6(8): 76–79.

[5] Song D, Dai Y, Jin J, 2025, Observation on the Efficacy of Yigong San Combined with Enteral Nutrition in Treating Malnutrition in Elderly Patients with Qi-Deficiency Constitution Undergoing Chemotherapy for Gastrointestinal Tumors. Shanxi Journal of Traditional Chinese Medicine, 41(12): 13–15.

[6] Ta N, 2022, Discussion on the Impact of Dietary Nursing on the Nutritional Status of Patients With Gastrointestinal Tumors During Chemotherapy. Chinese Journal of Health Preservation, 40(21): 110–112.

[7] Duan Q, Zuo L, Yao X, 2021, Clinical Study on the Impact of Dietary Nursing Interventions on the Nutritional Status of Patients with Gastrointestinal Tumors During Chemotherapy. Chinese Community Doctors, 37(33): 120–121.

[8] Zhang J, 2022, The Impact of Dietary Nursing Interventions on the Nutritional Status of Patients During Chemotherapy for Gastrointestinal Tumors. Electronic Journal of Clinical Medical Literature, 9(30): 4–6.

[9] Zhang X, Li Y, Feng L, et al., 2024, Evidence Summary of Nutritional Management for Patients Undergoing Chemotherapy for Gastrointestinal Tumors. Journal of Nurses Training, 39(23): 2555–2562.

[10] Zhao W, Zhou X, 2022, The Impact of Comprehensive Nutritional Interventions on the Nutritional Status and Quality of Life of Patients Undergoing Chemotherapy for Gastrointestinal Tumors. Medicine, Diet Therapy and Health, 20(21): 23–25 + 127.

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Study on the Effect of Lean Management in Optimizing Nursing Staff Allocation from the Perspective of Cultivating General Practice Nurses

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Abstract: This study aims to explore the implementation effect of using lean management theory to optimize nursing staff allocation based on the perspective of general practice nurses, so as to provide empirical evidence for the refined management of nursing human resources in primary and comprehensive medical institutions. Nursing staff and inpatients in the Department of General Practice and related linked departments of a general hospital were selected as research subjects. The traditional nursing staff allocation model was adopted before the intervention, while after the intervention, the service concept of general practice nurses was integrated and lean management optimization strategies were implemented, including value stream sorting, hierarchical staffing, flexible scheduling, process reengineering and continuous improvement. Differences in nursing staff utilization efficiency, nursing quality indicators, nurses' job burnout level, and patient and nurse satisfaction before and after the intervention were compared. Results After the intervention, the balance of nursing staff allocation and per capita effective nursing working hours were significantly improved, and the proportion of non-value-added working time decreased; the incidence of adverse nursing events decreased, and the qualified rate of basic nursing and implementation rate of specialized nursing increased; nurses' job burnout scores decreased, and both nurses' job satisfaction and patient nursing satisfaction were significantly higher than those before the intervention ($p < 0.05$). Lean management from the perspective of general practice nurses can accurately match nursing service needs with human resource supply, reduce resource waste, improve nursing efficiency and quality, and improve nurses' practice experience and patients' medical experience. It is a scientific and feasible model for optimizing nursing staff allocation.

Keywords: General practice nurse; Lean management; Nursing staff allocation; Nursing quality; Job burnout; Satisfaction

Online publication: May 31, 2026

1. Introduction

With the transformation of China's medical and health service system toward "health-centered", primary

medical institutions and general practice departments undertake diversified service tasks such as diagnosis and treatment of common diseases, chronic disease management, rehabilitation nursing and health education, which put forward higher requirements for the comprehensive service ability of nursing staff. General practice nurses have a full-cycle, all-round and full-population nursing service perspective, which can comprehensively evaluate patients' physical, psychological and social needs and adapt to continuous and comprehensive nursing service scenarios. At present, nursing staff allocation is generally faced with problems such as structural imbalance, uneven workload, redundant processes and manpower waste. The traditional empirical allocation model is difficult to match the dynamic needs of general practice nursing services, easily leading to uneven nurse workload, high incidence of job burnout and fluctuating nursing quality [1].

Lean management originates from the lean production concept, whose core is to identify and eliminate non-value-added activities, optimize processes, improve resource utilization efficiency and achieve continuous improvement, and has been widely used in the medical and nursing field. Combining the comprehensive service perspective of general practice nurses with lean management, taking patient needs as the orientation, process optimization as the starting point and accurate staffing as the goal, can effectively solve the problem of mismatch between supply and demand of nursing staff. Based on the characteristics of general practice nursing services, this study implements lean management-oriented optimization of nursing staff allocation, evaluates its implementation effect, and provides practical reference for the reform of nursing human resource management [2].

2. Methods

2.1. Before intervention

The traditional nursing staff allocation model was adopted, mainly including fixed shifts, fixed posts and empirical scheduling. Manpower was roughly allocated according to the number of beds, without hierarchical and flexible deployment combined with the needs of general practice nursing services. Processes were not systematically optimized, and non-professional nursing work occupied a lot of time.

2.2. After intervention

Guided by the perspective of general practice nurses, lean management was implemented to optimize nursing staff allocation, with specific measures as follows:

2.3. Establishment of lean management and general practice nursing optimization team

The team was composed of the director of nursing department, department head nurses, key general practice nurses and quality control nurses, with clear division of labor. The whole process of general practice nursing services was sorted out, waste links in staffing and process operation were identified, and optimization plans were formulated and supervised [3].

2.4. Value stream analysis from general practice perspective

Taking the whole process of general practice patients including admission assessment, basic nursing, specialized nursing, chronic disease management, health guidance and discharge follow-up as the object, a value stream map was drawn to distinguish value-added activities (direct nursing, condition observation, health education) and non-value-added activities (repeated documentation, item searching, invalid handover,

cross-department waiting). Time consumption and manpower consumption of each link were counted to determine the optimization priorities.

2.5. Hierarchical and classified nursing staff allocation

Nursing staff were stratified according to the ability, working years and qualifications of general practice nurses: Level N0 (new nurses) were responsible for basic nursing and daily care; Level N1 (primary nurses) for routine nursing and condition monitoring; Level N2 (key nurses) for specialized nursing, chronic disease management and health guidance; Level N3 and above (supervisor nurses) for nursing of difficult cases, quality control and team guidance. According to the patient's condition classification and nursing demand intensity, "nurse-patient matching and ability-level correspondence" was implemented to avoid manpower waste and ability mismatch [4].

2.6. Flexible dynamic scheduling

Combined with the flow fluctuation rules of general practice outpatient, ward and community services, APN flexible scheduling, peak staffing increase and cross-regional mobile deployment modes were implemented. A general practice nursing manpower pool was established to cope with manpower demands such as outpatient peaks, home visits and sudden public health events, so as to achieve "no shortage of manpower at peaks and no waste at troughs" and reduce overtime and manpower idleness.

2.7. Process reengineering to eliminate waste

Nursing documentation was simplified with electronic and templated writing; fixed management of items and drugs was optimized to reduce nurses' searching time; handover process was integrated with "bedside handover and one-time verification" to reduce handover time; non-professional work (material transportation, environmental cleaning) was assigned to auxiliary staff to free up nurses' effective nursing time.

2.8. Continuous improvement and quality feedback

A mechanism of daily inspection, weekly summary and monthly analysis was established to collect feedback from nurses and patients, regularly evaluate the effect of staffing, dynamically adjust the plan for weak links, and form a closed-loop management of "Plan-Do-Check-Act" [5].

3. Observation indicators

3.1. Nursing manpower efficiency indicators

Per capita effective nursing working hours, proportion of non-value-added working time, balance of staffing, overtime hours.

3.2. Nursing quality indicators

Qualified rate of basic nursing, implementation rate of specialized nursing, incidence of adverse nursing events (falls, pressure ulcers, infusion extravasation, etc.).

3.3. Nurses' occupational indicators

The Maslach Burnout Inventory (MBI) was used to evaluate scores of emotional exhaustion,

depersonalization and personal accomplishment; Nurses' Job Satisfaction Scale was used to evaluate satisfaction.

3.4. Patient satisfaction indicators

A self-designed nursing satisfaction questionnaire was used to evaluate from the dimensions of service attitude, nursing skills, communication and guidance, and process convenience, with a total score of 100. A score ≥ 90 was defined as satisfaction.

3.5. Statistical methods

SPSS 22.0 statistical software was used for data analysis. Measurement data were expressed as ($\overline{x} \pm s$), and *t*-test was used for comparison between groups; enumeration data were expressed as [n(%)], and χ^2 test was used for comparison between groups. $p < 0.05$ indicated statistically significant difference.

4. Results

4.1. Comparison of nursing manpower efficiency indicators

After the intervention, per capita effective nursing working hours increased significantly, the proportion of non-value-added working time and per capita weekly overtime hours decreased significantly, and the balance of staffing was significantly improved, with statistically significant differences compared with those before the intervention ($p < 0.05$).

4.2. Comparison of nursing quality indicators

After the intervention, the qualified rate of basic nursing and implementation rate of specialized nursing increased significantly, and the incidence of adverse nursing events decreased significantly, with statistically significant differences compared with those before the intervention ($p < 0.05$).

4.3. Comparison of nurses' job burnout and job satisfaction

After the intervention, nurses' scores of emotional exhaustion and depersonalization decreased significantly, and scores of personal accomplishment and job satisfactions increased significantly, with statistically significant differences compared with those before the intervention ($p < 0.05$) [6].

4.4. Comparison of patient nursing satisfaction

Before the intervention, patient nursing satisfaction was (82.16 ± 6.35) points, with 249 satisfied cases and a satisfaction rate of 83.00%; after the intervention, patient nursing satisfaction was (94.28 ± 3.72) points, with 287 satisfied cases and a satisfaction rate of 95.67%. Both the satisfaction score and proportion after the intervention were significantly higher than those before the intervention, with statistically significant differences ($p < 0.05$).

5. Discussion

5.1. Integration of general practice nurse perspective and lean management meets the needs of nursing service transformation

General practice nursing emphasizes continuity, comprehensiveness and coordination, covering patients'

full-cycle health services, requiring nursing staff allocation to take into account multi-scenario needs such as outpatient, ward, community and chronic disease management. Lean management, with the core of eliminating waste, optimizing processes and accurate allocation, is highly consistent with the concept of general practice nurses of "patient-centered, resource coordination and efficient service". This study integrates the whole-process service perspective of general practice nurses into lean management, breaking through the empirical and fixed limitations of traditional staffing, realizing dynamic matching between nursing staff and service needs, and improving resource utilization efficiency [7].

5.2. Lean management for staff optimization can significantly improve nursing manpower efficiency

Through value stream analysis, non-value-added links such as repeated documentation, item searching and invalid handover are accurately identified. Process reengineering and flexible scheduling are implemented to effectively reduce nurses' non-professional working time and devote more time to direct nursing services. Hierarchical staffing achieves "ability-level correspondence and post matching", avoiding the waste of senior nurses' ability caused by undertaking basic work, while ensuring the standardized growth of junior nurses. The results of this study show that after the intervention, per capita effective nursing working hours increased, non-value-added time decreased and overtime reduced, confirming that lean management can release the potential of nursing staff and achieve "cost reduction and efficiency improvement" [8].

5.3. Staff optimization helps improve nursing quality and prevent adverse events

Scientific staffing is the basic guarantee of nursing quality. Flexible deployment and ability-level correspondence under lean management ensure standardized and continuous nursing services throughout the process, reducing operational omissions caused by insufficient manpower and overload. The perspective of general practice nurses strengthens condition assessment, health guidance and risk prediction. Combined with lean process optimization, the incidence of adverse events such as falls and pressure ulcers is effectively reduced, and the quality of basic nursing and specialized nursing is improved. The nursing quality indicators in this study were significantly improved, indicating that staffing optimization can be directly transformed into nursing safety and service quality improvement [9].

5.4. Lean management improves nurses' practice experience and reduces job burnout

Unbalanced traditional staffing easily leads to uneven nurse workload, frequent overtime and reduced job accomplishment, causing job burnout. In this study, flexible scheduling, burden reduction and efficiency improvement, and ability-level adaptation reduce nurses' work pressure, optimize work processes, and improve work autonomy and sense of value. After the intervention, nurses' emotional exhaustion decreased, personal accomplishment and satisfaction increased, indicating that lean management takes into account manpower efficiency and nurses' humanistic care, which is conducive to stabilizing the nursing team and improving practice well-being [10].

5.5. Staff optimization improves patient satisfaction and meets the goal of high-quality nursing

Lean management guided by the perspective of general practice nurses optimizes service processes around patient needs, improves the continuity and professionalism of nursing, reduces waiting time, strengthens

communication guidance and health management, and comprehensively improves medical experience. Patient satisfaction in this study was significantly improved, indicating that optimizing nursing staff allocation not only improves internal management efficiency, but also translates into high-quality services perceptible to patients, in line with the high-quality development of public hospitals and the requirements of high-quality nursing services [6].

5.6. Research limitations and prospects

This study is a single-center and phased study with a limited sample size and no long-term follow-up data included. The development level of general practice nursing in medical institutions of different regions and levels varies, so the promotion of research results needs to be combined with actual situations. In the future, multi-center, large-sample and long-term tracking studies can be carried out to further improve the lean management staffing system from the perspective of general practice nurses, and improve the allocation accuracy combined with information-based and intelligent tools, so as to provide more sufficient empirical support for the standardization and refinement of nursing human resource management.

6. Conclusion

Cultivating the perspective of general practice nurses and using lean management to optimize nursing staff allocation can effectively eliminate process waste, achieve accurate manpower matching, improve nursing efficiency and quality, reduce nurses' job burnout, and improve nurses' and patients' satisfaction. This model conforms to the characteristics of general practice nursing services and the requirements of high-quality medical development, with scientificity, feasibility and promotion value, and can provide practical reference for the reform of nursing staff allocation in medical institutions at all levels.

Disclosure statement

The author declares no conflict of interest.

References

[1] Tan L, Zhang J, Yu H, 2024, Using Lean Management Tools and Methods to Comprehensively Improve the Application Number of Appropriate Technologies of Traditional Chinese Medicine Nursing. Capital Food and Medicine, 31(17): 116–118.

[2] Wang F, Liu W, Li S, et al., 2025, Study on the Current Situation of Nursing Human Resources in Community Health Service Centers in Shanghai. Shanghai Nursing, 25(06): 1–5.

[3] Li J, Wang L, 2025, Current Situation and Optimization Countermeasures of Nursing Staff Allocation in General Practice Departments. Chinese Journal of General Practice, 23(02): 321–324.

[4] Wu D, Sun X, 2024, Study on the Effect of Lean Process Reengineering in Reducing Non-Value-Added Nursing Working Time. Chinese Nursing Management, 24(07): 1032–1036.

[5] Wu S, Xia J, Ning Y, et al., 2024, Analysis on the Current Situation and Influencing Factors of Nursing Clinical Support System in Tertiary Hospitals in Shenzhen. Chongqing Medicine, 53(13): 2033–2038.

[6] Fan J, Xu H, Qu Y, 2024, Analysis on the Current Situation and Influencing Factors of TCM Nursing Needs of

Inpatients in Public Tertiary Hospitals. Chongqing Medicine, 53(S01): 107–109.

[7] Wang F, Li Y, Du J, et al., 2024, Study on the Current Situation and Countermeasures of Needle Stick Injuries Among Hospital Nurses. Journal of Chengdu Medical College, 19(1): 19–23.

[8] Zhang Y, Shi X, Tong X, et al., 2025, Investigation on the Influence of Work Environment Perception on Job Burnout of 3300 Clinical Nurses in Western Anhui. Chinese Journal of General Practice, 23(05): 789–793.

[9] Ma F, Liu Y, Wang Y, 2025, Application of "8S" Management Model in Hospital Nursing Management. Health Advice, 2025(23): 10–12.

[10] Fan J, Xu H, Qu Y, 2024, Analysis on the Current Situation and Influencing Factors of TCM Nursing Needs of Inpatients in Public Tertiary Hospitals. Chongqing Medicine, 53(S01): 107–109.

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Integration of Competency Map and Online Courses in Clinical Practical Skills

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Abstract: Against the background of digital medical education development, the teaching of *Clinical Practical Skills* in higher vocational colleges is faced with problems such as insufficient teaching pertinence, unreasonable resource allocation, and disconnection between practical ability training and clinical needs. Based on this, this paper studies the integration of the competency map of *Clinical Practical Skills* and online courses, explores the existing problems in the teaching of *Clinical Practical Skills* in higher vocational colleges, analyzes the important value of their integration, and puts forward targeted integration strategies. The aim is to optimize the allocation of teaching resources, improve students' clinical practical ability, and provide practical references for the reform of medical education in higher vocational colleges.

Keywords: Clinical practical skills; Competency map; Online courses; Medical education; Integrated teaching

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1. Introduction

The core goal of medical education is to cultivate high-quality medical talents with solid theoretical foundation and excellent clinical practical ability. As a core course of medical majors in higher vocational colleges, *Clinical Practical Skills* is a key link connecting medical theory and clinical practice. As an important tool for sorting out the hierarchy of professional abilities and clarifying the standards of ability training, a competency map can clearly define the components, hierarchical relationships and evaluation criteria of clinical practical skills. Integrating the competency map of *Clinical Practical Skills* with online courses is not only an inevitable trend to adapt to the development of digital medical education, but also an important measure to solve the current pain points in the teaching of clinical practical skills and improve teaching quality [1]. Therefore, it is of great significance to explore the integration path of the competency map of *Clinical Practical Skills* and online courses.

2. Existing problems in the teaching of *clinical practical skills* in higher vocational colleges

2.1. Lack of systematicness and accuracy in skill training

In the current teaching of *Clinical Practical Skills* in higher vocational colleges, some colleges have not systematically sorted out the hierarchy of clinical practical skills, with vague teaching objectives and unclear paths and standards for skill training. Most teaching contents are theory-oriented, without hierarchical design according to students' learning stages, cognitive levels and skill needs of clinical posts, resulting in students' inability to identify their weak skill links and blind learning. Meanwhile, teachers find it difficult to accurately grasp the key and difficult points in teaching, and lack pertinence in teaching students of different levels. As a result, students with weak foundations cannot keep up with the teaching progress, while those with good foundations cannot get further improvement, leading to serious lack of systematicness and accuracy in skill training.

2.2. Poor connection between online and offline teaching

Although medical colleges in higher vocational education have gradually constructed online course resources, some resources are characterized by single content and fixed forms, mostly teaching videos and electronic courseware, lacking interactive and practical simulated operation resources, which is disconnected from the needs of clinical practical skill training. Meanwhile, online course resources have not been effectively connected with offline teaching, and the allocation of teaching resources lacks overall planning, resulting in repeated construction and waste of resources. In addition, online platforms have relatively simple functions, lacking precise push of learning content, real-time monitoring of learning process and scientific evaluation of learning effects, which cannot provide students with personalized learning experience or assist teachers in targeted teaching guidance, leading to low utilization efficiency of teaching resources.

2.3. Disconnection between practical ability training and clinical needs

The teaching of *Clinical Practical Skills* in higher vocational colleges mostly relies on classroom simulation practice and on-campus training, which is not closely integrated with real clinical scenarios. Students lack practical experience in real clinical environments, and the cultivation of clinical thinking and problem-solving ability is insufficient. The teaching evaluation system of some colleges still focuses on theoretical examinations and written assignments, with one-sided, single and vague evaluation of students' practical operation ability, which cannot comprehensively, objectively and accurately reflect students' clinical practical skill level. Meanwhile, the evaluation results fail to be fed back to the teaching process in a timely manner, making it difficult to effectively adjust teaching contents and methods, resulting in failure to continuously improve teaching quality and a large gap between the quality of student training and the actual needs of clinical posts.

3. Important value of integrating the competency map of *clinical practical skills* and online courses

3.1. Conducive to improving the accuracy and systematicness of clinical skill training

Based on the systematic and comprehensive sorting of the clinical practical skill map, the competency map is divided into three modules: basic skills, professional skills and comprehensive skills, clarifying the skill

elements, hierarchical corresponding relationships and evaluation standards, providing a clear framework and basis for the teaching of *Clinical Practical Skills*. If this idea is applied to online courses, the content and path of online courses can be designed according to the requirements of this method, enabling students to clarify the ability goals and development tasks to be achieved at each stage [2]. Meanwhile, according to students' ability coordinates and learning progress, suitable resources can be accurately pushed to them, and corresponding personalized education intervention measures can be given to realize "teaching students in accordance with their aptitude". Similarly, for teachers, this competency map can help them clarify the key and difficult points of teaching, reasonably arrange the teaching process, and form a gradient and organically integrated whole for clinical practical skill training, thus greatly improving the accuracy and comprehensiveness of skill training.

3.2. Conducive to optimizing the allocation of teaching resources

The integration of the two can promote the integration and optimal allocation of teaching resources, avoiding repeated construction and waste of resources. Guided by the competency map, the development and construction of online course resources will be more targeted. Around the training requirements of various clinical practical skills, diversified resources such as teaching videos, case analyses and simulated operation exercises can be produced, achieving a high degree of matching between teaching resources and skill training goals. Meanwhile, online courses break the limitations of time and space, allowing students to study and practice skills anytime and anywhere with fragmented time, effectively improving learning efficiency. Teachers can monitor students' learning process in real time through online platforms, collect students' learning data, timely find problems in the teaching process, and provide targeted teaching guidance, realizing the innovation of teaching methods. In addition, the integrated teaching model can give full play to the advantages of online teaching, integrate high-quality teaching resources inside and outside the school, realize resource sharing, provide all-round support for teaching and learning, and achieve two-way empowerment [3].

3.3. Conducive to connecting with actual clinical needs

The construction of the competency map fully integrates the skill needs of medical talents from clinical practice bases and grassroots health workers, integrating the actual requirements of clinical posts into all links of skill training. After the integration of the two, online courses can introduce real clinical cases and simulate actual clinical operation scenarios, allowing students to practice repeatedly in a virtual environment, accumulate clinical practice experience, cultivate clinical thinking and problem-solving ability, effectively make up for the disconnection between on-campus training and clinical practice, and make students' skill training more in line with the needs of clinical posts.

4. Integration strategies of the competency map of *clinical practical skills* and online courses

4.1. Systematically construct a clinical practical skill map to clarify the core framework of integration

Constructing a scientific and practical competency map is the basis for the integration of the two. Guided by the skill needs of clinical posts and combined with the talent training goals of medical majors in higher vocational colleges, clinical practical skills should be comprehensively and systematically sorted and

classified.

First, conduct extensive research. Taking medical students, clinical teachers, internship bases and general practitioners as research objects, adopt questionnaire surveys and interviews to collect their needs for clinical practical ability training, requirements for professional skills and problems encountered in teaching, providing a basis for the construction of the competency map [4].

Second, divide the hierarchy of clinical practical skills. Divide clinical practical skills into three levels: basic skills, professional skills and comprehensive skills, and clarify the skill composition of each level: basic skills cover clinical essential basic operation skills such as inquiry and physical examination, medical record writing and aseptic operation; professional skills target different medical majors, including diagnosis, treatment techniques and characteristic nursing of various diseases; comprehensive skills mainly include clinical thinking ability, condition analysis ability, communication and cooperation ability, and adaptability [5].

Third, formulate the learning objectives and abilities for each learning stage, establish an electronic version of the competency map with network tools to lay a foundation for future docking with online courses, and set up a mechanism that can revise and improve the competency map at any time according to the development of clinical medical technology and changes in clinical post needs to ensure its applicability and scientificity.

4.2. Enrich online course resources based on the competency map to create diversified learning carriers

Based on the competency map and around the training requirements of various clinical practical skills, develop and improve diversified and high-quality online course resources to create a diversified learning carrier integrating learning, practice and assessment.

First, produce a relevant teaching video resource library, including intuitive and vivid teaching videos for the operation specifications of basic skills, judgment processes of specialized skills, and clinical thinking training of comprehensive skills, such as animation demonstrations, on-site demonstrations and case explanations, allowing students to intuitively master the key points of skills [6].

Second, establish a rich clinical case library, including real medical cases of different types and degrees, with the main information, treatment plans and key technical points of each case provided, facilitating students to master and improve their clinical thinking ability in the process of case analysis.

Third, design virtual simulation operation resources. Schools can develop a virtual simulation training system, which combines virtual reality technology and simulation technology to build a simulated clinical scenario training platform, allowing students to practice repeatedly on the platform, familiarize themselves with the process and improve their practical operation ability [7].

Fourth, compile a hierarchical and graded practice question bank. Schools can form a ladder and graded assessment question bank, designing questions at primary, advanced and senior levels according to the competency map, technical hierarchy and evaluation standards to meet the needs of students at different levels. Meanwhile, sort out the existing online teaching resources, delete repetitive and obsolete content, realize classified management and precise retrieval of resources, facilitating students to find corresponding teaching materials according to the goals of the competency map and improving resource utilization [8].

4.3. Build a diversified integrated application model to empower the whole process of teaching and learning

Explore the organic integration path of the competency map and online courses, and build a diversified integrated application model of "precise push–real-time monitoring–scientific evaluation–continuous improvement" to empower the whole process of teaching and learning.

First, precisely push learning resources to students. Based on the digital competency map docking with the online teaching management platform, record and analyze relevant data such as students' ability assessment scores, learning progress and answer situations, determine their position in the competency map and missing ability points, and then provide corresponding teaching videos, simulation training, case analysis and other contents for them to study and improve purposefully.

Second, conduct dynamic learning monitoring. Collect data on students' learning time, learning content, practice completion and posting interaction frequency through the online teaching system. Teachers can grasp students' progress in real time in the background of the platform, timely find possible problems in their learning process, and provide appropriate guidance and intervention in the forms of online Q&A, live broadcast and group discussion, making teaching more personalized and precise [9].

Third, establish a scientific learning effect evaluation mechanism. In accordance with the requirements of the competency map, combine various online and offline evaluation methods to comprehensively evaluate students' learning effects. Online assessments include theoretical knowledge assessment, virtual simulation assessment and case discussion assessment; offline assessments verify students' operation ability through practical hands-on training and clinical practice. Comprehensively evaluate students' knowledge mastery, hands-on operation ability and clinical thinking judgment ability, and feed back to the online platform in real time to let them know their learning progress [10].

Fourth, establish a continuous teaching improvement mechanism. Based on the analysis of students' learning materials and evaluation results, summarize the advantages and disadvantages in the integrated teaching process, timely adjust the online teaching content and structure, improve the ability assessment standards, optimize teachers' teaching methods and strategies, and realize the spiral improvement of education. Meanwhile, strengthen technical support to solve problems such as online teaching network congestion and online training failures, ensuring the smooth development of blended teaching.

5. Conclusion

In summary, against the background of digital medical education reform, integrating the competency map of *Clinical Practical Skills* with online courses is an important measure to solve the current pain points in the teaching of clinical practical skills in higher vocational colleges and improve teaching quality, and also an inevitable choice to cultivate high-quality medical talents and meet the development needs of medical and health services. In the process of practical integration, attention should be paid to constructing a scientific and practical competency map, developing diversified and high-quality online course resources, and building an application model of "precise push–real-time monitoring–scientific evaluation–continuous improvement" to improve students' clinical practical ability. With the continuous development of science and technology, schools should constantly enrich the forms of integration, improve the effect of integration, and promote the digital and precise development of medical education in higher vocational colleges.

Disclosure statement

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References

[1] Hao L, Xu L, Chang L, et al., 2025, Post-Competency-Based Teaching Design of Respiratory System Disease Diagnosis and Treatment Technology — Taking the Course of Clinical Practical Skills as an Example. Health Vocational Education, 43(09): 40–45.

[2] Xu X, Li L, Yang S, et al., 2025, Research on Practical Teaching Reform Based on the Integration of "Post-Course-Competition-Certificate" — Taking the Course of Clinical Practical Skills as an Example. Health Vocational Education, 43(01): 34–38.

[3] Zheng L, Chen B, Lu Y, et al., 2024, Construction and Implementation of a Micro-Lecture System for Clinical Practical Skills of Traditional Chinese Medicine Assistant General Practitioners. Research and Practice on Innovation and Entrepreneurship Theory, 7(23): 10–13 + 84.

[4] Cao Y, Leng J, Song D, 2024, Application of SPOC Blended Teaching Mode in the Practical Teaching of Diagnostics of Traditional Chinese Medicine. Guangming Chinese Medicine, 39(09): 1886–1888.

[5] He M, Ma J, Wang W, 2024, Preliminary Study on the Online Teaching Mode of Clinical Skills in Obstetrics and Gynecology. China Continuing Medical Education, 16(07): 54–57.

[6] Zhang X, Zhao L, 2024, Thoughts on the Development of Basic-Clinical Integrated Courses in Medical Universities. China Modern Doctor, 62(06): 100–102.

[7] Zhou J, Xi J, Hu L, et al., 2023, Practice and Thinking of "Remote Simulation" Online Assessment in the Final Clinical Skills Assessment of Standardized Training for Internal Medicine Residents. Chinese Hospitals, 27(06): 78–80.

[8] Liu P, Li W, Fu Z, et al., 2023, Online Teaching Practice and Reflection of Clinical Skills. The Journal of Medical Theory and Practice, 36(08): 1424–1426.

[9] Wang C, Liu Y, 2022, Online Design and Practice Discussion of the Course of Clinical Skills Training. Xinjiang Medical Journal, 52(08): 989–991.

[10] Zu X, 2022, Application of "Internet +" Combined With PBL Teaching Mode in the Teaching of Orthopedic Surgery Nursing. Health Vocational Education, 40(05): 62–64.

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Effect Evaluation of Physical Therapy Combined with Rehabilitation Training in the Treatment of Lumbar Disc Herniation

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Abstract: *Objective*: To evaluate the intervention effect of physical therapy combined with rehabilitation training on lumbar disc herniation (LDH). *Methods*: A total of 74 LDH patients admitted from August 2023 to August 2025 were selected and equally divided using a random number table. The combined group received physical therapy combined with rehabilitation training, while the reference group received rehabilitation training alone. The differences in total effective rate and pain scores between the two groups were compared. *Results*: The combined group exhibited a higher total effective rate, reduced pain scores after 4 weeks of treatment, increased functional recovery scores, expanded lumbar spine mobility, and improved quality of life scores compared to the reference group ($p < 0.05$). *Conclusion*: Physical therapy combined with rehabilitation training can enhance the total effective rate in LDH patients, alleviate pain symptoms, restore lumbar spine function and joint mobility, and improve patients' quality of life.

Keywords: Physical therapy; Rehabilitation training; Lumbar disc herniation; Pain score; Lumbar spine mobility

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1. Introduction

The etiology of LDH includes lumbar mechanical injury, excessive strain, or degenerative changes in the intervertebral disc, with the pathological basis being damage to the fibrous ring structure. Patients may experience symptoms such as low back and leg pain due to nucleus pulposus herniation, which can significantly affect their quality of life over the long term [1]. Currently, surgery and conservative therapy are the preferred treatment modalities for this condition. However, surgery involves significant trauma and is prone to postoperative complications; therefore, most patients opt for conservative treatment. Rehabilitation training offers a non-invasive advantage, improving lumbar spine stability and enhancing muscle strength, thereby alleviating disease symptoms [2]. Combining physical therapy can further improve lumbar spine mobility using various treatment techniques, demonstrating a significant synergistic effect and higher treatment feasibility. Based on this, this study selected 74 LDH patients to evaluate the therapeutic effect of

physical therapy combined with rehabilitation training.

2. Materials and methods

2.1. General information

A total of 74 LDH patients admitted from August 2023 to August 2025 were selected and equally divided using a random number table. The combined group included 37 patients (21 males and 16 females), aged between 25 and 70 years (mean age: 48.95 ± 4.17 years), with a disease duration ranging from 5 months to 6 years (mean duration: 3.28 ± 0.75 years). The disease was located at L4-5 in 18 patients and at L5-S1 in 19 patients. The reference group included 37 patients (20 males and 17 females), aged between 26 and 72 years (mean age: 48.81 ± 4.22 years), with a disease duration ranging from 6 months to 7 years (mean duration: 3.34 ± 0.52 years). The disease was located at L4-5 in 21 patients and at L5-S1 in 16 patients. No significant differences were observed between the groups ($p > 0.05$).

2.1.1. Inclusion criteria

Diagnosed with LDH through imaging examinations such as CT; presenting with symptoms such as low back pain and muscle weakness; aged under 75 years; disease duration exceeding 3 months; normal communication ability; highly informed about the study.

2.1.2. Exclusion criteria

Suffering from lumbar fractures or severe osteoporosis; having a history of lumbar spine surgery; presenting with contraindications such as skin infections; having cardiovascular or cerebrovascular diseases; participating in other studies or withdrawing midway.

2.2. Methods

The reference group underwent rehabilitation training:

(1) Rubbing the waist

The doctor washed their hands and placed them on the patient's psoas major muscle, rubbing from top to bottom for approximately 15 times until the waist felt warm.

(2) Flying swallow exercise

The patient was instructed to lie prone and alternately lift their upper and lower limbs while forcefully extending their head and upper body to assume a flying swallow posture. Each session included 10 repetitions, performed once or twice daily.

(3) Backward walking training

The patient was asked to walk backward on an open and flat surface for 30 minutes each session, once daily.

(4) Exercise therapy

Trunk muscle stretching exercises were performed.

The patient was instructed to lie supine, arch their chest, and lift their chest and shoulders while inhaling deeply, then return to the starting position and exhale slowly. The patient was then asked to lie supine, flex their lower limbs, and lift their hips as high as possible while arching their chest and waist and inhaling deeply, then return to the starting position and exhale slowly. While lying prone, the patient was instructed to

extend their lower limbs and alternately lift them to the maximum amplitude. While lying prone, the patient lifted their upper body, allowing their upper limbs to naturally flex forward. Each of these exercises was performed 10 times daily.

The combined group received physical therapy in addition to rehabilitation training:

(1) Medium-frequency stimulation

A medium-frequency electrotherapy device was used, with electrode patches placed on the Weizhong, Kunlun, Huantiao, or Jiaji acupoint. The carrier frequency was set to 4 kHz, the modulation amplitude to 75%, the current intensity to 15–25 mA, and the modulation frequency to 100 Hz. Each treatment session lasted 20 minutes, performed once daily, five times a week.

(2) Acupuncture

Acupoint selection included Shenshu, Taixi, Yaoyan, Ashi, Yanglingquan, Weizhong, and Jiaji. The patient was assisted into a lateral recumbent position, and the acupoints were disinfected before acupuncture treatment. A uniform reinforcing-reducing method was used, with the needle depth determined based on the patient's individual condition (50–70 mm). After achieving deqi, the needle handle was manipulated using lifting-thrusting and twirling techniques for 1 minute, and the needle was retained for 30 minutes. While the needle was retained, a moxa stick was placed on the needle handle, 2–3 cm from the skin, and ignited for moxibustion treatment. Moxibustion was performed once daily, preferably five times a week.

(3) Cupping

Xuanbi lotion was heated for 5 minutes to reach a temperature of 45°C. Ten milliliters of the lotion was poured into a glass jar, and cupping was performed using the flashing fire method on the Ashi, Yaotongdian, and Jiaji acupoint. The cups were left in place for 10 minutes, and cupping was performed every 3 days.

The treatment duration for both rehabilitation training and physical therapy was 4 weeks.

2.3. Observation indicators

(1) Pain score

The Visual Analog Scale (VAS) was used, with scores ranging from 0 to 10 and higher scores indicating greater pain intensity.

(2) Functional recovery score

The Japanese Orthopedic Association (JOA) score was used, which includes subjective symptoms (9 points), clinical signs (6 points), and limitations in daily life (14 points), with a maximum score of 29 points. Higher scores indicate better functional recovery.

(3) Lumbar spine mobility

A goniometer was used to measure the rotation, lateral flexion, extension, and flexion mobility of the lumbar spine.

(4) Quality of life score

The Generic Quality of Life Inventory-74 (GQOL-74) was used, which includes physical function, psychological function, material life, and social function, with each item scored out of 100 points. Higher scores indicate better quality of life.

2.4. Efficacy evaluation criteria

Significant efficacy was defined as symptom resolution and straight leg raise of more than 70°; preliminary efficacy was defined as symptom alleviation and straight leg raise of 50–70°; no efficacy was defined as no change in symptoms and straight leg raise of less than 50°.

2.5. Statistical analysis

Data were processed using SPSS 28.0 software. Continuous variables were compared using *t*-tests, and categorical variables were compared using chi-square tests. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Comparison of total effective rate between the two groups

The total effective rate in the combined group was significantly higher than that in the reference group ($p < 0.05$). See **Table 1**.

Table 1. Comparison of total effective rate between the two groups [n/%]

Group	Number of cases	Significant efficacy	Initial efficacy	No efficacy	Total effective rate
Combination group	37	21	15	1	97.30% (36/37)
Reference group	37	16	14	7	81.08% (30/37)
χ^2	-	-	-	-	5.046
p	-	-	-	-	0.025

3.2. Comparison of pain scores between the two groups

After 4 weeks of treatment, the pain score in the combined group was significantly lower than that in the reference group ($p < 0.05$). See **Table 2**.

Table 2. Comparison of pain scores between the two groups [$\overline{x} \pm$ s, points]

Group	Number of cases	Before treatment	After treatment
Combination group	37	5.35 ± 1.49	3.01 ± 0.76
Reference group	37	5.39 ± 1.52	3.86 ± 0.94
t	-	0.114	4.277
p	-	0.909	0.000

3.3. Comparison of functional recovery scores between the two groups

After 4 weeks of treatment, the functional recovery score in the combined group was significantly higher than that in the reference group ($p < 0.05$). See **Table 3**.

Table 3. Comparison of functional recovery scores between the two groups [$\overline{x} \pm s$, points]

Group	Number of cases	Subjective symptoms		Clinical signs		Limitation of daily living	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Combined group	37	4.12 ± 1.35	6.05 ± 0.44	2.51 ± 1.04	4.09 ± 1.15	6.18 ± 1.46	11.86 ± 2.31
Reference group	37	4.10 ± 1.27	5.81 ± 0.56	2.53 ± 1.07	3.54 ± 1.10	6.21 ± 1.49	9.47 ± 2.24
t	-	0.066	2.050	0.082	2.102	0.087	4.518
p	-	0.948	0.044	0.935	0.039	0.931	0.000

3.4. Comparison of lumbar range of motion between the two groups

After 4 weeks of treatment, the lumbar range of motion in the combined group was significantly greater than that in the reference group ($p < 0.05$). See **Table 4**.

Table 4. Comparison of lumbar range of motion between the two groups [$\overline{x} \pm s$, °]

Group	Number of cases	Rotation		Lateral Flexion		Extension		Flexion	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Combined group	37	22.34 ± 3.15	34.18 ± 4.02	20.11 ± 2.74	30.49 ± 3.62	18.39 ± 2.71	29.66 ± 3.18	45.09 ± 5.33	77.16 ± 6.42
Reference group	37	22.39 ± 3.18	29.75 ± 3.97	20.16 ± 2.78	26.84 ± 3.52	18.41 ± 2.65	25.27 ± 3.12	45.13 ± 5.36	72.11 ± 6.35
t	-	0.068	4.769	0.078	4.397	0.032	5.994	0.032	3.402
p	-	0.946	< 0.001	0.938	< 0.001	0.974	< 0.001	0.974	0.001

3.5. Comparison of quality of life scores between the two groups

After 4 weeks of treatment, the quality of life score in the combined group was higher than that in the reference group ($p < 0.05$). See **Table 5**.

Table 5. Comparison of quality of life scores between the two groups [$\overline{x} \pm s$, points]

Group	Number of cases	Physical function		Psychological function		Material life		Social function	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Combined group	37	73.72 ± 6.83	88.94 ± 7.26	72.46 ± 7.14	86.38 ± 7.03	75.18 ± 6.47	89.26 ± 7.58	74.39 ± 6.92	87.53 ± 7.84
Reference group	37	73.68 ± 6.91	82.37 ± 7.53	72.51 ± 7.08	82.84 ± 7.92	75.21 ± 6.52	84.46 ± 7.63	74.42 ± 6.87	83.91 ± 7.69
t	-	0.025	3.821	0.030	2.033	0.020	2.715	0.019	2.005
p	-	0.980	< 0.001	0.976	0.046	0.984	0.008	0.985	0.049

4. Discussion

Lumbar disc herniation (LDH) is an orthopedic disease caused by pathological factors such as rupture of the annulus fibrosus and disc degeneration. The cauda equina and nerve roots are continuously compressed,

leading to symptoms such as lower limb dysfunction and lumbocrural pain [3]. Its main predisposing factors include prolonged sitting or standing, poor dietary habits, and environmental changes, which can severely reduce patients' self-care abilities. Surgery is the primary treatment for this disease, effectively correcting nucleus pulposus herniation, relieving compression on the cauda equina or nerve roots, and thereby improving disease symptoms. However, surgery is traumatic, involves high treatment costs, and is prone to various postoperative complications, which can affect treatment efficacy [4]. In comparison, conservative therapy offers greater convenience, allowing for the reasonable selection of treatment modalities based on the patient's disease characteristics to achieve better therapeutic outcomes.

Rehabilitation training is a fundamental treatment method for LDH patients. It utilizes long-term and scientific training programs to improve blood circulation in the lumbar region, promote rapid absorption of inflammatory responses, and thereby repair damaged lumbar tissues while enhancing the strength of the lumbar and back muscle groups. Combined with physiotherapy, it can regulate lymphatic circulation, relieve muscle spasms, reduce tissue edema severity, and induce continuous endorphin secretion, thereby improving pain symptoms. Physiotherapy encompasses multiple measures with multi-target mechanisms, capable of addressing the etiology and pathogenesis of LDH to enhance treatment efficacy and promote disease recovery [5].

The results showed that the overall response rate in the combined treatment group was higher than that in the reference group. After four weeks of treatment, the pain score in the combined group was lower than that in the reference group, while the functional recovery score, lumbar range of motion, and quality of life score were higher in the combined group ($p < 0.05$). The analysis suggests that rehabilitation training can standardize training of the core muscle groups in the lumbar and back regions, thereby improving muscle strength, activating the neuro-muscular system function, and restoring lumbar stability. Various training exercises can stimulate body receptors, inhibit the release of inflammatory factors, and thereby reduce the degree of inflammatory response and alleviate pain [6]. Techniques such as the flying swallow exercise and backward walking training can restore the physiological function of the intervertebral discs, enhance their dynamic stability, and thereby improve lumbar function and increase range of motion. However, rehabilitation training has a relatively slow onset and primarily focuses on functional training, making it difficult to comprehensively regulate the patient's physiological state, resulting in suboptimal long-term efficacy. Physiotherapy includes modalities such as intermediate-frequency stimulation and acupuncture, which have different mechanisms of action and exhibit synergistic effects. Among them, computerized intermediate-frequency stimulation can activate the opioid peptide system and regulate microcirculation in the lumbar region using the gate control theory, rapidly clearing inflammatory factors around the lesion and thereby alleviating pain symptoms. It also has regulatory mechanisms on systemic blood circulation and nerve conduction processes, promoting blood circulation and accelerating metabolism [7]. Acupuncture includes needle acupuncture and moxibustion therapies. Needle acupuncture can promote blood circulation and remove blood stasis while strengthening the waist and kidneys. In specific acupoint selection, acupuncturing the Shenshu acupoint can replenish Qi and strengthen yang while nourishing the kidneys and yin; acupuncturing the Taixi acupoint can nourish the kidneys and regulate menstruation while reducing fire and nourishing yin; acupuncturing the Ashi, Yanglingquan, and Weizhong acupoint can promote blood circulation and remove blood stasis while continuously relieving pain, dispelling wind pathogens, and promoting blood circulation and flexibility; acupuncturing the Jiaji acupoint can relax muscles and improve blood circulation in the lumbar region [8]. Moxibustion generates thermal effects, providing warm stimulation

to acupoints, thereby improving meridian conduction function and relieving pathological manifestations such as nerve root edema. Additionally, acupuncture can accelerate lymphatic return, improve symptoms such as joint stiffness and limited range of motion, and thereby increase lumbar range of motion. The combination of needle acupuncture and moxibustion produces immediate therapeutic effects, rapidly relieving lumbocrural pain symptoms and effectively restoring lumbar function. Cupping therapy stimulates both meridians and acupoints, having effects such as removing dampness and dispersing cold, dredging meridians, and relieving pain and swelling. It can relax the muscles in the lumbar and back regions, improve local metabolic status, and transport nutrients to the lumbar region, thereby repairing tissues [9]. The local effects of cupping therapy can reduce inflammatory exudation, improve tissue edema, and thereby clear aseptic inflammation, reducing pain scores while improving joint function. The Xuanbi lotion used in cupping therapy contains herbs such as Lycopodiaceae, Clematis, and Atractylodes, which can exert analgesic effects by dispersing cold through thermal effects and meridian stimulation [10]. After combined treatment, patients' clinical symptoms are significantly relieved, reducing the multiple impacts of LDH on their quality of life and enabling them to return to normal life. Additionally, combined treatment can prevent disease recurrence, maintain long-term stability of lumbar function, reduce patients' psychological burden, improve their physical and mental comfort, and significantly enhance their quality of life.

5. Conclusion

In conclusion, physiotherapy combined with rehabilitation training can improve the overall treatment efficacy for LDH patients, alleviate lumbocrural pain symptoms, improve lumbar function and range of motion, and facilitate effective enhancement of patients' quality of life, serving as a common treatment modality for patients with this disease.

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhang M, Zhang Y, 2025, Efficacy of Physiotherapy Combined with Rehabilitation Training in the Treatment of Lumbar Disc Herniation and Its Impact on JOA Scores. China Practical Medicine, 20(15): 162–165.

[2] Lin Q, 2025, Effects of Cupping Therapy Combined with Core Muscle Group Training on Pain and Lumbar Function in Patients with Lumbar Disc Herniation. China Modern Drug Application, 19(6): 168–171.

[3] Wu Z, 2022, Clinical Effects of Intermediate-Frequency Pulsed Electrical Stimulation Combined with Mecobalamin Tablets in the Treatment of Patients with Lumbar Disc Herniation. Medical Equipment, 35(14): 92–94.

[4] Shi R, 2025, Therapeutic Effects of Intermediate-Frequency Pulsed Electrical Stimulation Combined with Mecobalamin Tablets in Lumbar Disc Herniation. Marriage and Health, 31(15): 67–69.

[5] Tan W, Yuan D, Chen Y, et al., 2025, Clinical Study on the Treatment of Lumbar Disc Herniation with Pricking Blood Therapy Combined With "Tongji" Electroacupuncture. Journal of Traditional Chinese Medicine, 43(2): 220–224.

[6] Jiang Y, Wang H, Mou J, 2025, Effects of Mixed-Frequency Electroacupuncture Therapy Combined with Ginger-Partitioned Moxibustion on Patients with Lumbar Disc Herniation Complicated by Sciatica with Cold-Dampness Syndrome. Clinical Misdiagnosis and Mistreatment, 38(18): 103–107.

[7] Liu C, Ma H, 2026, Clinical Study on the Treatment of Lumbar Disc Herniation With Tongdu Zhengji Manipulation Combined with Warm Needle Acupuncture. Tianjin Journal of Traditional Chinese Medicine, 43(2): 177–181.

[8] Luan L, 2026, Clinical Effects of Acupuncture Combined with Mecobalamin and Celecoxib in the Treatment of Lumbocrural Pain with Kidney Deficiency and Blood Stasis Syndrome in Lumbar Disc Herniation. Clinical Rational Drug Use, 19(4): 155–157.

[9] Peng B, Feng M, Li L, et al., 2025, Study on the Efficacy of Automatic Pressure-Controlled Cupping Therapy in Lumbar Disc Herniation. China Journal of Orthopaedics and Traumatology, 38(11): 1133–1138.

[10] Jin M, Zhou P, Zhou C, 2025, Analgesic Effects of Pricking Blood Cupping Therapy in the Acute Phase of Blood Stasis-Type Lumbar Disc Herniation. Clinical Medicine and Education, 23(3): 227–229.

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Observation on the Efficacy and Safety of Riociguat in Patients with Chronic Obstructive Pulmonary Disease (COPD) Complicated by Pulmonary Arterial Hypertension (PAH)

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Abstract: *Objective*: To investigate the efficacy and safety of riociguat in patients with chronic obstructive pulmonary disease (COPD) complicated by pulmonary arterial hypertension (PAH). *Methods*: A total of 98 patients with COPD and PAH admitted to Zhongxiang People's Hospital from January 2023 to December 2024 were selected and randomly divided into a control group and an observation group using a random number table method, with 49 patients in each group. The control group received conventional treatment, while the observation group received riociguat in addition to the conventional treatment. Clinical efficacy, pulmonary function indicators, pulmonary artery pressure indicators, blood gas indicators, and 6-minute walking distance were compared between the two groups, and adverse reactions during treatment were recorded. *Results*: After treatment, the total effective rate in the observation group was 93.88%, higher than that in the control group (79.59%). The pulmonary function indicators, pulmonary artery pressure indicators, blood gas indicators, and 6-minute walking distance in the observation group were superior to those in the control group, with statistically significant differences ($p < 0.05$). There was no significant difference in the total incidence of adverse reactions between the two groups ($p > 0.05$). *Conclusion*: Riociguat treatment can improve pulmonary function, pulmonary artery pressure, and blood gas status in patients with COPD complicated by PAH, enhance exercise tolerance and clinical efficacy, and is safe without increasing the risk of adverse reactions.

Keywords: Chronic obstructive pulmonary disease; Pulmonary arterial hypertension; Riociguat; Efficacy; Safety

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1. Introduction

Pulmonary arterial hypertension (PAH), as a frequent and serious complication of chronic obstructive pulmonary disease (COPD), cannot be ignored. As COPD progresses, chronic hypoxemia, pulmonary

inflammation, endothelial dysfunction, and other factors collectively lead to pulmonary vascular remodeling and constriction, causing PAH, which in turn leads to right heart dysfunction and even death [1,2]. The incidence of COPD complicated by PAH increases with disease severity and is particularly common in patients with severe COPD, affecting their quality of life, exercise tolerance, and prognosis [3]. Epidemiological data show that the incidence of PAH in COPD patients is 20–50%, and both the incidence and severity of PAH increase with the progression of COPD [4]. Therefore, finding a safe and effective treatment regimen to improve the condition of patients with COPD complicated by PAH has become a key focus of clinical research. Currently, the primary and core strategy for treating PAH is to optimize the treatment of the underlying pulmonary disease, including long-term oxygen therapy, bronchodilators, smoking cessation, pulmonary rehabilitation, etc. However, some patients still have severe PAH and progressive right heart dysfunction, with limited effects on reducing pulmonary artery pressure and difficulty in effectively delaying disease progression. Riociguat activates soluble guanylate cyclase (sGC) through a dual mechanism, enhancing the NO-cyclic guanosine monophosphate (cGMP) signaling pathway without relying on nitric oxide (NO), thereby dilating pulmonary vessels, reducing pulmonary artery pressure, and improving pulmonary circulation [5]. However, there are currently few studies on its application in patients with COPD complicated by PAH. Based on this, this study aimed to investigate the efficacy and safety of riociguat in patients with COPD complicated by PAH.

2. Materials and methods

2.1. General information

From January 2023 to December 2024, this study admitted and treated 98 patients with COPD complicated by PAH. They were randomly divided into a control group and an observation group using a random number table method, with 49 patients in each group. This study was approved by the Medical Ethics Committee of our hospital, and all patients participating in the study signed informed consent forms.

2.1.1. Inclusion criteria

(1) Met the diagnostic criteria for COPD [6];
(2) Diagnosed with PAH [7];
(3) Age > 18 years;
(4) Normal cognitive and communication abilities and clear consciousness.

2.1.2. Exclusion criteria

(1) Combined with important organ dysfunction such as liver and kidney dysfunction or malignancy;
(2) Presence of mental disorders;
(3) Combined with hematological diseases;
(4) Combined with other serious pulmonary diseases such as tuberculosis;
(5) Combined with severe left heart dysfunction or arrhythmia;
(6) Allergic to the study drugs.

2.2. Methods

2.2.1. Control group

Conventional treatment regimen:

(1) Bronchodilators

Salbutamol aerosol [produced by GlaxoSmithKline Pharmaceuticals (UK) Co., Ltd., National Medical Products Administration Approval Number H20150673, specification: 100 μg/puff], 100 μg each time, with a maximum daily dose not exceeding 8 times;

(2) Anti-inflammatory treatment

For patients with repeated acute exacerbations, budesonide formoterol powder for inhalation (AstraZeneca, Approval Number H20140458, specification: 2 mL:1 mg) was given, 1 inhalation each time, twice a day;

(3) Oxygen therapy

For patients with resting oxygen saturation < 88%, oxygen was administered at a flow rate of 1–2 L/min for at least 15 hours per day;

(4) Symptomatic treatment

Diuretic, anticoagulant, cough-relieving, and expectorant treatments were given according to the patient's condition.

2.2.2. Observation group

The observation group received oral riociguat tablets (Bayer AG, National Medical Products Administration Approval Number H20200015, specification: 1 mg/tablet) in addition to the conventional treatment in the control group. The initial dose was 1 mg each time, three times a day; after 1 week of treatment, if the patient tolerated it well without obvious adverse reactions such as headache, dizziness, or hypotension, the dose was adjusted to 1.5 mg each time, three times a day; after another week of observation, if the patient still tolerated it well, the dose could be further adjusted to 2 mg each time, three times a day; the maximum dose did not exceed 2.5 mg each time, three times a day. If the patient developed obvious adverse reactions during dose adjustment, the current dose was maintained or appropriately reduced.

Both groups received continuous treatment for 8 weeks.

2.3. Observation indicators

2.3.1. Clinical efficacy evaluation

After treatment, clinical efficacy was evaluated based on the improvement in cardiac function classification, symptom relief, and changes in exercise tolerance, divided into three grades: markedly effective, effective, and ineffective:

(1) Markedly effective

Cardiac function classification improved by ≥ 2 grades, symptoms significantly relieved, and 6-minute walking test (6MWT) increased by ≥ 100 m;

(2) Effective

Cardiac function classification improved by 1 grade, symptoms relieved to some extent, and 6MWD increased by 50–99 m;

(3) Ineffective

Did not meet the above criteria or the condition worsened [8]. The total effective rate was the sum of the proportions of markedly effective and effective cases.

2.3.2. Pulmonary function parameter measurement

Using pulmonary function testing equipment, the forced expiratory volume in the first second (FEV1) and forced vital capacity (FVC) of the subjects were measured, and the ratio of FEV1/FVC was calculated simultaneously.

2.3.3. Pulmonary artery pressure indicator detection

Pulmonary artery pressure (mPAP) and pulmonary artery systolic pressure (PASP) were detected using a cardiac ultrasound diagnostic instrument (Philips EPIQ7C), operated by experienced ultrasound physicians.

2.3.4. Blood gas indicator detection

2 mL of arterial blood was drawn from the patient in a fasting state (anticoagulated with heparin), and an Abbott i-STAT blood gas analyzer (USA) was used to detect the partial pressure of oxygen (PaO2) and partial pressure of carbon dioxide (PaCO2) in the arterial blood. The entire detection process must strictly follow aseptic operation specifications to prevent air from mixing in.

2.3.5. 6-minute walking distance detection

Using the 6-minute walking test, the patient walked as fast as possible in a straight, obstacle-free corridor for 6 minutes, and the walking distance was recorded. The patient received routine oxygen inhalation for 10 minutes before the test to avoid the influence of strenuous exercise on the results. During the detection process, the patient was closely observed for any discomfort, and the test was immediately stopped if chest pain or worsening dyspnea occurred.

2.3.6. Adverse reaction monitoring

During the continuous treatment period, the occurrence of adverse reactions was observed and recorded daily, including symptoms such as headache, dizziness, chest tightness, gastrointestinal discomfort, and fatigue. Statistical Methods Data were processed using SPSS 27.0. Measurement data conforming to a normal distribution were expressed as ($\overline{x} \pm s$), and a *t*-test was used; count data were expressed as [n(%)], and a χ^2 test was used. $p < 0.05$ indicated a statistically significant difference.

3. Results

3.1. Comparison of baseline data between the two groups

The comparison of baseline data between the two groups showed no statistically significant differences ($p > 0.05$), as shown in **Table 1**.

Table 1. Comparison of baseline data between the two groups [n(%)/ $\overline{x} \pm s$]

Group	Number of cases (n)	Gender		Age (years)	COPD duration (years)
		Female	Male		
Observation group	49	21 (42.86)	28 (57.14)	63.80 ± 5.84	8.52 ± 2.16
Control group	49	24 (48.98)	25 (51.02)	63.40 ± 5.60	8.86 ± 2.20
χ^2/t value		0.370		0.346	0.772
p value		0.543		0.730	0.442

3.2. Comparison of clinical efficacy between the two groups

The overall effective rate in the observation group was significantly superior to that in the control group, with a statistically significant difference ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of clinical efficacy between the two groups [n(%)]

Group	Number of cases (n)	Markedly effective	Effective	Ineffective	Total effective rate
Observation group	49	25 (51.02)	21 (42.86)	3 (6.12)	46 (93.88)
Control group	49	19 (38.77)	20 (40.82)	10 (20.41)	39 (79.59)
χ^2 value					4.346
p value					0.037

3.3. Comparison of pulmonary function indicators between the two groups

Before treatment, there were no significant differences in various pulmonary function parameters between the two groups of subjects ($p > 0.05$). After intervention, all pulmonary function indicators in the observation group showed a tendency to be higher than those in the control group, and the differences were statistically significant ($p < 0.05$). See **Table 3**.

Table 3. Comparison of pulmonary function between the two groups ($\overline{x} \pm s$)

Group	Number of cases (n)	FEV_1 (L)		FVC (L)		FEV_1/FVC (%)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	49	0.88 ± 0.23	1.53 ± 0.35*	1.43 ± 0.39	2.05 ± 0.53*	54.51 ± 5.65	65.45 ± 6.02*
Control group	49	0.85 ± 0.26	1.12 ± 0.40*	1.49 ± 0.37	1.67 ± 0.54*	55.30 ± 5.53	58.14 ± 6.21*
t value		0.605	5.400	0.781	3.516	0.700	5.916
p value		0.547	< 0.001	0.437	< 0.001	0.486	< 0.001

Note: Compared with the same group before treatment, *$p < 0.05$.

3.4. Comparison of pulmonary artery pressure indicators and blood gas indicators between the two groups

Before treatment, there were no statistically significant differences in these indicators between the two groups ($p > 0.05$). After treatment, the values of $PaCO_2$, mPAP, and PASP in the observation group were all lower than those in the control group, while the value of PaO_2 was higher than that in the control group, with statistically significant differences ($p < 0.05$). See **Table 4**.

Table 4. Comparison of pulmonary artery pressure indicators and blood gas indicators between the two groups ($\overline{x} \pm s$)

Group	Number of cases (n)	PaO_2 (mmHg)		$PaCO_2$ (mmHg)		mPAP (mmHg)		PASP (mmHg)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	49	43.58 ± 5.14	76.54 ± 5.64*	58.79 ± 4.33	39.78 ± 3.56*	50.12 ± 4.56	32.63 ± 3.21*	52.44 ± 4.63	41.62 ± 3.85*

Control group	49	44.10 ± 5.20	68.58 ± 5.28*	58.25 ± 4.39	45.58 ± 3.88*	49.67 ± 4.27	39.48 ± 3.69*	51.79 ± 4.28	47.85 ± 4.20*
t value		0.498	7.212	0.613	7.710	0.504	9.804	0.722	7.654
p value		0.620	< 0.001	0.541	< 0.001	0.615	< 0.001	0.472	< 0.001

Note: Compared with the same group before treatment, *$p < 0.05$.

3.5. Comparison of 6-minute walk distance between the two groups

Before treatment, there was no statistically significant difference in the 6-Minute Walk Distance (6MWD) between the two groups ($p > 0.05$). After treatment, the 6MWD in the observation group was longer than that in the control group, with a statistically significant difference ($p < 0.05$), as shown in **Table 5**.

Table 5. Comparison of 6-minute walk distance between the two groups ($\overline{x} \pm s$)

Group	Number of cases (n)	6MWD (m)	
		Before treatment	After treatment
Observation group	49	326.18 ± 22.27	432.24 ± 28.68*
Control group	49	328.06 ± 22.11	386.46 ± 25.66*
t value		0.676	8.327
p value		0.419	< 0.001

Note: Compared with the same group before treatment, *$p < 0.05$.

3.6. Comparison of incidence rates of adverse reactions between the two groups

There was no statistically significant difference in the overall incidence rate of adverse reactions between the two groups ($p > 0.05$), as shown in **Table 6**.

Table 6. Comparison of incidence rates of adverse reactions between the two groups [n(%)]

Group	Number of cases (n)	Headache	Dizziness	Chest tightness	Gastrointestinal discomfort	Fatigue	Total incidence rate
Observation group	49	1 (2.04)	0 (0.00)	1 (2.04)	1 (2.04)	2 (4.08)	5 (10.20)
Control group	49	1 (2.04)	2 (4.08)	0 (0.00)	1 (2.04)	3 (6.12)	7 (14.28)
χ^2 value							0.380
p value							0.538

4. Discussion

Pulmonary arterial hypertension (PAH) is a severe complication of chronic obstructive pulmonary disease (COPD). Its core pathological mechanisms include pulmonary vasoconstriction triggered by long-term hypoxia, pulmonary vascular remodeling, and vascular endothelial injury mediated by inflammatory factors, ultimately leading to elevated pulmonary artery pressure [9]. Currently, the conventional treatment for COPD complicated by PAH primarily focuses on controlling the underlying disease and providing symptomatic support, but its effectiveness in improving PAH is limited. Riociguat, as a soluble guanylate cyclase (sGC) stimulator, can directly dilate pulmonary vessels and improve vascular remodeling.

The results of this study indicate that the total effective rate in the observation group after treatment was higher than that in the control group, while mean pulmonary artery pressure (mPAP) and pulmonary artery

systolic pressure (PASP) were lower in the observation group ($p < 0.05$), consistent with the findings of Ke Yijun et al. [10]. From the perspective of disease pathology, the development of COPD complicated by PAH is closely related to chronic hypoxemia, pulmonary inflammation, and endothelial dysfunction. Long-term hypoxic conditions stimulate pulmonary vasoconstriction, triggering pulmonary vascular remodeling, while pulmonary inflammatory responses further exacerbate vascular damage. Endothelial dysfunction leads to a decrease in nitric oxide (NO) production and reduced activity of the cyclic guanosine monophosphate (cGMP) signaling pathway, ultimately resulting in elevated pulmonary artery pressure and increased right ventricular load [11]. Although conventional treatment improves COPD symptoms and alleviates hypoxic conditions through bronchodilators, anti-inflammatory agents, and oxygen therapy, its ability to repair established pulmonary vascular lesions and restore the impaired NO-cGMP pathway is limited, making it difficult to effectively reduce pulmonary artery pressure. This often leads to persistent disease progression and suboptimal treatment outcomes in some patients. Unlike traditional drugs that rely on NO to activate sGC, riociguat can directly bind to the active site of sGC, activating the enzyme even in the presence of insufficient NO production, thereby effectively enhancing the activity of the NO-cGMP signaling pathway. Elevated cGMP levels promote relaxation of pulmonary vascular smooth muscle, reduce pulmonary vasoconstriction, and delay the process of pulmonary vascular remodeling through dual inhibition, fundamentally improving pulmonary circulation and reducing pulmonary artery pressure [12]. The reduction in pulmonary artery pressure effectively alleviates the right ventricular afterload, improves right ventricular systolic function, and increases cardiac output, thereby relieving core symptoms such as fatigue and chest tightness after activity in patients. Simultaneously, the decrease in pulmonary vascular resistance facilitates the resolution of pulmonary congestion, reduces airway secretion retention, improves the coordination of pulmonary ventilation and gas exchange, and further alleviates COPD-related symptoms such as cough and wheezing. Ultimately, this leads to an improvement in cardiac function classification, symptom relief, and exercise tolerance, thereby enhancing the overall treatment effectiveness. In the meta-analysis by Zhang Qianqian on riociguat for the treatment of pulmonary hypertension, it was also proposed that this drug can effectively increase patients' exercise tolerance and improve cardiac function [13].

The results of this study show that all pulmonary function parameters in the observation group were higher than those in the control group ($p < 0.05$), demonstrating the role of riociguat in improving pulmonary function. By reducing pulmonary artery pressure, riociguat decreases pulmonary vascular resistance, improves pulmonary tissue perfusion, alleviates pulmonary congestion, and provides more adequate oxygen and nutrient supply to pulmonary tissues, thereby reducing pulmonary tissue damage and improving pulmonary ventilation function [14]. Additionally, after the reduction in pulmonary artery pressure, the right ventricular load decreases, and right ventricular function improves, reducing the further impact of pulmonary circulation congestion caused by right ventricular dysfunction on pulmonary ventilation and creating a virtuous cycle, ultimately leading to improved pulmonary function [15]. Furthermore, the observation group also showed superior improvement in blood gas parameters compared to the control group ($p < 0.05$). On one hand, riociguat improves pulmonary circulation, increases the alveolar ventilation-perfusion ratio, and enhances gas exchange efficiency. On the other hand, improved pulmonary function strengthens the lungs' ventilatory capacity, further optimizing the gas exchange process, alleviating hypoxemia and hypercapnia, providing a favorable internal environment for the patient's metabolic processes, and helping to reduce multi-organ damage and improve overall health status.

This study also revealed that the 6-minute walk distance (6MWD) in the observation group was longer than that in the control group after treatment ($p < 0.05$), indicating a significant improvement in patients' exercise tolerance. The possible reasons are that the reduction in pulmonary artery pressure, improvement in pulmonary function, and optimization of blood gas status alleviate symptoms such as dyspnea and chest tightness during exercise in patients, reduce cardiopulmonary load during exercise, enabling patients to tolerate longer and more intense exercise, thereby improving exercise tolerance. In terms of safety, there was no statistically significant difference in the total incidence of adverse reactions between the two groups ($p > 0.05$), and no serious adverse reactions occurred in the observation group. Although riociguat may cause mild discomfort such as headache and dizziness, these are mostly related to the initial vasodilatory effect of the drug and can be effectively reduced by adjusting the dosage gradient, with most patients tolerating it well [16]. This result indicates that adding riociguat to conventional treatment does not increase the burden of adverse reactions in patients and ensures drug safety.

5. Conclusion

In conclusion, riociguat is effective in improving pulmonary function, reducing pulmonary artery pressure, optimizing blood gas status, and enhancing exercise tolerance in patients with COPD complicated by PAH, with good safety. However, this study has certain limitations, including a small sample size, a single-center design, a short observation period, and no long-term follow-up of patients, which prevented the assessment of the long-term efficacy and safety of riociguat. Future research should involve larger-sample, multicenter, randomized controlled long-term follow-up studies to further validate the efficacy and safety of riociguat in this population and explore in-depth the mechanisms of its effects on pulmonary vascular remodeling and right ventricular function, aiming to provide more sufficient evidence for individualized treatment.

Disclosure statement

The author declares no conflict of interest.

References

[1] Olsson K, Corte T, Kamp J, et al., 2023, Pulmonary Hypertension Associated with Lung Disease: New Insights into Pathomechanisms, Diagnosis, and Management. The Lancet Respiratory Medicine, 11(9): 820–835.

[2] Yu X, Cai C, Peng Z, et al., 2025, Research Progress on the Mechanisms of Pulmonary Hypertension in the Acute Exacerbation Stage of Chronic Obstructive Pulmonary Disease Complicated by Cor Pulmonale. Journal of Clinical Pulmonary Medicine, 30(1): 131–137.

[3] Huang A, Pan T, Gao Y, et al., 2025, Changes and Significance of Peripheral Blood NLRP3 Inflammasome Levels in Elderly Patients with Chronic Obstructive Pulmonary Disease Complicated by Pulmonary Hypertension. Geriatrics & Health Care, 31(3): 725–730.

[4] Zhou D, Liu C, Wang L, et al., 2024, Prediction of Clinical Risk Assessment and Survival in Chronic Obstructive Pulmonary Disease with Pulmonary Hypertension. Clinical and Translational Medicine, 14(6): e1702.

[5] Peng P, Wang X, Liu M, 2022, Meta-Analysis of Riociguat in Reversing Right Ventricular Remodeling and Improving Right Ventricular Function in Patients with Pulmonary Hypertension. Modern Medicine & Health,

38(12): 2034–2037.

[6] Chinese Medical Association, Chinese Medical Association Journal Editorial Board, Chinese Medical Association General Practice Branch, et al., 2024, China's Primary Care Guidelines for the Diagnosis and Management of Chronic Obstructive Pulmonary Disease (2024 Edition). Chinese Journal of General Practitioners, 23(6): 578–602.

[7] Pulmonary Embolism and Pulmonary Vascular Disease Group of the Respiratory Disease Branch of the Chinese Medical Association, Pulmonary Embolism and Pulmonary Vascular Disease Working Committee of the Respiratory Physicians Branch of the Chinese Medical Doctor Association, National Pulmonary Embolism and Pulmonary Vascular Disease Prevention and Treatment Collaboration Group, et al., 2021, China's Guidelines for the Diagnosis and Treatment of Pulmonary Hypertension (2021 Edition). Chinese Medical Journal, 101(1): 11–51.

[8] Liu H, Chen D, Zeng Z, 2024, Observation on the Therapeutic Effect of Bufei Yishen Decoction Combined with Respiratory Muscle Function Exercise in Elderly Patients with Chronic Obstructive Pulmonary Disease Complicated by Pulmonary Hypertension. Shanghai Medical & Pharmaceutical Journal, 45(9): 48–52.

[9] Wan Y, Kuang W, Chen X, et al., 2024, Correlation Between Serum Interleukins and Pulmonary Artery Pressure in Patients with Chronic Obstructive Pulmonary Disease Complicated by Pulmonary Hypertension. China Contemporary Medicine, 31(2): 26–29.

[10] Ke Y, Wang W, Men P, et al., 2021, Rapid Health Technology Assessment of the Effectiveness, Safety, and Cost-Effectiveness of Riociguat for the Treatment of Pulmonary Hypertension. Chinese Journal of Hospital Pharmacy, 41(20): 2105–2112.

[11] Li H, Sun F, Yuan P, et al., 2024, Effects of Balloon Pulmonary Angioplasty on Nocturnal Hypoxemia in Patients with Inoperable Chronic Thromboembolic Pulmonary Hypertension. Journal of Tongji University (Medical Edition), 45(5): 641–648.

[12] Cheng J, Sun C, Xue Y, 2020, Observation on the Clinical Efficacy of Riociguat Combined with Sildenafil in the Treatment of Congenital Heart Disease Complicated by Pulmonary Hypertension. Modern Medicine, 48(4): 512–515.

[13] Zhang Q, 2023, Meta-Analysis of Riociguat for the Treatment of Pulmonary Hypertension, thesis, Huazhong University of Science and Technology.

[14] Chang Z, 2021, Study on the Effects of Riociguat on Pulmonary Vascular Remodeling and Right Ventricular Hypertrophy in Shunt-Type Pulmonary Hypertension, thesis, Shandong University.

[15] Chen H, Li Y, Wang Q, et al., 2024, Clinical Efficacy of Ginkgo Biloba Extract Combined with Alprostadil in Patients with Chronic Obstructive Pulmonary Disease Complicated by Pulmonary Hypertension. Chinese Traditional Patent Medicine, 46(9): 2963–2967.

[16] Wei K, 2021, Analysis of the Efficacy and Safety of Riociguat Combined with Sildenafil in the Treatment of Pulmonary Hypertension After Congenital Heart Disease Surgery. Clinical Medical Engineering, 28(9): 1249–1250.

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Research Progress on Fall Prevention Among Elderly Hospitalized Patients Based on Perceived Fall Risk

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Abstract: With an aging population, falls have become a global public health issue. The level of perceived risk of falling among elderly inpatients directly influences adherence to preventive measures and serves as a key entry point for fall prevention interventions. This paper synthesizes relevant domestic and international research to review the definition, characteristics, and commonly used assessment tools of fall risk perception. It analyzes the characteristics and influencing factors of fall risk perception among elderly inpatients and explores fall prevention interventions for this population based on fall risk perception, thereby providing a theoretical basis for the development of fall prevention strategies for elderly inpatients.

Keywords: Falls; Perception of fall risk; Elderly inpatients; Fall prevention

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1. Introduction

The World Health Organization (WHO) reports that approximately 684,000 people worldwide die each year as a result of falls, making falls the second leading cause of accidental injury-related deaths [1]. Falls are one of the primary causes of unplanned hospitalizations among older adults and, in severe cases, can even lead to death [2]. The daily fall rate among hospitalized patients worldwide ranges from 3.6% to 12.6% [3]. In China, the incidence of falls ranges from 1.4% to 18.2%, and approximately 14.23% of elderly inpatients experience at least one fall within a year [4,5]. More than 35% of patients experience soft tissue injuries, fractures, or even death following a fall, posing a serious threat to patient health [6]. Falls not only severely endanger patient health, increase medical costs, and prolong hospital stays, but also impose an economic burden on families and society, and constitute a major safety hazard that can trigger medical disputes [2].

The 2022 "Global Guidelines on Fall Prevention and Management in Older Adults" recommend focusing on older adults' perception of fall risk [7]. Older adults' perception of fall risk influences behavioral changes; enhancing this perception can promote their engagement and adherence to fall prevention programs [8,9]. The higher an older adult's self-perceived risk of falling, the more likely they are to engage in proactive fall prevention behaviors [10]. Research by Hill et al. indicates that assessing patients' perception of fall risk and encouraging their active participation in their own fall prevention efforts can reduce the incidence of falls by approximately 50% [11]. However, many older adults are unable to accurately perceive their fall risk, leading to overconfidence or excessive caution, which increases their risk of falling [12]. Multiple studies indicate that only about one-third of patients can accurately identify their fall risk [13,14]. Therefore, the rationality of fall risk perception is a key target for fall interventions among elderly inpatients.

Currently, most fall prevention studies still rely on healthcare-provider-led risk assessments and interventions, with insufficient attention paid to patients' subjective risk perceptions [15]. In recent years, fall risk perception has gradually emerged as a research focus. Dolan et al. and others have proposed developing preventive measures based on patient-perceived risk factors to prevent falls [16]. Currently, research on fall risk perception among elderly inpatients in China remains insufficient. Therefore, this review summarizes the concepts, assessment tools, influencing factors, and intervention strategies to provide a theoretical basis and practical reference for patient-centered fall prevention.

2. The concept and core elements of falls risk perception

2.1. The concept of falls risk perception

There is currently no universally accepted definition of fall risk perception. In 1998, Braun defined fall risk perception as the perception of evaluating falls as a health issue and determining the importance of associated risk factors [17]. In 2021, Choi et al. defined fall risk perception as an individual's judgment of their own risk of imminent falls based on a subjective assessment of environmental risk factors and their own gait ability [18]. In 2022, Bao Guanjun et al. introduced the concept of fall risk perception in China for the first time, interpreting it as the subjective cognition of high-risk groups regarding the likelihood of a fall and its potential harm [19]. Nie Zuoting et al. pointed out that fall risk perception refers to the subjective judgment, perception, and evaluation made by older adults during daily activities regarding the likelihood of future fall events and the severity of their consequences, based on their own physiological state, cognitive function, and the environment in which they find themselves [20]. In 2024, Nan Jiang employed a conceptual analysis method to systematically define fall risk perception, defining it as: the process by which an individual first self-assesses the probability of falling and then decides whether to take the risk seriously [21].

2.2. Attributes of fall risk perception

Fall risk perception is a constantly evolving and dynamic psychological process [22]. Fall risk perception among older adults involves both recognition and management. Older adults tend to recognize their own susceptibility to falls and then take proactive measures to reduce this risk [23]. Nan J and colleagues identified four core attributes of fall risk perception among older adults [9]:

(1) Fall risk perception is dynamic, exhibiting both continuous and stage-based characteristics;

(2) Fall risk perception involves whether one takes the risk of falling seriously;

(3) Fall risk perception is a self-assessment of the probability of falling, driven by the individual's independence;

(4) Perception of fall risk involves a variety of complex emotional responses. Three antecedents of fall risk perception among older adults: demographic and health factors, psychological factors, and environmental factors. Perception of fall risk leads to four consequences among older adults: risk-taking behavior, risk-compensating behavior, risk-transferring behavior, and emotional responses.

3. Assessment tools for fall risk perception

3.1. General-purpose fall risk perception assessment scales

3.1.1. Fall risk perception questionnaire for patients (FRPQ)

This questionnaire was developed in 2021 by Korean researchers Choi et al. to assess the level of fall risk perception among nursing home residents [19]. The questionnaire comprises three dimensions with a total of 27 items: the Personal Activity Ability dimension has 8 items, the Chronic Disease Factors dimension has 6 items, and the Environmental Factors dimension has 13 items. It uses a 4-point Likert scale, with a total score ranging from 0 to 81; a higher score indicates a higher level of fall risk perception among patients. The overall Cronbach's α coefficient for the scale is 0.948. In 2022, Chinese scholars Bao Guanjun et al. conducted a cross-cultural adaptation of the FRPO scale; the resulting Chinese version, after localization, comprises 3 dimensions and a total of 26 items [24]. The overall Cronbach's α coefficient for the Chinese version of the FRPO is 0.942, indicating good reliability and validity. The total score ranges from 0 to 78, with scores of 0–37, 38–63, and 64–78 indicating low, moderate, and high levels of perception, respectively [25]. In 2024, Choi et al. revised the FRPQ by reducing the number of items to 14, creating a short-form FRPQ, which offers the advantage of being quick and easy to administer repeatedly [26].

3.1.2. Fall-related perceptions scale among inpatients (FPS)

This scale was developed in 2015 by Twibell et al. and consists of 38 items across 4 subscales and 3 single items [27]:

(1) The Confidence in Avoiding Falls subscale includes 7 items and measure participants' perceived confidence in performing fall-risk activities during hospitalization.

(2) The Hospital Fall Fear Scale consists of 7 items and measures participants' level of concern about falling while engaging in high-risk activities.

(3) The Hospital Fall Consequences Scale consists of 12 items and assesses the potential adverse consequences of a fall.

(4) The Intention to Participate in Fall Prevention Scale consists of 9 items and measures participants' intention to seek help when engaging in high-risk behaviors.

(5) hree single-item measures assess, respectively, the perceived likelihood of falling, the likelihood of injury following a fall, and fear of falling during the hospital stay. This scale has a Cronbach's α coefficient ranging from 0.84 to 0.95, indicating good reliability and validity.

3.1.3. Fall risk self-assessment questionnaire of the STEADI

This questionnaire was developed by the Veterans Affairs Greater Los Angeles Healthcare System (VA-GLAHS) in 2011 [28]. It consists of 12 items. The total score ranges from 0 to 14, with a score of ≥ 4

indicating a risk of falling. Li Yaling et al. conducted a Chinese adaptation study to develop the Chinese version of the STEADI Fall Risk Self-Assessment Questionnaire [29]. The Cronbach's α coefficients for this questionnaire in three groups of older adults—inpatient wards, outpatient clinics, and the community were 0.716, 0.674, and 0.608, respectively. This questionnaire is suitable for self-administration by older inpatients and can be completed quickly for preliminary screening.

3.1.4. I Engaging fall self-assessment tool

This scale was developed by Tzeng et al. in 2014 to assess fall risk in hospitalized elderly patients [30]. It consists of two sections: fall risk factors and fall prevention measures, comprising a total of 12 dimensions and 61 items. Guo Xiaobei et al. conducted cross-cultural adaptation and revision to develop the Chinese version of the I Engaging Fall Self-Assessment Tool [31]. The Chinese version of the scale has an overall Cronbach's α coefficient of 0.973, a test-retest reliability of 0.851, and a content validity index of 0.956. It demonstrates good reliability and validity and can be used as a self-assessment tool for fall risk in hospitalized elderly patients.

3.1.5. Falls efficacy scale-international (FES-I)

This scale was developed by Kempen et al. and primarily assesses patients' self-efficacy in preventing falls, indirectly reflecting their level of perceived risk of falling [32]. The scale comprises two dimensions, indoor and outdoor activities; and consists of 16 items. A higher score indicates greater efficacy in preventing falls and a higher perception of fall risk. The scale has a Cronbach's alpha coefficient of 0.96 and a test-retest reliability of 0.96, demonstrating good reliability and validity. Guo Qiyun et al. conducted cross-cultural adaptation and revision in 2015, resulting in the Chinese version of the FES-I [33].

3.1.6. Self-awareness of falls in the elderly scale (SAFE)

This scale was developed by Taiwanese scholars Shyu et al. in 2018 to identify high-risk individuals with low self-awareness of fall risk, thereby improving the prediction of falls among elderly inpatients [34]. It comprises four dimensions, safety and environmental awareness, physical function awareness, medication awareness, and cognitive-behavioral awareness, with a total of 21 items. A higher score indicates a higher level of awareness regarding fall risk. He Xifei and colleagues tested this scale among elderly inpatients in China, yielding a Cronbach's α coefficient of 0.923, indicating that the Fall Awareness Scale possesses good reliability and validity [35].

3.1.7. Community-dwelling older adults' fall risk perception scale

This scale was developed in 2022 by Chinese scholars Bao Guanjun et al. [36]. It comprises three dimensions: perception of biobehavioral vulnerability to falls, perception of social and environmental vulnerability to falls, and perception of fall severity, totaling 17 items. The scale's overall Cronbach's α coefficient is 0.913, indicating good reliability and validity.

3.2. Specialized fall risk perception assessment scales

3.2.1. Fall risk perception scale for cancer patients

In 2024, Luo Ruijun et al. developed the Fall Risk Perception Scale for Cancer Patients to assess the level of fall risk perception among cancer patients [37]. The scale comprises five dimensions, perceived

susceptibility to falls, perceived susceptibility related to physical condition, perceived susceptibility related to personal activities, perceived susceptibility related to environmental factors, and perceived severity of falls, and consists of 30 items in total. The total score range of the scale is 30–150 points. The Cronbach's alpha coefficient for the total scale is 0.926, and the content validity is 0.867, indicating good reliability and validity.

3.2.2. Fall risk perception scale for Parkinson's disease (FRPS-PD)

In 2024, Yang X et al. developed the FRPS-PD to assess the level of fall risk perception in patients with Parkinson's disease [38]. The scale comprises two dimensions, risk perception and self-efficacy, with a total of 16 items. The Cronbach's α coefficient for the total scale is 0.952, and the content validity is 0.956, indicating good reliability and validity. However, the empirical application of this scale in clinical settings remains relatively limited.

4. Characteristics of fall risk perception among elderly inpatients

The perception of fall risk among elderly inpatients can be categorized into three types: overestimation, underestimation, and accurate assessment [19]. Those who overestimate the risk reduce their physical activity due to excessive fear, leading to muscle atrophy and decreased muscle strength, which in turn increases the risk of falling [39,40]. Those who underestimate the risk, however, disregard the danger of falling, engage in risky behaviors, and show lower adherence to preventive measures, thereby increasing the risk of falling [20].

Perceptual bias is a major cause of the discrepancy between subjective risk perception and objective risk, primarily manifesting as underperception and overperception [41]. Yang Xin et al. found that 67.6% of elderly patients in the high-risk group for falls exhibited underperception; in the moderate-risk group, 32.8% exhibited underperception and 30.2% exhibited overperception; and in the low-risk group, 64.7% exhibited overperception [10]. Lim et al. reported a 50.7% prevalence of overestimated fall risk perception among hospitalized elderly patients in Singapore [42]. Therefore, accurately assessing the level of fall risk perception in hospitalized elderly patients can help reduce the incidence of falls among this population.

Overestimating or underestimating fall risk leads to different coping behaviors regarding fall risk [43]. Those who underestimate fall risk tend to be overconfident and often engage in risky activities that exceed their physical capabilities [44]. Older adults overestimating their abilities and engaging in inappropriate risk-taking behaviors is a common cause of falls among this population [16]. Overconfidence and a reluctance to accept aging lead to poor adherence to fall prevention measures, resulting in a situation where healthcare providers must repeatedly educate patients, yet older inpatients struggle to maintain long-term compliance [45]. Those with an overestimated perception of fall risk fear falling and become overly dependent on others; over time, this can lead to muscle atrophy and declining physical function, thereby increasing the risk of falls [43]. Therefore, shifting the focus of prevention from an expert perspective to the patient themselves and accurately assessing the level of fall risk perception is of great significance for improving the effectiveness of fall prevention.

5. Factors influencing fall risk perception among elderly inpatients

5.1. Demographic factors

Perception of fall risk is influenced by age, educational level, alcohol consumption, sleep, and a history of falls within the past three months [10]. Age and educational level are significant factors affecting the perception of fall risk [46]. Higher levels of education are associated with higher levels of perceived fall risk; however, among those aged 80 and older, there exists a "cognitive blind spot" characterized by insufficient perception, with some older adults failing to recognize the risk despite having significant functional impairments [47]. Individuals with an education level of elementary school or below underestimates the incidence of falls 3.74 times more frequently than those with a high school education or higher [25]. Individuals with Type D personality have a lower risk of falling [48]. Men tend to have fewer negative perceptions regarding the consequences of falls [49]. Patients with a history of falls are prone to developing a fear of falling again, place greater emphasis on fall prevention, and exhibit higher levels of perceived fall risk [50]. Excessive fear or even phobia of falling can lead to an overestimation of fall risk and may even develop into hypokinesia, which is detrimental to recovery [51].

5.2. Physical condition

Individuals in poorer physical condition may underestimate their own capabilities through self-adaptive mechanisms, thereby developing an overestimation of fall risk. However, some studies suggest that older adults with objectively poorer physical condition are more likely to underestimate fall risk [52,53]. Sakurai et al. found that older adults with lower step-over ability were more likely to overestimate their own functional capacity and had lower perceptions of fall risk. This may be because older adults with poorer physical condition experience a decline in health, requiring more energy and time for adaptation and adjustment, leading to an irrational perception of fall risk [52,54]. Hughes et al. found that older adults with better self-rated health had lower perceptions of fall risk [55]. This result suggests that objective physical condition must undergo individual cognitive processing and be transformed into self-rated physical condition before it can influence the perception of fall risk.

5.3. Disease factors

Most participants who acknowledged their risk of falling suffered from chronic diseases that affect mobility and balance, such as multiple sclerosis and Parkinson's disease [56]. A lower number of comorbidities is one of the factors leading to patients underestimating their risk of falling [14]. DE SOUZA et al. pointed out that comorbidity status and the use of antihypertensive and lipid-lowering medications influence patients' perception of fall risk [47]. KANTOW et al. found that older adults' fall risk perception scores were associated with hypertension [57]. A study by Li Lei et al. indicated that the fewer chronic conditions a patient had, the lower their level of fall risk perception [48].

5.4. Psychological factors

An individual's psychological state has an amplifying effect on fall risk perception; emotions can influence an individual's risk perception by depleting cognitive resources [58]. Fear is a fundamental component of risk perception; it can trigger avoidance decisions and foster pessimistic risk perceptions [59,60]. Anxiety influences fall risk perception by intensifying an individual's fear of falling [61]. Anxiety or fear related to falling can impair goal-directed attention systems, consume limited cognitive resources, and reduce cognitive processing

efficiency, thereby leading to biases in risk perception [62]. Individuals with depression exhibit impaired cognitive function, particularly slowed cognitive processing speed, suggesting that this may affect perceptual judgment by reducing available cognitive resources [63]. Thus, emotions such as fear, anxiety, and depression play a significant role in the perception of fall risk, and their mechanisms of action may be indirectly realized through the depletion of cognitive resources.

5.5. Environmental factors

Accurate assessment of physical environmental risk factors influences older adults' perception of fall risk [54]. Some older adults believe that environmental factors (such as uneven ground) are more closely related to falls than physiological factors, possibly because they tend to attribute falls to the external environment [64]. This attribution reflects the role of self-esteem in older adults' perception of fall risk [65]. With technological advancements, age-friendly devices have expanded from traditional assistive devices to smart devices, both of which may influence the perception of fall risk. While assistive devices can enhance a sense of security and compensate for functional decline, they may also evoke feelings of discrimination, leading older adults to deny their high fall risk due to a reluctance to acknowledge disability and aging [66]. The frustration and shame resulting from failed experiences with smart devices further prompt older adults to avoid using such devices [67]. Older adults who perceive their physical environment as poor experience greater anxiety about falling and are more likely to restrict their activities and reduce social connections [68]. The extent to which older adults are familiar with their home and surrounding environment may also influence how they construct their perception of risk [64].

5.6. Sociocultural factors

Older adults are often labeled by society with negative, ageist stereotypes such as frailty, slowness, and reduced mobility [69]. Ageist stereotypes may be a significant factor influencing older hospitalized patients' perception of their risk of falling. In a culture that values conformity, older adults in China are easily influenced by others' evaluations [70]. They may adopt corresponding cognitive and behavioral patterns due to their identification with these stereotypes, thereby reinforcing them and leading to an overestimation of their own risk of falling [71]. Ageist and stereotypical labels may trigger feelings of aversion in older adults, prompting them to adopt opposing cognitive and behavioral strategies to resist these stereotypes, which manifests as underestimating the risk of falling and engaging in overly risky activities [72]. For older adults, independent mobility symbolizes dignity and self-worth, whereas the loss of autonomy implies becoming a burden to the family [65]. Research has found that some older adults consider maintaining independence and avoiding embarrassment more important than preventing falls, leading to irrational risk perception [22]. Self-esteem may indirectly influence risk perception by downplaying the perceived severity of fall consequences.

6. Fall Prevention interventions for elderly inpatients based on perception of fall risk

6.1. Enhancing fall risk perception and health education

Inadequate perception of fall risk among elderly inpatients is a major factor hindering their adoption of preventive behaviors [73]. Therefore, it is particularly important to enhance elderly inpatients' awareness of their own fall risk. A study by Hao et al. indicated that personalized, practical health education is crucial for

improving risk perception and preventive behaviors among the elderly. Elderly inpatients face a higher risk of falls [74]. In fall prevention, it is essential not only to assess fall risk but also to evaluate patients' perception of their own risk, thereby enabling individualized and targeted protection [19].

To enhance elderly inpatients' ability to perceive fall risk, a multidimensional health education strategy must be developed. First, the reinforcement of risk perception should be based on the identification of patients' cognitive biases. Studies indicate that some patients who are actually at high risk exhibit "underperception of risk"; therefore, health education should focus on explaining intrinsic risk factors closely related to older adults. Regarding health education methods, single-channel verbal instruction has limited effectiveness, whereas multimodal, interactive approaches offer greater advantages. Health education delivered through text-and-image, audiovisual, personalized, and digital formats can all effectively enhance patients' perception of fall risk [10]. Hill et al. noted that video-based education is more effective than text-and-image-based education in improving patients' ability to self-assess fall risk, increasing their motivation to prevent falls, and boosting their confidence in fall prevention [75]. Personalized health education reduced the fall rate among hospitalized patients by 50%; case-based health education can improve patient adherence to fall prevention measures and enhance awareness of fall risk [11,76]. The tool for preventing accidental injuries among older adults developed by the U.S. CDC plays a positive role in enhancing older adults' perception of fall risk [77]. Health education content should cover three dimensions, environmental safety, physical function, and psychological motivation, to stimulate patients' intrinsic motivation to actively participate in prevention.

6.2. Psychological intervention

Through psychological counseling and cognitive restructuring, help patients establish an objective understanding of risk, alleviate fear, or increase their level of concern. Cognitive-behavioral intervention is an evidence-based psychological approach that modifies patients' behavior by correcting erroneous cognitions, helping them develop appropriate cognitive and behavioral patterns to promote health [78]. Pfeiffer et al. conducted cognitive-behavioral interventions with patients who had suffered hip or pelvic fractures; results showed significant improvements in fall-related self-efficacy and fall risk perception one month after intervention [79]. A study by Xue Yaping et al. demonstrated that cognitive behavioral intervention can improve patients' balance and significantly alleviate their fear of falling, thereby facilitating an objective perception of fall risk [80]. Additionally, psychological support for patients can be enhanced through family support and peer education, helping them develop a proactive preventive mindset and improve their risk perception. Combining psychological intervention with health education can effectively correct risk perception biases among elderly inpatients and increase adherence to preventive behaviors.

6.3. Exercise intervention

Exercise intervention is one of the most commonly used methods to alleviate the fear of falling among elderly inpatients. By improving physical function, enhancing positive psychological attitudes, and increasing self-efficacy regarding falls, it effectively reduces the fear of falling and promotes an objective perception of fall risk [79]. Song Bo et al. found that moderate exercises such as standing, shoulder circles, head turns, eye-closing, and toe-tapping can improve cognitive function in the elderly, help them perceive fall risks, and reduce the incidence of falls [81]. Yun et al. implemented the Otago Exercise for patients with kinesophobia following hip and knee replacement surgery, which reduced the severity of postoperative kinesophobia

and alleviated the level of perceived fall risk [82]. Haertner et al. employed exercise imagery therapy, which resulted in improved flexibility and grip strength as well as reduced fear of falling following the intervention [83]. Exercise interventions improve physical function through diverse exercise modalities, thereby alleviating the fear of falling and helping patients objectively perceive fall risk.

6.4. Developing fall management strategies for elderly inpatients by integrating fall risk and risk perception assessments

Elderly inpatients face a high risk of falls and often exhibit a bias in their perception of this risk. It is recommended that fall prevention efforts not only assess the fall risk of elderly inpatients but also evaluate their perception of their own risk, thereby enabling personalized and targeted protection [10]. Solares et al. noted that the discrepancy between objective risk and perceived risk further increases the risk of falls [84]. Delbaere et al. pointed out that fall risk assessment should encompass both objective risk assessment and perceived risk assessment [44]. To implement individualized nursing interventions, it is essential to not only rely on patients' fall risk classification but also to consider their psychological characteristics and level of perception. Measuring patients' fall risk from a psychological and cognitive perspective is crucial for enhancing the effectiveness of fall prevention.

7. Conclusion

Perception of fall risk among elderly inpatients is a core factor influencing their fall prevention behaviors and directly impacts the effectiveness of fall prevention. Accurate perception of fall risk helps elderly inpatients avoid risky behaviors and adopt healthy practices to reduce their risk of falling. Enhancing elderly inpatients' perception of fall risk can effectively increase their proactive engagement and adherence to fall prevention measures. However, existing research still faces challenges such as insufficiently targeted assessment tools, a lack of longitudinal studies, and a lack of innovation in intervention models. Future fall prevention strategies should shift from a "healthcare-provider-centered" approach to a "patient-centered" one. Fall risk perception assessment should be integrated as a key component of routine nursing evaluations. By combining subjective and objective risk assessments to identify individual perceptual biases and implementing stratified, targeted interventions, we can effectively improve fall prevention outcomes for elderly inpatients and reduce fall incidence.

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References

[1] World Health Organization, 2021, Falls, visited on 2025-2-25, https://www.who.int/zh/news-room/fact-sheets/

detail/falls.

[2] Appeadu M, Bordoni B, 2023, Falls and Fall Prevention in Older Adults. StatPearls Publishing.

[3] Abreu H, Reiners A, Azevedo R, et al., 2015, Incidence and Predicting Factors of Falls of Older Inpatients. Revista de Saude Publica, 49: 37.

[4] Zhang J, Wang M, Liu Y, 2016, Psychometric Validation of the Chinese Version of the Johns Hopkins Fall Risk Assessment Tool for Older Chinese Inpatients. Journal of Clinical Nursing, 25(19–20): 2846–2853.

[5] Wang K, Chen M, Zhang X, et al., 2022, The Incidence of Falls and Related Factors Among Chinese Elderly Community Residents in Six Provinces. International Journal of Environmental Research and Public Health, 19(22): 14843.

[6] Guo X, Wang Y, Yang X, et al., 2021, Implementation of Fall Prevention Intervention Strategies for Hospitalized Elderly Patients Based on a Patient-Centered Framework. Journal of Nursing, 36(1): 50–53.

[7] Montero-Odasso M, Van D, Martin F, et al., 2022, World Guidelines for Falls Prevention and Management for Older Adults: A Global Initiative. Age and Ageing, 51(9): afac205.

[8] Kiyoshi-Teo H, Northrup-Snyder K, Davis M, et al., 2020, Qualitative Descriptions of Patient Perceptions About Fall Risks, Prevention Strategies and Self-Identity: Analysis of Fall Prevention Motivational Interviewing Conversations. Journal of Clinical Nursing, 29(21–22): 4281–4288.

[9] Nan J, Li Z, Zou X, et al., 2025, Fall Risk Perception in Older Adults: A Concept Analysis. Journal of Clinical Nursing, 34(3): 1032–1044.

[10] Yang X, Yao M, Zhang Y, et al., 2023, A Study on the Discrepancy Between Fall Risk and Risk Perception Among Hospitalized Elderly Patients. Chinese Journal of Nursing, 58(19): 2326–2332.

[11] Hill A, McPhail S, Waldron N, et al., 2015, Fall Rates in Hospital Rehabilitation Units After Individualised Patient and Staff Education Programmes: A Pragmatic, Stepped-Wedge, Cluster-Randomised Controlled Trial. The Lancet, 385(9987): 2592–2599.

[12] Ellmers T, Freiberger E, Hauer K, et al., 2023, Why Should Clinical Practitioners Ask About Their Patients' Concerns About Falling? Age and Ageing, 52(4): afad057.

[13] Dabkowski E, Cooper S, Duncan J, et al., 2022, Adult Inpatients' Perceptions of Their Fall Risk: A Scoping Review. Healthcare, 10(6): 995.

[14] Bao G, Liu Y, Zhang W, et al., 2022, Accuracy of Self-Perceived Risk of Falls Among Hospitalised Adults in China: An Observational Study. BMJ Open, 12(12): e065296.

[15] de Jong L, Francis-Coad J, Waldron N, et al., 2021, Does Free-Text Information in Falls Incident Reports Assist to Explain How and Why the Falls Occurred in a Hospital Setting? Journal of Patient Safety, 17(8): e1472–e1479.

[16] Dolan H, Slebodnik M, Taylor-Piliae R, 2022, Older Adults' Perceptions of Their Fall Risk in the Hospital: An Integrative Review. Journal of Clinical Nursing, 31(17–18): 2418–2436.

[17] Braun B, 1998, Knowledge and Perception of Fall-Related Risk Factors and Fall-Reduction Techniques Among Community-Dwelling Elderly Individuals. Physical Therapy, 78(12): 1262–1276.

[18] Choi J, Choi S, Lee J, et al., 2021, Development and Validation of the Fall Risk Perception Questionnaire for Patients in Acute Care Hospitals. Journal of Clinical Nursing, 30(3–4): 406–414.

[19] Bao G, Liu Y, Luo Y, et al., 2022, Advances in Research on Inpatients' Perception of Fall Risk. Nursing Research, 36(19): 3468–3472.

[20] Nie Z, Chen L, Zeng K, et al., 2024, Current Status of Research on Fall Risk Perception Among Older Adults and Its Implications for Proactive Fall Prevention. Chinese General Practice, 27(19): 2395–2400.

[21] Jiang N, 2024, Development of a "Digital Avatar"-Based Toolkit for Assessing Fall Risk Perception Among Community-Dwelling Older Adults with Stroke, thesis, Jiangnan University.

[22] Gettens S, Fulbrook P, Jessup M, et al., 2018, The Patients' Perspective of Sustaining a Fall in Hospital: A Qualitative Study. Journal of Clinical Nursing, 27(3–4): 743–752.

[23] Owen C, Gaulton C, Roberts H, et al., 2022, Perceptions of People with Parkinson's and Their Caregivers of Falling and Falls-Related Healthcare Services: A Qualitative Study. PLoS One, 17(10): e0276588.

[24] Bao G, Zhu L, Liu Y, et al., 2022, Chinese Adaptation and Reliability and Validity Testing of the Patient Perceived Risk of Falling Scale. Chinese Journal of Nursing, 57(22): 2811–2816.

[25] Zhao Z, Wang X, Xu X, et al., 2024, A Study on the Consistency Between Perceived Fall Risk and Objective Risk Assessment, and Influencing Factors Among Hospitalized Elderly Patients with Chronic Comorbidities. China Medical Herald, 21(29): 125–129.

[26] Choi J, Lee S, Park E, et al., 2024, Psychometric Properties of the Fall Risk Perception Questionnaire-Short Version for Inpatients in Acute Care Hospitals. Journal of Korean Academy of Nursing, 54(2): 151–161.

[27] Twibell R, Siela D, Sproat T, et al., 2015, Perceptions Related to Falls and Fall Prevention Among Hospitalized Adults. American Journal of Critical Care, 24(5): E78–E85.

[28] Rubenstein L, Vivrette R, Harker J, et al., 2011, Validating an Evidence-Based, Self-Rated Fall Risk Questionnaire for Older Adults. Journal of Safety Research, 42(6): 493–499.

[29] Li Y, Ding F, 2020, A Study on the Application of the STEADI Self-Assessment Scale for Fall Risk Among Community-Dwelling Older Adults. Journal of Nursing, 35(9): 84–87.

[30] Tzeng H, Yin C, Fitzgerald K, et al., 2015, Engaging User Testing: Lessons Learned from Inpatients and Health Care Providers. Journal of Nursing Care Quality, 30(3): 275–282.

[31] Guo X, Wang Y, Yang X, et al., 2021, Chinese Adaptation and Reliability and Validity Testing of a Self-Assessment Tool for Falls. Journal of Nursing Management, 21(12): 866–871.

[32] Kempen G, Yardley L, Van H, et al., 2007, The Short FES-I: A Shortened Version of the Falls Efficacy Scale-International to Assess Fear of Falling. Age and Ageing, 37(1): 45–50.

[33] Guo Q, Guo M, Zhang L, et al., 2015, Evaluation of the Reliability and Validity of the Chinese Version of the International Fall Effectiveness Scale. Chinese General Practice, 18(35): 4273–4276.

[34] Shyu M, Huang H, Wu M, et al., 2018, Development and Validation of the Self-Awareness of Falls in Elderly Scale Among Elderly Inpatients. Clinical Nursing Research, 27(1): 105–120.

[35] He X, Liu Q, Wang M, et al., 2023, Validity and Reliability Testing of the Elderly Fall Awareness Scale Among Elderly Inpatients. Nursing Research, 37(1): 47–51.

[36] Bao G, Luo Y, Liu Y, et al., 2022, Development and Validity and Reliability Testing of a Fall Risk Perception Scale for Community-Dwelling Older Adults. Journal of Nursing, 37(24): 9–13.

[37] Luo R, Wan Y, Xie R, et al., 2024, Development and Validity and Reliability Testing of a Fall Risk Perception Scale for Cancer Patients. Journal of Nursing, 39(4): 6–10.

[38] Yang X, Yao M, Guo Z, et al., 2024, Development and Validation of Fall Risk Perception Scale for Patients with Parkinson's Disease. Frontiers in Psychology, 15: 1289067.

[39] Huang Y, Canning C, Song J, et al., 2022, How Does Perceived Fall Risk Influence Decisions About Whether to Undertake Activities in People with Parkinson's Disease and Their Care Partners? A Qualitative Study. Disability and Rehabilitation, 44(20): 6000–6008.

[40] Tymkew H, Taylor B, Vyers K, et al., 2023, Patient Perception of Fall Risk in the Acute Care Setting. AJN The

American Journal of Nursing, 123(6): 20–25.

[41] Arni P, Dragone D, Goette L, et al., 2021, Biased Health Perceptions and Risky Health Behaviors: Theory and Evidence. Journal of Health Economics, 76: 102425.

[42] Lim M, Seow J, Ang S, et al., 2018, Disparity Between Perceived and Physiological Risks of Falling Among Older Patients in an Acute Care Hospital. Applied Nursing Research, 42: 77–82.

[43] Gambaro E, Gramaglia C, Azzolina D, et al., 2022, The Complex Associations Between Late Life Depression, Fear of Falling and Risk of Falls: A Systematic Review and Meta-analysis. Ageing Research Reviews, 73: 101532.

[44] Delbaere K, Close J, Brodaty H, et al., 2010, Determinants of Disparities Between Perceived and Physiological Risk of Falling Among Elderly People: Cohort Study. BMJ, 341.

[45] Xie M, Zhang Z, Zhang L, 2022, Reflections and Insights on Nurses' Self-Assessments and Real-World Fall Incidents in the Management of Hospital Patient Falls. General Nursing, 20(4): 457–462.

[46] Gamage N, Rathnayake N, Alwis G, 2018, Knowledge and Perception of Falls Among Community Dwelling Elderly: A Study from Southern Sri Lanka. Current Gerontology and Geriatrics Research, 2018: 7653469.

[47] Souza L, Batista R, Camapanharo C, et al., 2022, Factors Associated with Risk, Perception and Knowledge of Falls in Elderly People. Revista Gaúcha de Enfermagem, 43: e20200335.

[48] Li L, Zhang J, Wen Z, et al., 2024, A Study on the Current Status and Influencing Factors of Fall Risk Perception Among Community-Dwelling Older Adults with Stroke. Military Nursing, 41(6): 14–17.

[49] Tay P, Chan A, Tan P, et al., 2020, Sex Differences in Perceptions Toward Falls Among Older Adults Living in the Community in Singapore. Journal of Aging and Health, 32(10): 1355–1362.

[50] Bai S, 2024, A Study on Factors Influencing Fear of Falling Among Hospitalized Elderly Diabetes Patients, thesis, Yangzhou University.

[51] Zhang Y, Zhang K, 2023, Research Progress on Activity Limitations Related to Fear of Falling Among the Elderly. Chinese Journal of Nursing, 58(1): 112–116.

[52] Sakurai R, Fujiwara Y, Ishihara M, et al., 2013, Age-Related Self-Overestimation of Step-Over Ability in Healthy Older Adults and Its Relationship to Fall Risk. BMC Geriatrics, 13: 44.

[53] Mihaljcic T, Haines T, Ponsford J, et al., 2015, Self-Awareness of Falls Risk Among Elderly Patients: Characterizing Awareness Deficits and Exploring Associated Factors. Archives of Physical Medicine and Rehabilitation, 96(12): 2145–2152.

[54] Song J, Yang P, Liu G, et al., 2022, A Comparative Study of the U.S. CDC Community-Based Fall Risk Assessment and the Fall Function Scale in Assessing Fall Risk Among Community-Dwelling Older Adults. Chinese General Practice, 25(25): 3097–3100 + 3106.

[55] Hughes K, Van B, Eakin E, et al., 2008, Older Persons' Perception of Risk of Falling: Implications for Fall-Prevention Campaigns. American Journal of Public Health, 98(2): 351–357.

[56] Kerr L, Newman P, Russo P, 2023, "I Don't Want to Impose on Anybody": Older People and Their Families Discuss Their Perceptions of Risk, Cause and Care in the Context of Falls. International Journal of Older People Nursing, 18(6): e12578.

[57] Kantow S, Seangpraw K, Ong-Artborirak P, et al., 2021, Risk Factors Associated with Fall Awareness, Falls, and Quality of Life Among Ethnic Minority Older Adults in Upper Northern Thailand. Clinical Interventions in Aging, 16: 1777–1788.

[58] Deligianni F, Guo Y, Yang G, 2019, From Emotions to Mood Disorders: A Survey on Gait Analysis Methodology. IEEE Journal of Biomedical and Health Informatics, 23(6): 2302–2316.

[59] Slovic P, 1987, Perception of Risk. Science, 236(4799): 280–285.

[60] Hadjistavropoulos T, Delbaere K, Fitzgerald T, 2011, Reconceptualizing the Role of Fear of Falling and Balance Confidence in Fall Risk. Journal of Aging and Health, 23(1): 3–23.

[61] Payette M, Bélanger C, Lévesque V, et al., 2016, Fall-Related Psychological Concerns and Anxiety Among Community-Dwelling Older Adults: Systematic Review and Meta-Analysis. PLoS One, 11(4): e0152848.

[62] Young W, Olonilua M, Masters R, et al., 2016, Examining Links Between Anxiety, Reinvestment and Walking When Talking by Older Adults During Adaptive Gait. Experimental Brain Research, 234(1): 161–172.

[63] Brailean A, Aartsen M, Muniz-Terrera G, et al., 2017, Longitudinal Associations Between Late-Life Depression Dimensions and Cognitive Functioning: A Cross-Domain Latent Growth Curve Analysis. Psychological Medicine, 47(4): 690–702.

[64] Horton K, 2007, Gender and the Risk of Falling: A Sociological Approach. Journal of Advanced Nursing, 57(1): 69–76.

[65] Ratcliffe J, Lancsar E, Flint T, et al., 2017, Does One Size Fit All? Assessing the Preferences of Older and Younger People for Attributes of Quality of Life. Quality of Life Research, 26(2): 299–309.

[66] Peterson L, Meng H, Dobbs D, et al., 2017, Gender Differences in Mobility Device Use Among U.S. Older Adults. The Journals of Gerontology Series B, 72(5): 827–835.

[67] Felber N, Tian Y, Pageau F, et al., 2023, Mapping Ethical Issues in the Use of Smart Home Health Technologies to Care for Older Persons: A Systematic Review. BMC Medical Ethics, 24(1): 24.

[68] Curl A, Fitt H, Tomintz M, 2020, Experiences of the Built Environment, Falls and Fear of Falling Outdoors Among Older Adults: An Exploratory Study and Future Directions. International Journal of Environmental Research and Public Health, 17(4): 1224.

[69] Lin Z, Yang Y, Kou Y, 2020, Metastereotypes of Older Adults and Their Impact on Social Interaction. Psychological Development and Education, 36(6): 686–693.

[70] Zhang J, Lin S, 2019, Actor and Object Effects of Aging Stereotypes on Death Anxiety Among Elderly Couples. Psychological Science, 42(2): 372–378.

[71] Pan W, Wen F, Zuo B, 2018, Age Stereotype Threat and Its Research Manipulation. Advances in Psychological Science, 26(9): 1670–1679.

[72] Zhou S, Li Z, 2021, A Study on Factors Influencing Job Performance Under Age Stereotype Threat. Journal of the Graduate School of the Chinese Academy of Social Sciences, 2021(6): 18–26.

[73] Lin Y, Xu Z, Zeng Q, et al., 2025, A Study on Older Adults' Perception of Fall Risk and Preventive Behaviors Based on the Health Belief Model: A Systematic Review. Research on Aging, 13(4): 1–17.

[74] Tang H, Vu H, Tang H, et al., 2023, Knowledge, Attitude and Practice on Fall Risk Factors and Prevention Among Rural Older Community-Dwellers in Vietnam. PLoS One, 18(11): e0295119.

[75] Hill A, McPhail S, Hoffmann T, et al., 2009, A Randomized Trial Comparing Digital Video Disc with Written Delivery of Falls Prevention Education for Older Patients in Hospital. Journal of the American Geriatrics Society, 57(8): 1458–1463.

[76] Liu X, Xie Z, Xiao X, et al., 2018, Application of Case-Based Teach-Back in Health Education for Fall Prevention Among Cancer Patients. Chinese Clinical Nursing, 10(5): 424–426 + 430.

[77] Sarmiento K, Lee R, 2017, STEADI: CDC's Approach to Make Older Adult Fall Prevention Part of Every Primary Care Practice. Journal of Safety Research, 63: 105–109.

[78] Wu X, Huang Z, Ran B, 2021, Factors Contributing to Fear of Falling Among Hospitalized Elderly Patients and

Recent Advances in Cognitive Behavioral Intervention. Modern Medicine and Health, 37(9): 1501–1504.

[79] Pfeiffer K, Kampe K, Klenk J, et al., 2020, Effects of an Intervention to Reduce Fear of Falling and Increase Physical Activity During Hip and Pelvic Fracture Rehabilitation. Age and Ageing, 49(5): 771–778.

[80] Xue Y, Ding Y, Yu J, et al., 2021, A Meta-Analysis of the Effects of Cognitive Behavioral Intervention on Fear of Falling and Balance Ability in Older Adults. Nursing Research, 35(10): 1720–1725.

[81] Song B, Liu C, Lv S, 2020, The Role of Moderate Physical Exercise in Reducing Fall Rates and Improving Cognitive Function in Older Adults. Chinese Journal of Gerontology, 40(4): 807–810.

[82] Yun J, Lee J, 2015, Effects of a Thera-Band Exercise Program on Pain, Knee Flexion ROM, and Psychological Parameters Following Total Knee Arthroplasty. Journal of Korean Academy of Nursing, 45(6): 823–833.

[83] Haertner L, Elshehabi M, Zaunbrecher L, et al., 2018, Effect of Fear of Falling on Turning Performance in Parkinson's Disease in the Lab and at Home. Frontiers in Aging Neuroscience, 10: 78.

[84] Solares N, Calero P, Connelly C, 2023, Patient Perception of Fall Risk and Fall Risk Screening Scores. Journal of Nursing Care Quality, 38(2): 100–106.

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Nonpharmacological Management of Cancer-Related Fatigue in Breast Cancer Patients Undergoing Chemotherapy: A Best Evidence Summary

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Abstract: *Objective*: To retrieve and summarize the best evidence on non-pharmacological management of cancer-related fatigue in breast cancer patients undergoing chemotherapy, and to provide an evidence-based foundation for individualized management. *Methods*: Clinical guidelines, expert consensus, systematic reviews, and other relevant literature were systematically searched in domestic and international databases from inception to April 2026. Two researchers independently screened the literature, assessed quality, and extracted and synthesized the evidence. *Results*: A total of 28 publications were included, consisting of 2 clinical decisions, 5 guidelines, 2 expert consensus statements, 16 systematic reviews, and 3 randomized controlled trials. The evidence was synthesized into seven themes: multidisciplinary team collaboration, assessment and screening, exercise intervention, psychological and behavioral intervention, traditional Chinese medicine and complementary and alternative therapies, nutritional support, and health education. *Conclusion*: Clinical implementation should integrate local contexts and patient characteristics, applying the best available evidence to deliver individualized nonpharmacological management, so as to alleviate fatigue and improve quality of life.

Keywords: Breast cancer; Chemotherapy; Cancer-related fatigue; Nonpharmacological management; Exercise intervention; Evidence summary; Evidence-based nursing

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1. Introduction

Breast cancer is the most frequently diagnosed cancer and a leading cause of cancer-related mortality among women worldwide [1,2]. Chemotherapy, a core component of comprehensive breast cancer treatment,

is associated with various adverse effects [3,4]. Cancer-related fatigue (CRF) is one of the most debilitating symptoms during chemotherapy, with an incidence of 60–90%, severely impairing patients' quality of life and treatment adherence [5,6]. CRF during chemotherapy is more prominent and persistent, with some patients experiencing chronic fatigue for years after treatment [7]. Given its impact, nonpharmacological management strategies have been recommended as first-line interventions by guidelines due to their safety and feasibility [8–10]. However, current evidence is fragmented, and its applicability in the chemotherapy setting requires systematic synthesis. This study aims to integrate the best available evidence on nonpharmacological management of CRF in breast cancer patients undergoing chemotherapy, providing an evidence-based reference for clinical nursing practice.

2. Methods

2.1. Problem establishment

An evidence-based nursing question was constructed using the PIPOST framework [11].

(1) P (Population)
Patients aged ≥ 18 years with pathologically confirmed breast cancer and CRF;

(2) I (Intervention)
Nonpharmacological management strategies as the core approach, encompassing exercise intervention, psychological intervention, complementary and alternative therapies, sleep management, and nutritional support;

(3) P (Professional)
Oncology clinical nurses, physicians, rehabilitation therapists, and community nursing staff;

(4) O (Outcome)
CRF severity, quality of life, treatment adherence, and intervention safety indicators;

(5) S(Setting)
Inpatient oncology wards, day chemotherapy centers, community, and home settings;

(6) T (Type)
Clinical decision support tools, best practice recommendations, guidelines, expert consensus statements, evidence summaries, systematic reviews, and meta-analyses.

As CRF spans the entire treatment trajectory and is most severe during chemotherapy, this study initially searched broadly for evidence, then focused on applicability and safety in the chemotherapy setting during synthesis.

2.2. Search strategy

Guided by the "6S" evidence pyramid model, a top-down search of relevant resources was conducted, primarily including: BMJ Best Practice, UpToDate, DynaMed, Guidelines International Network (GIN), National Guideline Clearinghouse (NGC),Registered Nurses' Association of Ontario(RNAO), National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN), and Medlive (Chinese guideline network), American Society of Clinical Oncology (ASCO), Society for Integrative Oncology(SIO), National Comprehensive Cancer Network (NCCN), European Society for Medical Oncology(ESMO), Breast Cancer Committee of Chinese Anti-Cancer Association, and Chinese Nursing Association, Joanna Briggs Institute (JBI), Evidence-Based Practice Database and the Cochrane Library, PubMed, CINAHL, Web of Science, China National Knowledge Infrastructure(CNKI), WanFang database, VIP database, and China Biology Medicine (CBM) Database. The search keywords included:

“breast cancer” “breast neoplasm” “breast tumor” “cancer-related fatigue” “CRF” “cancer fatigue” “exercise” “physical activity” “aerobic exercise” “resistance training” “strength training” “yoga” “tai chi” “mind-body therapy” “cognitive behavioral therapy” “psychological intervention” “relaxation” “acupuncture” “acupressure” “auricular therapy” “guideline” “consensus” “evidence summary” “systematic review” “meta-analysis” “best practice” [12]. A search strategy combining subject headings and free-text terms was adopted, with a search timeframe from database inception to April 2026.

2.3. Inclusion and exclusion criteria for evidence

2.3.1. Inclusion criteria

(1) Population
Patients aged ≥ 18 years with a pathological diagnosis of breast cancer;

(2) Content
Studies addressing nonpharmacological management strategies for CRF, including but not limited to exercise intervention, psychosocial intervention, complementary and alternative therapies, sleep management, and nutritional support;

(3) Type of evidence
Clinical practice guidelines, expert consensus statements, best practice recommendations, systematic reviews, and meta-analyses;

(4) Language
Chinese or English.

2.3.2. Exclusion criteria

(1) Guidelines that had been superseded or updated, as well as guidelines interpretations or translated versions;

(2) Duplicate publications or articles for which the full text could not be obtained;

(3) Evidence summary articles, as they represent secondary syntheses and the original evidence they cite can be directly traced back to the included guidelines or systematic reviews.

2.4. Literature quality appraisal tools

Clinical practice guidelines were appraised using the Appraisal of Guidelines for Research and Evaluation II(AGREE II)instrument [13]. The AGREE II instrument covers six domains, comprising 23 key items and two additional items for overall assessment of the evidence. All items, including the additional ones, are rated on a 7-point scale. The score for each domain is the sum of the scores of all items within that domain, and the raw total scores are required to be standardized using the following formula: [(actual score-theoretical minimum score)/ (theoretical maximum score-theoretical minimum score)] × 100%. Quality grading was determined based on the standardized scores: Grade A (recommended), with scores ≥ 60% in all domains; Grade B (recommended with modifications), with at least three domains scoring ≥ 30% but with one or more domains scoring < 60%; and Grade C (not recommended), with three or more domains scoring < 30% [13].

Systematic reviews, expert consensus statements, and best practice recommendations were appraised using the corresponding critical appraisal tools from the Joanna Briggs Institute(JBI) [14]. The JBI critical appraisal checklist comprises 11 items for systematic reviews and 6 items for expert consensus statements. Each item was rated as”Yes”, “No”, “Unclear”, or “Not applicable”.

2.5. Literature quality appraisal process

Data were independently extracted by two researchers trained in evidence-based nursing, including literature type, title, and original evidence statements. Disagreements were resolved by a third expert. Evidence synthesis principles:

(1) Consistent evidence was expressed concisely and professionally;

(2) Complementary evidence was merged logically;

(3) Conflicting evidence was resolved by tracing original sources and prioritizing evidence-based, high-quality, and recent authoritative evidence.

Evidence grading: items from JBI evidence summaries retained their original levels; for clinical decisions and guidelines, original studies were traced and graded using the 2014 JBI Evidence Pre-grading System [14].

3. Search results

3.1. General characteristics of included studies

The initial search retrieved 2,047 articles. After removing 687 duplicate records, 1,152 articles were excluded based on title and abstract screening, and a further 180 articles were excluded after full-text review. A total of 28 articles were ultimately included, comprising 2 clinical decision support tools, 5 guidelines, 2 expert consensus statements, and 16 systematic reviews and meta-analyses [8,9,16–41]. Given the lack of recent high-quality secondary research in certain intervention areas, 3 randomized controlled trials were additionally included to ensure the timeliness and completeness of the evidence [16–18]. The literature screening flow diagram is presented in **Figure 1**, and the general characteristics of the included studies are presented in **Table 1**.

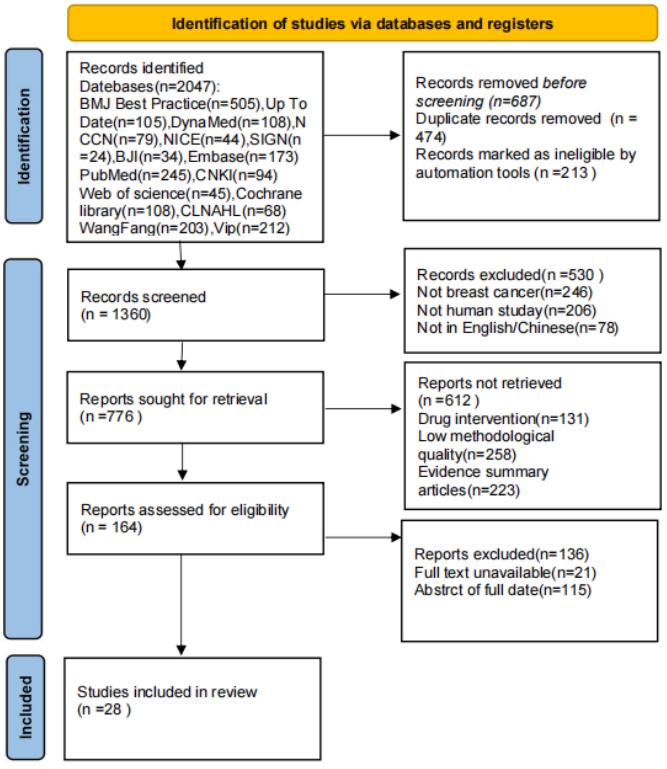


Figure 1. Literature screening flow diagram.

Table 1. General characteristics of the included studies (n = 28)

Author	Publication/ Update date	Source (institution/database)	Type	Research subjects
Escalante [19]	2026	UpToDate	Clinical decision support tools	Prevalence, screening, and clinical assessment of CRF
Escalante [20]	2026	UpToDate	Clinical decision support tools	Treatment of CRF
NCCN [9]	2026	NCCN	Guideline	Screening, assessment, and management of CRF
ASCO [22]	2024	PubMed	Guideline	Whole-course management of CRF
NICE [23]	2025	NICE	Guideline	Supportive care for breast cancer patients
CACA [24]	2025	CNKI	Guideline	Clinical Guideline for Breast Cancer Diagnosis, Treatment, and Rehabilitation
Cui [21]	2023	CNKI	Guideline	Guidelines for integrated traditional Chinese and Western medicine diagnosis, assessment, and comprehensive treatment of CRF
CARM [25]	2025	CNKI	Expert consensus statements	Standardized pathway for CRF screening, assessment, nonpharmacological intervention, and multidisciplinary management
Han [8]	2025	CNKI	Expert consensus statements	Nursing practice of integrated traditional Chinese and Western medicine for CRF
Li [27]	2025	PubMed	Systematic Review	Effects of mind–body exercise on CRF
Li [28]	2024	PubMed	Systematic Review	Effects of 12 interventions on CRF in breast cancer patients
Qi Y [26]	2024	PubMed	Systematic Review	Effects of yoga intervention on the symptom cluster of fatigue, sleep, and pain in breast cancer patients
Lange [29]	2024	PubMed	Systematic Review	Effects of resistance training and combined resistance plus aerobic training on CRF
Wu [30]	2023	PubMed	Systematic Review	Effects of different exercise therapies on CRF in breast cancer patients
Medeiros T D [31]	2022	PubMed	Systematic Review	Effects of exercise on CRF during adjuvant radiotherapy and chemotherapy for breast cancer
Y [32]	2021	Pubmed	Systematic Review	Effects of home-based walking on CRF
Huizinga F [33]	2021	PubMed	Systematic Review	Effects of home-based physical activity on patients with CRF
Cano-Uceda A [34]	2025	PubMed	Systematic reviews and meta-analyse	Effects of supervised exercise programs on fatigue
Lee J [35]	2025	PubMed	Systematic reviews and meta-analyse	Effectiveness of comprehensive exercise interventions during and after treatment
Ke G [36]	2025	BMJ	Systematic Review	Effects of nonpharmacological interventions on CRF
Li Y [37]	2025	PubMed	Systematic reviews and meta-analyse	Effects of 12 exercise modalities on CRF
James [38]	2024	MDPI	Systematic Review	Feasibility, safety, and effectiveness of nutritional counseling during chemotherapy
Yuan Y [39]	2022	PubMed	Systematic Review	Efficacy of six psychosocial therapies on CRF in cancer patients

Lan X [40]	2024	PubMed	Systematic Review	Efficacy of mindfulness-based stress reduction (MBSR) on CRF in breast cancer patients
Habibi S [41]	2025	PubMed	Systematic Review	Effects of oral nutritional supplements on CRF in patients undergoing chemoradiotherapy
Greeley K M [16]	2025	PubMed	RCT	Effects of Cognitive behavioral therapy (CBT) for insomnia (CBT-I) on fatigue in cancer survivors
Vikmoen O [17]	2025	PubMed	RCT	Effects of supervised heavy-load training on breast cancer patients during chemotherapy
Hou X [18]	2025	PubMed	RCT	Effects of Baduanjin exercise on breast cancer patients

3.2. Results of the quality evaluation of the included studies

3.2.1. Quality appraisal of included guidelines

Table 2. Quality appraisal of included guidelines (*n* = 5)

Guideline	Scope and Purpose	Stakeholder Involvement	Rigor of Development	Clarity of Presentation	Applicability	Editorial Independence	Domains ≥ 60% (n)	Domains ≥30% (n)	Grade
NCCN [9]	90	75	70	85	70	85	6	6	A
ASCO [22]	90	85	85	90	65	85	6	6	A
NICE [23]	85	80	85	85	75	90	6	6	A
CACA [24]	85	75	60	80	65	40	5	6	B
Cui [21]	80	65	55	80	60	30	4	6	B

Note: All percentages represent standardized domain scores. Grade A = all six domains ≥ 60%; Grade B = at least three domains ≥ 30% but at least one domain < 60%. All five guidelines were recommended for inclusion.

3.2.2. Quality appraisal of included expert consensus statements

Table 3. Quality appraisal of included expert consensus statements (*n* = 2)

Item	(1)	(2)	(3)	(4)	(5)	(6)	Overall appraisal
Han [8]	Yes	Yes	Yes	Yes	Yes	Yes	Include
CARM [25]	Yes	Yes	Yes	Yes	Yes	Yes	Include

Note: The JBI critical appraisal checklist for text and opinion papers (2016) was used.

3.2.3. Quality appraisal of the included systematic reviews

Table 4. Evaluation Results of Systematic Evaluation Quality (n = 16)

Item	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
L[i [27]]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Li [28]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Qi Y [26]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Lange [29]	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	No	Yes	Yes
Wu [30]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Medeiros Torres D [31]	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes
Y [32]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	No	Yes	Yes

Huizinga F [33]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cano-Uceda A [34]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Lee J [35]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ke G [36]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Li Y [37]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
James [38]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Unclear
Yuan Y [39]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lan X [40]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Habibi S [41]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The JBI systematic review critical appraisal checklist was used.

3.2.4. Quality Appraisal of the Included Randomized Controlled Trials

Table 5. Quality appraisal of included randomized controlled trials (n = 3)

Item	True randomization	Allocation concealment	Baseline similarity	Participant blinding	Outcome assessor blinding	Therapist blinding	Identical treatment	Follow-up complete	ITT analysis	Outcome measurement identical	Outcome measurement reliable	Appropriate statistics	Overall appraisal
Vikmoen O [17]	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Include
Hou X [18]	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes	Include
Greeley K M [16]	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Include

3.3. Evidence summary and level of evidence

A total of 24 pieces of usable evidence were extracted in this study. After synthesis and analysis, eight evidence themes were ultimately formulated. See Table 6.

Table 6. Evidence summary and level of evidence

Evidence theme	Evidence content	Evidence level
Multidisciplinary team	1. Establish a multidisciplinary team centered on breast cancer patients undergoing chemotherapy, integrating oncology, nursing, rehabilitation, nutrition, and psychology disciplines to provide a comprehensive and individualized fatigue management plan [21,24,25].	5b
Screening and assessment	2. Routine screening for CRF should be conducted for all breast cancer patients undergoing chemotherapy. A 0–10 numeric rating scale (NRS) is recommended for rapid assessment; patients with moderate to severe fatigue (NRS ≥ 4) require further comprehensive evaluation using multidimensional scales [9,19,21,25].	5b
	3. The primary step in managing CRF is to rule out treatable etiologies [19,20,23].	5b
	4. Screening frequency: Regular fatigue screening should be integrated from diagnosis through follow-up across the entire cancer care continuum [9,25].	5b

Exercise intervention principles	5. Exercise for CRF patients should follow the principles of individualization and gradual progression [22,23,34,35].	1a
	6. Supervised combined aerobic and resistance training is the preferred nonpharmacological strategy for CRF in breast cancer patients undergoing chemotherapy and rehabilitation [22].	1a
	7. The recommended exercise frequency and duration are at least 150 minutes of moderate-intensity aerobic exercise per week combined with 2–3 sessions of resistance training per week [9,29–31].	1a
Exercise types and safety	8. Low- to moderate-intensity exercise is recommended during active treatment and can be gradually increased to moderate–high levels after treatment based on physical recovery, with greater CRF improvement seen post-treatment [35].	1a
	9. Types of aerobic exercise include brisk walking, jogging, cycling, swimming, and home-based walking; home-based walking is an effective modality with a low barrier to entry and high adherence, and can significantly alleviate CRF [32–34].	1a
	10. Types of resistance exercise include dumbbells, elastic bands, and fixed-equipment training; intensity at 40–80% 1RM, 8–15 repetitions per exercise, 1–3 sets, with 1–2 minutes of rest between sets [17,29,36].	1a
	11. High-load strength training during chemotherapy is feasible and safe, and can effectively mitigate the decline in capillary density and aerobic enzyme levels, thereby preventing the exacerbation of physical fatigue [17].	1b
	12. Supervised exercise guided by a rehabilitation therapist should be prioritized whenever feasible [34].	1a
	13. Mind–body exercises are integral components of exercise intervention [18,26,27,36,37].	1a
	14. Exercise safety contraindications: Exercise is prohibited when platelets < 50,000/μL, hemoglobin < 10 g/dL, neutrophils < 1,500/mm^3, or in cases of untreated pathological fractures, severe bone pain, or acute infection. Patients with osteoporosis or bone metastases should avoid high-impact, twisting, and weight-bearing flexion and extension movements [25,36].	5b
Psycho-behavioral Intervention	15. CBT-I can significantly improve daytime fatigue levels [16,28,40]. Recommended: one session per week, 90 minutes per session, for 8–20 weeks [28,39].	1a
	16. MBSR can reduce fatigue severity and improve psychological distress. An 8-week group program is recommended [22,36,39,40].	1a
	17. CBT-I can significantly and sustainably improve daytime fatigue levels through the mechanisms of reducing nocturnal wakefulness (by 42%) and increasing total sleep time (by 24%) [16].	1b
	18. The recommended frequency for relaxation training is 1–2 times per day, 15–30 minutes per session [39].	1a
TCM and complementary and alternative therapies	19. Xiaoyao San with modifications is recommended for patients with liver depression and spleen deficiency syndrome [21].	5b
	20. TCM nonpharmacological nursing techniques and traditional Baduanjin exercises are recommended as adjunctive nursing measures to alleviate CRF [8,21,25,36].	5b
Nutrition and multimodal management	21. Nutritional counseling and oral nutritional supplementation (ONS) during chemotherapy can help maintain body weight and muscle mass [38,41].	1a
	22. American ginseng at a dose of 2,000 mg per day for 8 weeks can be used to improve CRF in patients undergoing treatment [21,22,36].	1b
Health education and self-management	23. A structured lifestyle education prescription should be provided to patients [23,35,38].	1a
	24. Patients should be guided to conduct self-monitoring records [9,23].	5b

4. Discussion

4.1. Multidisciplinary team collaboration ensures the implementation of CRF management

Given the complex pathogenesis of CRF, a single-discipline intervention is insufficient to address it

comprehensively. Evidence recommends establishing a multidisciplinary team centered on breast cancer patients undergoing chemotherapy to develop individualized fatigue management plans [20,23,24]. Team collaboration bridges information gaps across disciplines, ensuring consistent evidence implementation at all stages.

4.2. Standardized assessment and screening as the prerequisite for precise intervention

Evidence items 2 to 4 summarized the accurate identification and assessment of CRF in breast cancer patients undergoing chemotherapy. The evidence recommends routine CRF screening for all breast cancer patients undergoing chemotherapy, using a 0–10 NRS for rapid assessment, with scores of 1–3 indicating mild, 4–6 moderate, and 7–10 severe fatigue; patients with moderate to severe fatigue require further comprehensive evaluation using multidimensional scales [9,20,24,41]. Furthermore, the primary step in managing CRF is to rule out treatable etiologies, which necessitates screening for reversible contributing factors such as anemia, hypothyroidism, malnutrition, pain, and sleep disturbances [22,41]. CRF screening should be integrated throughout the entire cancer care trajectory, starting from diagnosis and performed regularly at initial visits, during treatment, and during post-treatment follow-up, to ensure efficient and precise CRF management [9,24]. Nurses should incorporate fatigue screening into the daily assessment routine for chemotherapy patients, and promptly initiate multidimensional assessment and multidisciplinary intervention for those with moderate to severe fatigue. In summary, standardized, continuous screening and assessment constitute the foundational step in the precise management of CRF; only by accurately identifying fatigue severity and ruling out reversible contributing factors can subsequent nonpharmacological interventions be implemented in a targeted and effective manner.

4.3. Exercise intervention as the core strategy for CRF management

Evidence items 5–14 summarized the principles, types, and safety contraindications of exercise intervention. The ASCO-SIO guideline recommends combined aerobic and resistance training as the preferred nonpharmacological strategy for CRF [21]. Supervised combined training ensures proper form, appropriate intensity, and adherence, making it more effective than home-based self-directed exercise; it should be prioritized when feasible [21]. The recommended prescription is at least 150 minutes per week of moderate-intensity aerobic exercise plus 2–3 weekly resistance training sessions [9,28,30]. The treatment stage moderates exercise effects: the effect size for CRF reduction is greater after treatment than during active treatment, indicating that exercise intensity and goals should be dynamically adjusted according to the treatment stage.

Mind–body exercises, as an integral component of exercise intervention, offer the dual benefits of physical conditioning and psychological regulation. Yoga is recommended as an NCCN Category 1 recommendation, with a suggested frequency of 2–3 sessions per week, 60–90 minutes per session [21,25,26,29]. Tai Chi, with a minimum frequency of three sessions per week, 30–60 minutes per session, demonstrates superior overall effectiveness in improving fatigue, quality of life, and depression [35,36]. Baduanjin, performed for 40 minutes per day, three days per week, and continued for 12 weeks [17]. The aforementioned mind–body exercise regimens are all characterized by low intensity and high adherence, making them particularly suitable for implementation in community and home settings.

The safety of exercise is a prerequisite for clinical implementation. The evidence specifies contraindications for exercise during chemotherapy, including a platelet count below 50,000/μL, hemoglobin below 10 g/dL, neutrophil count below 1,500/mm^3, as well as the presence of untreated pathological fractures, severe bone pain, or acute infection, in which cases exercise is prohibited [24,35]. Nurses should

thoroughly assess hematological parameters and bone safety status before guiding patients in exercise. Patients with osteoporosis or bone metastases should avoid high-impact, twisting, and weight-bearing flexion and extension movements.

4.4. Psycho-behavioral intervention as an important collaborative management approach

Psycho-behavioral interventions and exercise interventions form an effective complement to one another. Evidence items 15 to 18 summarized the content of psycho-behavioral interventions. CBT is recognized as one of the most effective psychological interventions for alleviating CRF, with a recommended schedule of one session per week, 90 minutes per session, for 8–20 weeks [27,38]. For patients with comorbid insomnia, CBT-I can significantly improve daytime fatigue levels through the mechanisms of reducing nocturnal wakefulness and increasing total sleep time. MBSR is recommended as an 8-week group program, consisting of one 2–2.5 hour face-to-face session per week combined with 30–45 minutes of daily home practice, and has been shown to effectively reduce fatigue severity and improve psychological distress [21,35,38,39]. Relaxation training, performed 1–2 times per day for 15–30 minutes per session, has a positive effect on improving sleep quality and associated fatigue during chemotherapy [38]. In clinical practice, psychological interventions should be implemented as a vital supplement to exercise programs; particularly for patients with comorbid anxiety, depression, or sleep disturbances, CBT or MBSR should be prioritized and integrated into the care plan to achieve comprehensive management effects through combined physical and psychological treatment.

4.5. TCM techniques as a locally adapted complementary approach

Evidence items 19 to 20 propose that TCM syndrome differentiation and treatment, as well as TCM nursing techniques, offer locally adapted options for CRF management that fit the domestic clinical context [20]. Regarding nonpharmacological techniques, acupuncture, moxibustion, acupressure, and auricular acupressure are all included in the recommendations [20,21,24,35]. Specifically, acupuncture is recommended 2–3 times per week, 20–30 minutes per session; moxibustion is recommended once daily, 20–30 minutes per session; acupressure is recommended 1–2 times per day, 1–5 minutes per acupoint; and auricular acupressure targets ear acupoints such as Liver, Spleen, Kidney, and Shenmen. The above techniques are characterized by ease of operation, low economic cost, and high patient acceptability, and can be independently implemented by clinical nurses after standardized training, holding considerable potential for wider adoption in primary care and community settings.

4.6. Nutritional support playing an adjunctive role

Evidence items 21 to 22 indicate that nutritional counseling and oral nutritional supplementation during chemotherapy are feasible and safe, and can help maintain body weight and muscle mass, thereby indirectly supporting fatigue management; however, indiscriminate supplementation should be avoided [37,40]. American ginseng at a dose of 2,000 mg per day for 8 weeks can be used to improve CRF in patients undergoing treatment [20,21,35]. It should be noted that nutritional support should serve as an adjunctive measure to exercise and psychological interventions rather than a replacement, and its clinical application should be individualized according to the patient's nutritional status and treatment phase.

4.7. Health education implemented throughout the management continuum

Evidence items 23–24 recommend providing patients with a structured lifestyle education prescription. The

educational content should cover CRF knowledge education, energy conservation techniques, and information on psychosocial support resources [22,37]. Meanwhile, patients should be guided to perform self-monitoring and use a fatigue diary to dynamically capture fatigue fluctuation patterns and intervention effects, thereby facilitating patient–clinician communication and dynamic adjustment of the management plan [9,22]. Health education should also focus on fostering patients' self-efficacy, helping them establish accurate expectations of nonpharmacological interventions and sustained intrinsic motivation for continued participation.

5. Summary

This study synthesized the best evidence on nonpharmacological management of CRF in breast cancer patients undergoing chemotherapy, covering seven areas: screening and assessment, exercise intervention, psycho-behavioral intervention, TCM techniques, nutritional support, and health education. Evidence indicates that exercise, particularly combined aerobic and resistance training is the preferred CRF management strategy, complemented by psycho-behavioral and TCM nursing interventions, with standardized screening and health education sustained throughout care. As primary providers, nurses should center on exercise, integrate psychological and TCM approaches to develop individualized, multidimensional plans, and promote evidence translation into home and community settings. Limitations include the predominance of English-language literature, the need for local validation of certain interventions, lower-level evidence in TCM and nutritional support, and insufficient safety data in specific chemotherapy contexts. Future high-quality primary studies are needed to strengthen the evidence base and support safe, effective implementation of nonpharmacological CRF protocols in the Chinese clinical context.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Zhang Y, Ji Y, Liu S, et al., 2025, Global Burden of Female Breast Cancer: New Estimates in 2022, Temporal Trend and Future Projections up to 2050 Based on the Latest Release From GLOBOCAN. Journal of the National Cancer Center, 5(3): 287–296.

[2] Sun K, Zhang B, Lei S, et al., 2024, Incidence, Mortality, and Disability-Adjusted Life Years of Female Breast Cancer in China, 2022. Chinese Medical Journal, 137(20): 2429–2436.

[3] Di Nardo P, Lisanti C, Garutti M, et al., 2022, Chemotherapy in Patients with Early Breast Cancer: Clinical Overview and Management of Long-Term Side Effects. Expert Opinion on Drug Safety, 21(11): 1341–1355.

[4] Muthanna F, Karuppannan M, Abdulrahman S, et al., 2023, Prevalence and Impact of Fatigue on Quality of Life (QOL) of Cancer Patients Undergoing Chemotherapy: A Systematic Review and Meta-analysis. Asian Pacific Journal of Cancer Prevention, 24(3): 769–781.

[5] Bower J, 2014, Cancer-Related Fatigue—Mechanisms, Risk Factors, and Treatments. Nature Reviews Clinical Oncology, 11(10): 597–609.

[6] Berger A, Mooney K, Alvarez-Perez A, et al., 2015, Cancer-Related Fatigue, Version 2.2015. Journal of the National Comprehensive Cancer Network, 13(8): 1012–1039.

[7] Li P, Wang Q, Liu L, et al., 2023, The Role of Complementary and Alternative Medicine on Cancer-Related Fatigue in Adults: An Overview of Systematic Reviews. Integrative Cancer Therapies, 22: 15347354231188947.

[8] Han J, Duan P, Wang F, et al., 2025, Expert Consensus on Integrated Traditional Chinese and Western Medicine Nursing for Cancer-Related Fatigue. Journal of Clinical Nursing, 24(4): 12–17.

[9] NCCN, 2026, Guidelines Detail, visited on 2026-04-03, https://www.nccn.org/guidelines/guidelines-detail?category=3&id=1424.

[10] Wang X, Gao L, Pang Y, et al., 2025, Effect of Mindfulness-Based Stress on Cancer-Related Fatigue in Breast Cancer Patients: A Systematic Review and Meta-analysis. Frontiers in Oncology, 15: 1585383.

[11] Zhu Z, Hu Y, Xing W, et al., 2017, The Composition of Different Types of Evidence-Based Problems. Journal of Nurses Training, 32(21): 1991–1994.

[12] DiCenso A, Bayley L, Haynes R, 2009, Accessing Pre-Appraised Evidence: Fine-Tuning the 5S Model Into a 6S Model. Evidence-Based Nursing, 12(4): 99–101.

[13] Brouwers M, Kho M, Browman G, et al., 2010, AGREE II: Advancing Guideline Development, Reporting and Evaluation in Health Care. Canadian Medical Association Journal, 182(18): E839–E842.

[14] Aromataris E, Lockwood C, Porritt K, et al., 2024, JBI Manual for Evidence Synthesis. JBI.

[15] Wang C, Hu Y, 2015, JBI Evidence Pre-grading and Evidence Recommendation Level System (2014 Version). Journal of Nurses Training, 30(11): 964–967.

[16] Greeley K, Rash J, Tulk J, et al., 2025, Impact and Mechanisms of Cognitive Behavioral Therapy for Insomnia on Fatigue Among Cancer Survivors: A Secondary Analysis of a Randomized Controlled Trial. Sleep, 48(6): zsaf014.

[17] Vikmoen O, Strandberg E, Svindland K, et al., 2025, Effects of Heavy-Load Strength Training During (Neo-) Adjuvant Chemotherapy on Cardiorespiratory Fitness, Aerobic Enzymes, Capillaries, Fatigue and Quality of Life in Women with Breast Cancer. FASEB Journal, 39(23): e71262.

[18] Hou X, Lan H, Cai L, et al., 2026, Baduanjin Exercise for Menopausal Symptoms in Breast Cancer Patients on Aromatase Inhibitors: A Randomized Controlled Pilot Study. Translational Exercise Biomedicine, 3(1): 13–23.

[19] UpToDate, 2026, Cancer-Related Fatigue: Prevalence, Screening, and Clinical Assessment, visited on 2026-04-25, https://www.uptodate.com/contents/cancer-related-fatigue-prevalence-screening-and-clinical-assessment.

[20] UpToDate, 2026, Cancer-Related Fatigue: Treatment, visited on 2026-04-25, https://www.uptodate.com/contents/cancer-related-fatigue-treatment.

[21] Cui Y, Yan Y, Wang Y, et al., 2025, Clinical Practice Guideline for the Integrated Traditional Chinese and Western Medicine Diagnosis and Treatment of Cancer-Related Fatigue. Chinese General Practice, 28(27): 3345–3358.

[22] Bower J, Lacchetti C, Alici Y, et al., 2024, Management of Fatigue in Adult Survivors of Cancer: ASCO-Society for Integrative Oncology Guideline Update. Journal of Clinical Oncology, 42(20): 2456–2487.

[23] National Institute for Health and Care Excellence, 2025, Early and Locally Advanced Breast Cancer: Diagnosis and Management. London: NICE.

[24] The Society of Breast Cancer China Anti-Cancer Association, Breast Oncology Group of the Oncology Branch of the Chinese Medical Association, 2025, Guidelines for Breast Cancer Diagnosis and Treatment by China Anti-Cancer Association (2026 Edition). China Oncology, 35(12): 1157–1255.

[25] Community Rehabilitation Working Committee of Chinese Rehabilitation Medicine Association, 2025, Chinese Expert Consensus on Community-Based Cancer-Related Fatigue Management (2025 Edition). Chinese General Practice, 28(33): 4117–4124.

[26] Qi Y, Li H, Chan D, et al., 2024, Effects of Yoga Interventions on the Fatigue-Pain-Sleep Disturbance Symptom

Cluster in Breast Cancer Patients: A Systematic Review. European Journal of Oncology Nursing, 70: 102594.

[27] Li L, He Y, Yang X, et al., 2025, The Impact of Mind-Body Exercise on Female Breast Cancer Patients: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Frontiers in Public Health, 13: 1641075.

[28] Li Y, Gao L, Chao Y, et al., 2024, Various Interventions for Cancer-Related Fatigue in Patients with Breast Cancer: A Systematic Review and Network Meta-analysis. Frontiers in Oncology, 14: 1341927.

[29] Lange J, Klassen O, Beinert K, 2024, Impact of Resistance Training on Fatigue Among Breast Cancer Patients Undergoing Chemotherapy: A Systematic Review and Meta-analysis. Supportive Care in Cancer, 32(11): 721.

[30] Wu T, Yan F, Wei Y, et al., 2023, Effect of Exercise Therapy on Cancer-Related Fatigue in Patients with Breast Cancer: A Systematic Review and Network Meta-analysis. American Journal of Physical Medicine & Rehabilitation, 102(12): 1055–1062.

[31] Medeiros Torres D, Jorge Koifman R, Da Silva Santos S, 2022, Impact on Fatigue of Different Types of Physical Exercise During Adjuvant Chemotherapy and Radiotherapy in Breast Cancer: Systematic Review and Meta-analysis. Supportive Care in Cancer, 30(6): 4651–4662.

[32] Yuan Y, Lin L, Zhang N, et al., 2022, Effects of Home-Based Walking on Cancer-Related Fatigue in Patients with Breast Cancer: A Meta-analysis of Randomized Controlled Trials. Archives of Physical Medicine and Rehabilitation, 103(2): 342–352.

[33] Huizinga F, Westerink N, Berendsen A, et al., 2021, Home-Based Physical Activity to Alleviate Fatigue in Cancer Survivors: A Systematic Review and Meta-analysis. Medicine & Science in Sports & Exercise, 53(12): 2661–2674.

[34] Cano-Uceda A, García-Fernández P, Peuyadé-Rueda B, et al., 2025, From Evidence to Practice: A Systematic Review and Meta-analysis on the Effects of Supervised Exercise on Fatigue in Breast and Prostate Cancer Survivors. Applied Sciences, 15(15): 8399.

[35] Lee J, Hwang Y, 2025, The Effects of Exercise Interventions on Fatigue, Body Composition, Physical Fitness, and Biomarkers in Breast Cancer Patients During and After Treatment: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Journal of Cancer Survivorship. Advance Online Publication.

[36] Ke G, Tao S, Xu H, et al., 2026, Exercise and Mind-Body Therapies for Fatigue in Breast Cancer: Evidence Mapping from Systematic Reviews. BMJ Supportive & Palliative Care, 16(3): 519–529.

[37] Li Y, Zhang J, Hu D, et al., 2025, Which Specific Modes of Exercise Training Are Most Effective for Breast Related Cancer Fatigue? Network Meta-analysis. Frontiers in Oncology, 15: 1491634.

[38] James S, Oppermann A, Schotz K, et al., 2025, Nutritional Counseling During Chemotherapy Treatment: A Systematic Review of Feasibility, Safety, and Efficacy. Current Oncology, 32(1): 3.

[39] Yuan Y, Lin L, Xie C, et al., 2022, Effectiveness Comparisons of Various Psychosocial Therapies for Cancer-Related Fatigue: A Bayesian Network Meta-analysis. Journal of Affective Disorders, 309: 471–481.

[40] Lan X, Xie H, Fu L, et al., 2024, Effects of Mindfulness-Based Stress Reduction on Cancer-Related Fatigue in Patients with Breast Cancer: A Meta-analysis of Randomized Controlled Trials. Frontiers in Oncology, 14: 1425563.

[41] Habibi S, Talebi S, Khosravinia D, et al., 2025, Oral Nutritional Supplementation in Cancer Patients: A Systematic Review and Dose–Response Meta-analysis. Clinical Nutrition, 47: 28–39.

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Gut Microbiota–Derived Metabolites of Dietary Polyphenols in Cognitive Aging:Bioavailability, Neuroinflammation, and Precision Nutrition Implications

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Abstract: Cognitive aging, the age-related degeneration of cognitive ability, is an increasing global health issue, with diet becoming a variable to work on its course. Despite established neuroprotective properties of dietary polyphenols, most of the parent compounds have poor systemic bioavailability, prohibiting their direct action in the central nervous system (CNS). Recent studies have redirected interest to microbiota-derived catabolites; urolithins, equol, enterolignans, phenolic acids, and short-chain fatty acids (SCFAs) that are less toxic and can enter the systemic circulation and possibly cross the blood-brain barrier (BBB). This review identifies polyphenols-derived microbial metabolites as those that are generated by the gut rather than parent polyphenols. Cellular, animal, and limited human evidence implicates these metabolites in cellular neuroinflammation regulation and mitochondrial functioning in cognitive aging, albeit with varying strengths and limitations. Previous studies mainly focused on parent compounds even though most polyphenols reach the colon in their original form, where they are converted to bioactive metabolites with greater bioavailability by gut microbes. This has made these metabolites appear to be the major mediators of health benefits, and this emphasizes the need of microbial transformation processes. Nonetheless, there are still gaps, such as sparse clinical data and a high inter-individual disparity on metabolite production caused by microbiome disparities. The review also differentiates between cognitive aging, cognitive decline, and mild cognitive impairment (MCI) and marks the necessity of metabotype-based precision nutrition approaches.

Keywords: Polyphenols; Gut microbiota; Urolithin A; Cognitive aging; Neuroinflammation; Precision nutrition; Metabotype; Blood–brain barrier

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1. Introduction

Cognitive decline is one of the most significant public health challenges associated with global population aging. By 2050, dementia is estimated to affect 153 million individuals, a number that highlights the

significance of establishing modifiable risk factors that would be effective in interventions at the population level [1]. Nutrition is a scaled and accessible area of early prevention, and among various biological characteristics, dietary polyphenols have a high research interest. Polyphenols are natural secondary metabolites in plants, including fruits, vegetables, whole grains, and legumes and beverages like tea and red wine [2]. Epidemiological studies have indicated that frequent intake of polyphenol-containing foods could help prevent cognitive impairment and dementia, whereas mechanistic research has shown antioxidant, anti-inflammatory, and neuroprotective effects to be some of the primary mechanisms [3,4]. Even in increasing mechanistic insights, there are gaps. There is limited human clinical evidence and most studies are based on animal or cellular models, and personal differences in microbiome composition also play a role in metabolite production have not been studied properly [5]. The review differentiates between cognitive aging, cognitive decline, and mild cognitive impairment (MCI), and seeks to evaluate microbial biotransformation, bioavailability, mechanistic connections to neuroinflammation and implications of inter-individual variations.

2. From dietary polyphenols to microbial metabolites

Dietary polyphenols consist of various broad structural classes that possess different physicochemical characteristics according to how they act along the gastrointestinal tract. These include flavonoids (flavonols, flavones, isoflavones, and anthocyanins), phenolic acids, stilbenes, lignans, and hydrolysable tannins (ellagitannins and gallotannins) [6]. Among these, the ellagitannins, which are also present in pomegranates, walnuts and berries, are high-molecular weight compounds which, through the process of hydrolyzing in the gut, are decomposed into ellagic acid, then formed into a family of urolithin isoforms by a series of demethylation and lactonization reactions by gut bacteria, predominantly *Gordonibacter* Isoflavones, especially daidzein of soy, are converted to equol by the *Lachnospiraceae* family of bacterial consortia, which has a far higher affinity as an estrogen receptor agonist than the dietary isoflavone [7]. Colonic bacteria convert plant lignans into the mammalian enterolignans enterodiol and enterolactone while flavonoids and hydroxycinnamic acids are broken down to smaller aromatic compounds such as 3-(4-hydroxyphenyl) propionic acid and ferulic acid [8].

The biological significance of these microbial changes is mainly due to the low bioavailability of whole polyphenol molecules by the system. The presence of high molecular weight, extensive glycosylation, and high hydrophilicity limits small intestinal absorption, and the overall implication is that large proportions of the ingested polyphenols are transported to the large intestine, where microbial communities present there impart their catabolic actions [9]. The products are simpler structurally, lower molecular weight, and tend to be more lipophilic than their parents, which makes them more receptive to intestinal absorption and systemic distribution [10]. The person with insufficient bacterial populations to produce urolithin will produce insignificant levels of plasma urolithin even after consuming large amounts of ellagitannin (which explains why food intake data is not a complete and possibly misleading measure of polyphenol bioactivity) [11].

3. Bioavailability and brain relevance

During microbial catabolism in the colon, low-molecular-weight phenolic catabolites are absorbed across the colonic epithelium into the portal circulation. These are then subjected to phase II biotransformation, mainly through sulfation, glucuronidation, and O-methylation in the intestinal mucosa and liver to produce

conjugated forms, which have better aqueous solubility and are carried into the systemic circulation [10]. These conjugates can be measurably expressed in plasma: urolithin A glucuronide, such as urolithin A glucuronide, has been found at nanomolar to low-micromolar concentrations in human plasma after dietary intake of pomegranate products, and ferulic acid and protocatechuic acid have been detected in human plasma and urine after controlled diets [12].

The ability of these circulating metabolites to penetrate the blood–brain barrier (BBB) is crucial to whether they can have direct effects on the central nervous system or not. The BBB is a highly selective interface created by specialized cerebral vascular endothelial cells that express tight junction proteins and is supported by astrocytic endfeet and pericytes. Diffusion across this barrier is generally a process of moderate lipophilicity, low molecular weight (usually less than 400–500 Da), and anti-efflux transporter systems resistance [10]. Carecho et al. conducted detailed physicochemical analysis of low-molecular-weight phenolic metabolites in the frame of BBB penetration, and found compounds such as 3-(4-hydroxyphenyl) propionic acid, ferulic acid, and urolithin isoforms possessing physicochemical properties potentially consistent with passive transcytosis, yet *in silico* [10]. More recently Garay-Mayol et al. showed that urolithins themselves and their phase II conjugates can penetrate an *in vitro* BBB model and have anti-inflammatory effects in human microglial cells- results, which are encouraging in terms of mechanism though are obtained using a simplified cell-based model which does not fully replicate the complexity of the *in vivo* BBB, including active efflux systems [13]. *In vivo* confirmation of CNS penetration by these metabolites at physiologically relevant plasma concentrations in humans is not yet available. These results do indicate, however, that circulating levels of microbial metabolites, and not necessarily dietary precursor intake, may be the more useful variable to determine possible neurological effect, and that plasma or urine levels of metabolites might yield mechanistically better information than dietary intake measures alone [14].

4. Key metabolites and their relevance to cognitive aging

A summary of key gut microbiota–derived polyphenol metabolites, including their dietary precursors, major food sources, blood–brain barrier relevance, and primary mechanisms, is presented in Table 1.

Table 1. Key gut microbiota–derived polyphenol metabolites: precursors, sources, bioavailability, and mechanistic relevance

Precursor class	Major food sources	Key microbial metabolites	BBB relevance	Main mechanisms
Ellagitannins / Ellagic acid	Pomegranates, walnuts, raspberries, strawberries	Urolithins A, B, C, D	UA detected in brain tissue (preclinical); phase II conjugates cross *in vitro* BBB	Mitophagy induction (PINK1/ Parkin); NF-κB ↓; NLRP3 ↓; anti-amyloid; neuroprotection via PI3K
Isoflavones (Daidzein)	Soy, tofu, tempeh, miso	Equol (S-equol)	Moderate lipophilicity; plasma-detectable; likely BBB-permeable	ERβ modulation; anti-inflammatory; synaptic plasticity support; association with frontal lobe cognition (human observational)
Lignans	Flaxseed, sesame, whole grains, legumes	Enterodiol, enterolactone	Detected in CSF; confirmed CNS exposure	ERβ agonism; antioxidant activity; synaptic plasticity; neuroprotection

Flavonoids (Quercetin, Rutin, anthocyanins)	Onions, apples, berries, and tea	3,4-diHPP, phenolic acids, SCFAs	Phenolic acids are plasma-detectable; direct BBB data limited; SCFAs exert indirect effects.	NF-κB / MAPK ↓; microglial anti-inflammatory polarization; gut–brain axis modulation via SCFAs
Tea polyphenols (EGCG and related)	Green, black, and white tea	Gallic acid, pyrogallol, ferulic acid	Ferulic and gallic acid confirmed in CNS (preclinical)	Cholinergic support; BDNF ↑; mitochondrial biogenesis; NF-κB ↓
Stilbenes (Resveratrol)	Red grapes, red wine, berries, peanuts	Dihydroresveratrol, lunularin, piceatannol	Highly variable; some metabolites show improved stability vs. the parent compound.	Sirtuin activation; AMPK pathway; anti-amyloid effects (preclinical); production capacity microbiome-dependent

BBB = blood–brain barrier; CNS = central nervous system; CSF = cerebrospinal fluid; ERβ = oestrogen receptor-β; SCFA = short-chain fatty acid. Unless otherwise stated, mechanisms are supported by in vitro or animal evidence; human confirmation is limited.

4.1. Urolithins

Urolithins are among the most thoroughly investigated gut microbiota–derived polyphenol metabolites in relation to neurological health. Synthesized by bacterial conversion of ellagitannins, they are found as multiple isoforms (urolithin A, B, C, D), with urolithin A (UA) having been best studied [1]. In preclinical models, UA has been demonstrated to cause mitophagy, the autophagic clearance of dysfunctional mitochondria, a mechanism that might be of significance in neurodegeneration, as the mitochondrial dysfunction is a well-established phenotype in the pathology of Alzheimer's disease (AD) and Parkinson's disease. The inquiry is whether these preclinical effects of mitophagy induction can be obtained in plasma levels that can be reached by diet or supplementation in the elderly human organism.

In a cellular model of early AD, Esselun et al. demonstrated that UA normalized mitochondrial membrane potential, reduced reactive oxygen species (ROS) production, and enhanced mitophagy markers through activation of the PINK1/Parkin pathway-findings derived from an in vitro system, which limits direct extrapolation to human disease [15]. Pamoda et al. also demonstrated that UA was capable of decreasing the amyloid-β toxicity of cell-based AD models and suppressing neuroinflammatory signaling, again, offering mechanistic plausibility but not yet clinical evidence [16]. Chen et al. reported in an animal model that urolithin B reduced age-associated cognitive impairment in mice by inhibiting apoptosis through cytochrome C and enhancing neuronal survival using the PI3K signaling pathway; the applicability of the doses used to intact human plasma concentrations should be cautiously considered [17]. Wang et al. conducted a review of urolithins as potential interventions for mild cognitive impairment that showed consistent relationships between UA exposure and cognitive biomarker improvements in preclinical research [12]. In the case of human microglial cells, Madsen et al. demonstrated that UA selectively regulated innate immune defense mechanisms and cellular metabolism compared with nicotinamide riboside, indicating possible direct immunomodulatory actions at the level of brain-resident immune cells [18].

4.2. Equol and mammalian enterolignans

In a set of gut bacteria, such as *Slackia isoflavoniconvertens*, the soy isoflavone daidzein is converted to equol; however, it occurs only in a limited number of adults, approximately 25–60 percent geographically and inter-individually, and it is highly unevenly distributed [19]. The medium lipophilicity of Equol enables its systemic bioavailability and BBB penetration. According to Dominguez-Lopez et al., in a study involving human participants who conducted the observations, noted that the cognitive performance in the frontal lobe

was directly related to elevated levels of microbial phenolic compounds such as equol-related compounds in the urine, which are epidemiologically but not causally correlated with cognitive performance in older adults [20].

Enterolactone and enterodiol, mammalian enterolignans formed by colonic bacteria from the plant lignan precursors, have been found in cerebrospinal fluid, indicating the known exposure of the central nervous system [10]. Their action as estrogen receptor-β agonists might play a role in maintaining synaptic plasticity in the setting of age-related sex hormone losses, but this mechanism needs validation by suitably designed human intervention trials [4].

4.3. Phenolic acids and short-chain fatty acids

Phenolic acids such as ferulic acid, 3, (4-hydroxyphenyl) propionic acid (3, 4-diHPP), protocatechuic acid, and gallic acid are common catabolites of flavonoids and hydroxycinnamic acids in the colon [8]. Ferulic acid has also been observed in brain tissue of rodents after peripheral exposure and shown to prevent amyloid-β aggregation and dampen neuroinflammation in preclinical *in vivo* human models [14]. The controlled clinical trials that can be used to show the translation of these findings to human cognitive outcomes have not been done yet.

Fermentation of polyphenols and dietary fiber results in short-chain fatty acids (SCFA), such as butyrate and propionate, which are now increasingly considered gut-brain axis signaling molecules with anti-inflammatory and epigenetic regulatory functions in the CNS [21]. Liu et al. assessed a set of dietary polyphenol-gut microbiota-SCFA production associations and found two-way effects where microbiota controlled by polyphenol affected cognitive ability, mood, and circadian rhythmicity in human and animal groups [6]. These relations are directional and causal and are the subject of the current study.

5. Neuroinflammation and mechanistic pathways

Neuroinflammation, the ongoing activation of microglia and astrocytes, increased generation of pro-inflammatory cytokines, and impaired neural homeostasis are basic aspects of age-related cognitive decline and neurodegenerative disease [22]. Polyphenol metabolites produced by gut microbiota have been demonstrated to regulate various convergent inflammatory signaling axes, most of which are preclinical (cell-based and animal-based) models; rarely has human evidence demonstrated direct connections between these metabolites and neuroinflammatory endpoints. The pathways listed below are the most coherent mechanistic targets so far found in preclinical literature.

Schematic pathway (Figure 1) from dietary polyphenol intake through gut microbial biotransformation to the generation of circulating metabolites with potential to cross the blood–brain barrier and modulate neuroinflammatory and mitochondrial pathways relevant to cognitive aging.

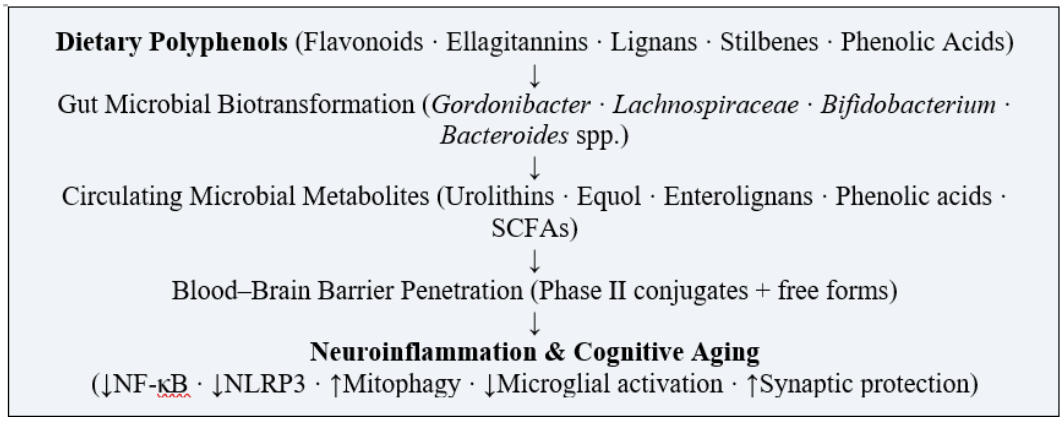


Figure 1. Conceptual framework: From dietary polyphenols to cognitive aging

BBB = blood–brain barrier; NF-κB = nuclear factor kappa-light-chain-enhancer of activated B cells; NLRP3 = NLR family pyrin domain-containing 3; SCFA = short-chain fatty acid.

5.1. Microglial activation and NF-κB / MAPK signaling

The main immune effector cells of the CNS is microglia. Persistent peripheral or central stimulation of the immune system, including TNF-alpha, IL-1, and IL-6, plays a role in synaptic dysfunction and neuronal death [23]. In an *in vitro* BBB model, Garay-Mayol et al. showed that urolithins and their phase II conjugates permeated the barrier, inhibited nuclear translocation of NF-kB in stimulated microglial cells, and inhibited expression of inflammatory downstream genes in a stimulus- dependent manner [13]. NF-kB signaling is upregulated by the MAPK cascade, which includes JNK and p38 kinases, and phenolic acids, such as ferulic acid, have demonstrated the ability to suppress the phosphorylation of these signaling intermediates in neuroinflammatory cell models [8]. Sarubbo et al. provide evidence of a multi-polar win of polyphenol metabolites and found microglial polarization of a pro-inflammatory (M1) to a neuroprotective (M2) phenotype as a common mechanism of action, but the applicability of this classification scheme to humans *in vivo* is still an active, controversial topic [24].

5.2. NLRP3 inflammasome regulation

The NLRP3 inflammasome is a multiprotein complex that leads to caspase-1-dependent maturation and release of IL-1 and IL-18, increasing neuroinflammatory processes. A number of microbial metabolites have been shown to inhibit NLRP3 activation in preclinical studies. Urolithin A has been shown to inhibit Mito-NLRP3-related signaling in macrophage and neuronal cell models in part by its mitophagy-activating effects because dysfunctional mitochondria are known NLRP3 activators [21]. A broad review conducted by Rakhra et al. found NLRP3 suppression to be a common response to polyphenol-microbiota-inflammation interactions across several classes of phenolic acids, but it has only limited support *in vivo* [21].

5.3. Mitochondrial dysfunction and mitophagy

Impaired mitophagy, failure to eliminate dysfunctional mitochondria drives accumulation of ROS and release of mitochondrial damage-associated molecular patterns (DAMPs), which in turn activate the NLRP3 inflammasome and perpetuate neuroinflammation. The ability of UA to induce potent mitophagy mediated

by PINK1/Parkin has been confirmed in several in vitro and in vivo experimental systems [15]. Makarov and Korkotian described UA as among the most mechanistically consistent nutritionally active inducers of mitophagy to date, and in Drosophila models, Asthana and Shravage [25,26] have shown that dietary interventions consisting of modulation of mitophagy could change phenotypes in Parkinson's disease, establishing a translational context for the mitophagy interventions.

5.4. Gut–brain axis: Indirect anti-inflammatory effects

Along with BBB-permeable metabolites, polyphenol catabolites could also act on the gut-brain axis in a series of indirect ways. The production of SCFAs by gut microbiota, specifically butyrate, regulates the maturation and activity of microglia by inhibiting histone deacetylase and altering the activity of signaling in the hypothalamic-pituitary axis [4]. Non-absorbed polyphenols have prebiotic-like effects on microbiome composition, selectively increasing anti-inflammatory taxa, including *Bifidobacterium* and *Akkermansia muciniphila*, and decreasing pro-inflammatory ones [27]. Such changes in composition favor the production of neuroprotective metabolites and inhibit gut-generated inflammatory signaling that can circulate throughout the body and affect neuroinflammatory tone [24]. Hong et al. identified the duality of the actions of tea polyphenol metabolites on neurological disorders, determining that both circulating metabolites and microbiome compositional remodeling contribute separately to brain protection, but the relative magnitude of these contributions in humans remains to be determined [8].

6. Precision nutrition implications

The inter-individual difference in the metabolism of dietary exposures to polyphenols is notable and constitutes one of the most important, yet often disregarded, aspects of the field. To be specific, the metabotype used in this review is the reproducible, individual-specific pattern of production of microbial metabolites in response to standardized exposure to polyphenols, not the number of polyphenols consumed per day (polyphenol intake) or the resultant, systemic concentration of the metabolite (circulating metabolite concentration). Iglesias-Aguirre et al. proposed a systematized definition of the concept of polyphenol metabotypes: equol-producing status and urolithin metabotype (metabotype 0, A, or B) were suggested as the most clinically relevant variables for stratification [19]. Patients with a non-equol-producing phenotype or a urolithin metabotype 0 profile (no production of urolithin) might obtain significantly less neuroprotective advantage of polyphenol-rich diets as compared to those possessing the necessary microbial communities [11].

This variability has direct implications for intervention design. Singh et al. conducted a human randomized control trial in which the direct supplementation of urolithin A, bypassing the gut microbial conversion completely, provided consistent plasma concentrations in a heterogeneous adult population, in contrast to the highly heterogeneous plasma concentrations attained following the same dosage of ellagitannin intake alone [11]. This result suggests that in low-conversion microbiomes of individuals, direct metabolite supplementation can be a more efficient approach compared to dietary enrichment of precursors. Jarrin-Orozco et al. found that baseline gut metabotype signatures correlated positively with quality of life in postmenopausal women after polyphenol exposure, in a randomized crossover trial, which suggests that metabotyping is a potentially useful stratification tool to predict intervention responsiveness [5]. Liu et al. defined precision approaches as the bridge between mechanistic discovery and population-level

implementation that they need, which, however, is especially true of the cognitively-targeted application of polyphenol research [28].

7. Limitations and future direction

A number of critical limitations limit the inferences that can be made based on the existing evidence base. Most of the mechanistic results are cell culture or animal-based, and the doses used in the preclinical trials are often higher than those that can be achieved by realistic dietary methods, so it is difficult to extrapolate them to human cognitive aging [24]. Parent polyphenol compounds have been much more extensively researched as compared to the circulating gut microbiota- derived metabolites, which are mechanistically more relevant species, and metabolite-specific human bioavailability data, which is particularly germane to phase II conjugates, are limited [29]. Most crucially, there is no direct human evidence of CNS penetration of these metabolites at nutritionally attainable concentrations, and the neuroinflammatory effects of these metabolites in cell models are not yet validated in human brain tissue or using studies of cerebrospinal fluid biomarkers. A number of structural barriers further help to broaden the translational discrepancy in preclinical mechanistic discoveries and human cognitive outcomes. Firstly, human intervention evidence regarding the polyphenol metabolites and cognitive endpoints is incredibly sparse: most of the existing trials tested surrogate biomarkers instead of validated cognitive outcomes, employed relatively short follow-ups, and were not designed to consider metabotype-stratified reactions. Second, there is a significant lack of certainty about dose equivalence between dietary exposure to polyphenols in a diet and direct supplementation of metabolites; the plasma concentrations that are obtained after food-based interventions are quite diverse and are typically lower than the concentrations used in preclinical mechanistic research. Third, inter-individual differences in gut metabotype, which are influenced by microbiome composition, age, sex, diet history, and host genetics, add a lot of noise to population-level analyses and can confound real treatment effects when analyzed unratified. Lastly, the cognitive outcome measures used in different studies are also heterogeneous, with short screening tools and elaborate neuropsychological batteries, which restrain comparability and preclude meta-analysis synthesis of metabolite-specific data, see **Table 2**.

Table 2. Representative studies on gut microbiota–derived polyphenol metabolites and cognitive or neurological outcomes

Author / Year	Model	Metabolite studied	Main findings	Key limitations
Chen et al., 2021 [17]	Animal (aging mice)	Urolithin B	Improved cognitive deficits; inhibited cytochrome C-mediated apoptosis; promoted neuronal survival via PI3K pathway	Animal model only; doses may exceed dietary relevance; no human cognitive data
Esselun et al., 2021 [15]	Cell (AD model)	Urolithin A	Normalized mitochondrial membrane potential; reduced ROS; enhanced PINK1/Parkin-mediated mitophagy markers in early AD cells	*In vitro* only; dose relevance to physiological plasma concentrations unclear
Madsen et al., 2024 [18]	Human microglial cells (*in vitro*)	Urolithin A	UA differentially regulated innate immune defense pathways and cellular metabolism vs. nicotinamide riboside; potential brain immune modulation	Cell model only; no in vivo CNS confirmation; mechanism not fully elucidated

Garay-Mayol et al., 2025 [13]	*In vitro* (BBB model + microglial cells)	Urolithins + phase II conjugates	Crossed *in vitro* BBB; exerted stimulus-dependent anti-inflammatory effects via NF-κB inhibition in human microglial cells	*In vitro* BBB model; complex metabolite mixture; in vivo BBB penetration not confirmed in humans
Domínguez-López et al., 2024 [20]	Human observational	Urinary phenolic metabolites (broad panel)	Higher urinary microbial phenolic metabolites associated with better frontal lobe cognitive performance scores	Cross-sectional; causality not established; parent compound vs. metabolite contribution not disaggregated
Godos et al., 2023 [29]	Systematic review / meta-analysis	Dietary (poly)phenols (parent compounds)	Consistent inverse association between polyphenol intake and cognitive decline across observational studies	Dietary intake assessed, not circulating metabolites; heterogeneity across studies; causality not inferable
Singh et al., 2021 [11]	Human RCT	Urolithin A (direct supplement)	Direct UA supplementation achieved consistent plasma levels across population regardless of gut microbiome variability; not achievable with ellagitannin diet alone	Short-term; cognitive outcomes not assessed; does not address dietary ellagitannin effects in high-converters
Jarrín-Orozco et al., 2025 [5]	Human RCT crossover	Gut metabolite profiles (metabotyping)	Polyphenol-related gut metabotype signatures positively correlated with quality-of-life outcomes in postmenopausal women	Female population only; quality-of-life measure not cognitive endpoint; generalizability uncertain

AD = Alzheimer's disease; BBB = blood–brain barrier; RCT = randomised controlled trial; ROS = reactive oxygen species; NF-κB = nuclear factor kappa-light-chain-enhancer of activated B cells.

The future research priority needs placebo-controlled intervention trials using well-characterized polyphenol metabolites with sensitive cognitive outcome measures; inclusion of baseline metabotyping to examine the different responses of subgroups; longitudinal biomarker studies of metabolite change with respect to cognitive aging; and mechanistic human studies involving neuroimaging or cerebrospinal fluid biomarkers. It will be critically important to establish dose-response between plasma concentrations of metabolites and cognitive outcomes, and standardize biomarker panels across studies to be able to translate the mechanistic evidence to actionable clinical advice.

8. Conclusion

The gut microbiota reshapes dietary polyphenols to produce a chemically distinct group of circulating metabolites, urolithins, equol, enterolignans, phenolic acids, and SCFAs, which are more systemically bioavailable than their dietary precursors and may have neurologically relevant effects, according to current preclinical evidence. Cell-based and animal experiments show that these metabolites have the potential to inhibit the important neuroinflammatory signaling pathways, such as NF-KB, NLRP3, and MAPK pathways, and trigger the mitophagy programs capable of suppressing the mitochondrial dysfunction typical of age-related neurodegeneration. These mechanistic findings are put into epidemiological context by human observational data to support associations between increased metabolite production and optimal cognitive performance [21]. Such associations are yet to be supported by sufficiently powered, metabolite-resolved intervention trials of validated cognitive outcomes in older adults.

Disclosure statement

The authors declare no conflict of interest.

References

[1] An L, Lu Q, Wang K, et al., 2023, Urolithins: A Prospective Alternative against Brain Aging. Nutrients, 15(18): 3884.

[2] Zafari R, Goudarzi N, Kamroo A, et al., 2025, The Effects of Polyphenols on Gut Microbial Metabolites and Composition in Neurodegenerative Diseases: A Systematic Review, Nutrition & Metabolism, 22(1):142.

[3] Luo L, 2025, Promoting Cognitive Health Through the Nexus of Gut Microbiota and Dietary Phytochemicals, Frontiers in Nutrition, 12, 1636131.

[4] Láng L, McArthur S., Lazar A, et al., 2024, Dietary (Poly) Phenols and the Gut-Brain Axis in Ageing, Nutrients,16 (10):1500.

[5] Jarrín-Orozco M, Romo-Vaquero M, Carrascosa C, et al., 2025, Polyphenol-Related Gut Metabotype Signatures Linked to Quality of Life in Postmenopausal Women: A Randomized, Placebo-Controlled Crossover Trial, Nutrients, 17(22): 3572.

[6] Liu S, Cheng L, Liu Y, et al., 2023, Relationship between Dietary Polyphenols and Gut Microbiota: New Clues to Improve Cognitive Disorders, Mood Disorders and Circadian Rhythms. Foods, 12(6): 1309.

[7] Zhang Q, Zhang W, Yuan X, et al., 2025, Urolithin A in Central Nervous System Disorders: Therapeutic Applications and Challenges. Biomedicines, 13(7): 1553.

[8] Hong M, Cheng L, Liu Y, et al., 2022, Mechanisms Underlying the Interaction Between Chronic Neurological Disorders and Microbial Metabolites via Tea Polyphenols Therapeutics. Frontiers in Microbiology, 13: 823902.

[9] Mahdi L, Graziani A, Baffy G, et al., 2025, Unlocking Polyphenol Efficacy: The Role of Gut Microbiota in Modulating Bioavailability and Health Effects. Nutrients, 17(17): 2793.

[10] Carecho R, Carregosa D, dos Santos C N, 2020, Low Molecular Weight (poly)Phenol Metabolites Across the Blood-Brain Barrier: The Underexplored Journey. Brain Plasticity, 6(2): 193-214.

[11] Singh A, D'Amico D, Andreux P A, et al., 2021, Direct Supplementation with Urolithin A Overcomes Limitations of Dietary Exposure and Gut Microbiome Variability in Healthy Adults to Achieve Consistent Levels Across the Population. European Journal of Clinical Nutrition, 76(2): 297-308.

[12] Wang W, Rangji C, Cairang N, et al, 2026, Urolithins: Promising Nutritional Interventions for Mild Cognitive Impairment. Journal of Functional Foods, 139: 107243.

[13] Garay-Mayol B, Giménez-Bastida J A, López-Cánovas D J, et al., 2025, Urolithins and Their Phase II Conjugates Cross the Blood-Brain Barrier and Exert a Stimulus-Dependent Anti-Inflammatory Effect on Microglial Cells by Inhibiting NF-κB Nuclear Translocation. Food & Function, 16(23): 9006-9021.

[14] Domínguez-López I, López-Yerena A, Vallverdú-Queralt A, et al., 2024, From the Gut to the Brain: The Long Journey of Phenolic Compounds with Neurocognitive Effects. Nutrition Reviews, 83(2): e533-e546.

[15] Esselun C, Theyssen E, Eckert G P, 2021, Effects of Urolithin A on Mitochondrial Parameters in a Cellular Model of Early Alzheimer Disease. International Journal of Molecular Sciences, 22(15): 8333.

[16] Pamoda D, Hone E, Khaira H, et al., 2021, Therapeutic Potential of Mitophagy-Inducing Microflora Metabolite, Urolithin A for Alzheimer's Disease. Nutrients, 13(11): 3744.

[17] Chen P, Chen F, Lei J, , et al., 2021, The Gut Microbiota Metabolite Urolithin B Improves Cognitive Deficits by Inhibiting Cyt C-Mediated Apoptosis and Promoting the Survival of Neurons Through the PI3K Pathway in Aging Mice. Frontiers in Pharmacology, 12: 768097.

[18] Madsen H B, Navarro C, Gasparini E, et al., 2024, Urolithin A and Nicotinamide Riboside Differentially Regulate Innate Immune Defenses and Metabolism in Human Microglial Cells. Frontiers in Aging Neuroscience, 16: 1503336.

[19] Iglesias-Aguirre C E, Cortés-Martín A, Ávila-Gálvez M Á, et al., 2021, Main Drivers of (Poly)phenol Effects on Human Health: Metabolite Production and/or Gut Microbiota-Associated Metabotypes? Food & Function, 12(21): 10324-10355.

[20] Domínguez-López I, Parilli-Moser I, Vallverdú-Queralt A, et al., 2024, Microbial Phenolic Metabolites Are Associated with Better Frontal Lobe Cognition. Food Science and Human Wellness, 13(6): 3266-3272.

[21] Rakhra G, Malhotra R, Prasad P, et al., 2026, Synergistic Effects of Polyphenols and Gut Microbiota-Derived Metabolites on Inflammation and Metabolic Syndrome: A Review. Molecular Nutrition & Food Research, 70(3): 70360.

[22] Connell E, Gall G L, Pontifex M G, et al., 2022, Microbial-Derived Metabolites as a Risk Factor of Age-Related Cognitive Decline and Dementia. Molecular Neurodegeneration, 17(1): 43.

[23] Ross F C, Mayer D E, Horn J, et al., 2024, Potential of Dietary Polyphenols for Protection from Age-Related Decline and Neurodegeneration: A Role for Gut Microbiota? Nutritional Neuroscience, 1-19.

[24] Sarubbo F, Moranta D, Tejada S, et al., 2023, Impact of Gut Microbiota in Brain Ageing: Polyphenols as Beneficial Modulators. Antioxidants, 12(4): 812.

[25] Makarov M & Korkotian E, 2023, Differential Role of Active Compounds in Mitophagy and Related Neurodegenerative Diseases. Toxins, 15(3): 202.

[26] Asthana J & Shravage B V, 2022, Exploring Therapeutic Potential of Mitophagy Modulators Using Drosophila Models of Parkinson's Disease. Frontiers in Aging Neuroscience, 14: 986849.

[27] Libriani S, Facchinetti G, Marti F, et al., 2026, The Association Between Gut Microbiota and Cognitive Decline: A Systematic Review of the Literature. Nutrition Research, 147: 16–31.

[28] Liu X, Alharbi A, Gibson R,et al., 2025, (Poly)phenol-Gut Microbiota Interactions and Their Impact on Human Health. Current Opinion in Clinical Nutrition & Metabolic Care, 28(4): 316–322.

[29] Godos J, Micek A, Mena P, et al., 2023, Dietary (Poly)phenols and Cognitive Decline: A Systematic Review and Meta-Analysis of Observational Studies. Molecular Nutrition & Food Research, 68(1): e2300472.

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Construction and Application of a Dual-qualified Faculty Training Content System Based on the COMET Competency Model under the Background of "New Medical Education"

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Abstract: *Objective*: To explore the construction of a "double-qualified" clinical nursing faculty training system based on the COMET (Competence Measurement) model under the "New Medical Science" background, and to evaluate its application effects on enhancing core teaching competence. *Methods*: Literature analysis and semi-structured interviews were conducted to identify preliminary training needs. A training system was subsequently developed using two rounds of Delphi expert consultations involving 15 experts. From January to December 2025, a specialized training program based on the COMET model was implemented among 110 clinical teaching supervisors and assistant supervisors in our hospital. The effects were evaluated using the Clinical Nursing Teacher Core Competence Scale and the Learning Satisfaction Scale. *Results*: After training, the total core teaching competence score of the faculty increased significantly from (60.84 ± 5.12) to (88.56 ± 3.45) ($p < 0.001$) The total learning satisfaction score of the participants rose from (85.56 ± 7.23) to (95.31 ± 5.64) ($p < 0.001$). Differences in scores across all dimensions were statistically significant (all $p < 0.05$). *Conclusion*: The "double-qualified" faculty training content system based on the COMET model is scientific and effective. It significantly enhances the core competence of clinical nursing teachers and learner satisfaction, providing a standardized and practical reference for faculty development under the "New Medical Science" paradigm.

Keywords: New medical science; COMET model; "Double-qualified" teachers; Faculty training; Nursing education

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1. Introduction

In the context of the deepening construction of "new medicine", medical education is undergoing a

comprehensive transformation from concept to model. New medicine emphasizes the integration of multiple disciplines, technological innovation and clinical practice, and puts forward higher requirements for the cultivation of medical talents [1]. As an important part of medical education, nursing education urgently needs to build a "dual-qualified" teaching staff that is proficient in both clinical practice and teaching innovation [2–4]. However, at present, clinical nursing teachers in China still have problems such as insufficient systematic training and imperfect evaluation mechanisms in terms of educational and teaching abilities, which restrict the quality of cultivation of high-quality nursing talents. COMET Vocational competency model, as a systematic and multi-dimensional competency assessment tool, has been widely applied in the field of vocational education in many countries. The model constructs a progressive competency development path from "nominal competency", "functional competency" to "process competency" and "overall design competency", providing a scientific basis for the development and evaluation of teachers' professional competence [5–8]. Therefore, based on the development needs of new medicine and in combination with the COMET competency model, this study aims to construct a "dual-qualified" teacher training content system for clinical nursing teachers and verify its application effect through empirical research, with the aim of providing theoretical support and practical paths for improving the overall teaching ability of the clinical nursing teaching staff and promoting the high-quality development of nursing education.

2. Objects and methods

2.1. Research object

During the period from January 2025 to December 2025, the nursing Department of our hospital organized the selection of 1–2 nurses who met the criteria from all clinical departments of the hospital as training subjects, totaling 110.

2.1.1. Inclusion criteria

(1) On-the-job nurses who have obtained nurse practice registration qualifications;
(2) Firm professional ideology, love for nursing education work, and good communication skills;
(3) Those with an associate degree should have more than 5 years of clinical experience, and those with a bachelor's degree should have more than 3 years of clinical experience;
(4) Have at least 2 years of clinical nursing teaching experience;
(5) Voluntary participation in this study.

2.1.2. Exclusion criteria

Those who are unable to complete the entire training due to leave, further education, etc.

2.2. Methods

2.2.1. Construction of training system

First, through literature analysis and semi-structured interviews with vocational college nursing teachers, clinical nursing experts, interns and newly recruited nurses in Sichuan Province, the demand for the training of "dual-qualified" teachers were initially understood. Based on this, a preliminary framework of the training content system was drawn up. Then, using the Delphi expert consultation method, two rounds of inquiries were conducted with 15 experts who had more than 10 years of experience in clinical nursing, nursing

education and management, ultimately establishing a dual-qualified teacher training content system based on the COMET competency model in the context of "new medicine".

2.2.2. Implementation of the training

Apply the constructed training system to the research subjects. The training was conducted in two phases:

(1) During the theoretical training period, full-time intensive training was adopted, and the trainees were divided into five groups according to the departments they were in: internal medicine, surgery, gynecology and pediatrics, critical care, and special departments. The training focused on nursing education theory and teaching methods, using a combination of theoretical lectures, group discussions, case studies, and teaching demonstrations and counter-demonstrations.

(2) During the practical training period, on-the-job teaching practice is adopted, and trainees carry out clinical teaching work for newly recruited nurses and interns. The training team conducts monthly quality supervision and feedback guidance on teaching.

2.3. Observe indicators

Evaluate the following indicators before and after the training:

(1) Instructor core competence

The instructor core competence evaluation form (22 items, Likert 5-level score) compiled by Pan Jingjing was used for assessment. The higher the score, the stronger the core competence.

(2) Learning satisfaction

The learning satisfaction scale revised by Wang Pengju (23 items, Likert 5-level score) was used for assessment. The higher the score, the more satisfied the students were with the teaching quality of their instructors.

2.4. Statistical methods

Data analysis was performed using SPSS 25.0 software. Measurement data were described as mean ± standard deviation, and paired *t*-tests were used to compare core competence scores before and after training; Count data were described in terms of frequency and percentage. $p < 0.05$ was considered statistically significant.

3. Fruiting

3.1. Comparison before and after core competence training for instructors

Compared with before the training, the total score of core competence and the scores of each dimension of the instructors after the training were higher than before the training, and the difference was statistically significant ($p < 0.05$). The specific data are shown in **Table 1**.

Table 1. Comparison of core competence scores of instructors before and after training (n = 110)

Dimensions/Entries	Before training	After the training	*t*	*p*
Total score of core competencies in teaching	60.84 ± 5.12	88.56 ± 3.45	-43.215	< 0.001
Guide the analysis of cases/handling of emergencies	4.12 ± 0.78	4.95 ± 0.22	-10.152	< 0.001
Use case/scenario simulation teaching	4.05 ± 0.82	4.88 ± 0.35	-9.214	< 0.001
Systematically explain your expertise	4.32 ± 0.65	4.92 ± 0.28	-8.432	< 0.001

3.2. Comparison of learning satisfaction before and after training

After the training, the total score and the scores of each dimension of the trainees' learning satisfaction with the teaching of the instructors were higher than before the training, and the difference was statistically significant ($p < 0.05$). The specific data are shown in **Table 2**.

Table 2. Comparison of trainees' learning satisfaction scores before and after training (n = 110)

Time	Total score	Teaching attitude	Teaching content	Teaching methods	Teaching effectiveness	Interaction between teachers and students
Before training	85.56 ± 7.23	18.21 ± 1.95	17.05 ± 2.11	16.78 ± 2.20	16.92 ± 2.35	16.60 ± 2.15
After training	95.31 ± 5.64	19.85 ± 1.42	18.76 ± 1.58	18.45 ± 1.63	18.90 ± 1.52	19.35 ± 1.49
t value	-7.215	-4.562	-4.123	-4.008	-4.789	-6.987
p value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

4. Discussion

4.1. COMET model-oriented training system breaks the "island effect" in the transformation of "dual-qualified" teachers' capabilities

The results of this study show that the total score of core competence in teaching and the scores of each dimension have significantly increased after training ($p < 0.001$). This indicates that the training system based on the COMET model has significant efficacy in promoting the transformation of clinical nurses to "dual-qualified" talents. "New medicine" demands that nursing teachers shift from "single skill imparting" to "comprehensive professional quality cultivation", while traditional training often falls into the "island effect" of disconnection between theory and practice [9–11]. The core value of the COMET model lies in its "professional mobility" orientation. By systematically deconstructing dimensions such as "environment, task, professional identity," the system leads teaching group leaders to focus not only on the standardization of operational steps, but also on the clinical thinking and humanistic care behind the operations [12]. This paradigm shift from "mechanical teaching" to "contextualized guidance" precisely addresses the pain points in the capacity building of dual-qualified teachers and achieves a deep logical integration of clinical specialty capabilities and medical teaching capabilities.

4.2. Precisely empower teaching implementation and evaluation capabilities to drive the connotative development of clinical nursing teaching

In this study, the score improvement in the dimension of teaching implementation and evaluation ability was the most significant. This is due to the deep application of "behavior-oriented teaching" in the training content system. In critical care Settings, there is a high degree of uncertainty in the teaching context [13–16]. This system, in the form of workshops, introduces the "open-ended task design" in COMET assessment to encourage teachers to exercise their ability to guide students to independently identify and solve problems in complex case analyses. In addition, the improvement in evaluation ability marks a leap for teachers from the concept of "outcome assessment" to "formative assessment". Through the COMET assessment program, teachers can more acutely perceive subtle changes in students' professional identity and professional

responsibility. This "evaluation-driven teaching, teaching and evaluation integrated" mechanism not only standardizes the clinical teaching process, but also enhances the rigor and scientific nature of clinical teaching in terms of connotation, providing a solid faculty guarantee for cultivating high-quality nursing talents that meet the standards of new medicine.

4.3. The deepening of professional identity is the core path to enhancing the intrinsic motivation of "dual-qualified" teachers

The results of the satisfaction survey show that teachers have a qualitative leap in their sense of professional belonging and satisfaction with their teaching work after training. In previous clinical practice, teaching group leaders often faced "role conflicts" between clinical tasks and teaching responsibilities. This training system helps to reconstruct professional identity by clarifying the professional competence profile of "dual-qualified" teachers. When teachers realize that mentoring is not just an administrative task but an advanced manifestation of their specialized professional competence, their initiative for professional development is effectively activated. This shift from being driven by external systems to being driven by internal values is key to building a sustainable clinical teaching echelon [17]. The training system constructed in this study not only provides methodological support, but also offers a replicable practical model for the standardization and professionalization of the clinical teaching staff in regional medical centers in the context of "new medicine".

5. Conclusion

This study also has certain limitations. First, the subjects were all from the same hospital, and the sample size was limited. Future multi-center, large-sample studies are needed to further verify the universality of the training system. Secondly, the long-term follow-up assessment of the training effect is still insufficient, and its long-term impact on the quality of clinical nursing teaching and patient outcomes needs to be further explored. Follow-up studies could extend the follow-up period and attempt to incorporate patient health indicators into the comprehensive evaluation system, thereby more comprehensively assessing the long-term benefits and deep value of the training system.

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References

[1] Yan H, 2023, An Exploratory Study on the Core Competence of Undergraduate Nursing Professionals in the Context of New Medicine Based on Healthy China, thesis, Nanchang University.

[2] Ma J, 2025, Pathways for Improving Public Health Literacy of Medical Students in the Context of New Medicine.

Chinese Journal of School Health, 46(12): 1827–1828.

[3] Tan F, Mei B, Li L, et al., 2020, Modern Medical Development 4.0: The Impact and Implications of the Industrial Revolution on Medical Development. Science China: Life Sciences, 55(7): 1464–1475.

[4] Hu S, 2026, Some Thoughts on Formulating the 15th Five-Year Plan for Health and Wellness Development. Health Economics Research, 43(1): 1–7.

[5] Liu D, Feng S, Gao J, 2025, Research on the Professional Ability Development Path of "Dual-Type" Teachers in Applied Colleges and Universities. Heilongjiang Researches on Higher Education, 2025(10): 128–136.

[6] Li M, Xu H, 2017, Research on Nursing Vocational Education in the United States. Modern Vocational Education, 2017(3): 18–19.

[7] Wang X, 2018, The Current Situation of Nursing in German Vocational Education and Its Implications for the Reform of On-site Teaching. Chinese Nursing Research, 32(20): 3301–3303.

[8] Lu X, Shi Y, 2017, The Development Trends and Implications of Teacher Team Building in Japan's Vocational Education. Educational Teaching Forum, 2017(27): 33–34.

[9] Huang R, Liu J, 2006, Reform and Development of Vocational Education in Denmark. Vocational Education Forum, 2006(19): 58–61.

[10] Kjersdam E, 1995, The Forming and Development of the Vocational Education in Denmark. Aalborg: Aalborg University Press, 35–82.

[11] He X, Xiao R, Zeng D, 2023, Research on the Construction of Professional Standards for "Dual-Qualified" Teachers in Vocational Colleges Based on COMET Competency Model. Adult Education, 43(8): 79–85.

[12] Zhao Z, Gao F, 2022, Theory and Practice of Comprehensive Vocational Ability Assessment (COMET). Chinese Vocational and Technical Education, 2022(8): 5–11.

[13] Rauner F, 2009, Messen Berufficher Kompetenzen. Munster: LIT.

[14] Pan H, Xu H, Yang H, 2026, The Connotation, Composition and Optimization Path of Talent Matching Mechanism in Vocational Education. Chinese Vocational and Technical Education, 2026(2): 58–66 + 78.

[15] Liu C, Wang X, 2024, From "Doing Things" to "Doing Things Well": Reflections and Prospects on Technology-Based Vocational Competence Assessment. Vocational Education Forum, 40(10): 106–113.

[16] Ursel H, 2015, Me Siento Bien en Mi Centro de Formacion—I Feel Good at My Training Institution: Results of an International Competence Assessment in Nursing. In Architectures for Apprenticeship—Achieving Economic and Social Goals, 100–104.

[17] Han J, Zhang X, Shen X, et al., 2022, Analysis of Factors Influencing the Competency of Clinical Nursing Teachers. Chinese Journal of Occupational Medicine, 49(2): 176–179.

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Curriculum Ideological and Political Design and Practice of Nurses' Humanistic Accomplishment Under the Background of Population Aging–Taking "Therapeutic Nurse-Patient Communication" as an Example

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Abstract: *Objective*: To explore the curriculum ideological and political design and practice of nurses' humanistic accomplishment under the background of population aging. *Methods*: Two grades of nursing students (geriatric nursing direction) from a vocational college in Hunan were selected as subjects. A total of 190 students of Grade 2024 were set as the experimental group, and 199 students of Grade 2023 as the control group. Taking therapeutic nurse-patient communication in the course Nurses' Humanistic Accomplishment as an example, the control group received conventional online-offline blended teaching. The experimental group was deeply integrated with ideological and political elements, and the "Four Thinking" education path–Guide Thinking, Integrate Thinking, Reflect Thinking, Practice Thinking was implemented, assisted by intelligent technology. Both groups adopted the BOPPPS teaching model. After the course, comprehensive course scores and the scores of the Communication Ability Scale for Nursing Students with the Elderly were compared between the two groups. *Results*: Compared with the control group, the comprehensive course scores and the communication ability scores with the elderly in the experimental group were significantly higher ($p < 0.05$). *Conclusion*: The implementation of curriculum ideology and politics in the course of Nurses' Humanistic Accomplishment can effectively improve academic performance and teaching effect of nursing students, and highlight value guidance.

Keywords: Aging; The elderly; Curriculum ideology and politics; Teaching reform; Nursing education

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1. Introduction

By the end of 2024, preliminary statistics showed that the dependency ratio of the population aged 65 and

over was 22.8% [1]. Elderly patients are far more dependent and sensitive to nursing services than other groups due to declined physiological functions, coexistence of multiple chronic diseases, and complex psychosocial needs [2–4]. This means that modern nurses need not only exquisite professional skills, but also profound humanistic accomplishment, including understanding of life dignity, empathy for patients' emotions, good communication skills, and noble professional ethics.

Based on the dual background of population aging and the requirements of curriculum ideology and politics, this study took the course Nurses' Humanistic Accomplishment as an example to highlight value guidance while emphasizing professional knowledge teaching.

2. Objects and methods

2.1. Research objects

A total of 190 nursing students (geriatric nursing direction) of Grade 2024 from a vocational college in Hunan were selected as the experimental group, and 199 students of Grade 2023 as the control group.

2.2. Teaching team

The teaching team consisted of 6 members: 4 full-time teachers and 2 part-time industrial teachers; 2 with the title of associate professor / deputy chief nurse, and 4 with lecturer / supervisor nurse, forming a school-enterprise dual teaching team.

2.3. Teaching content

Both groups received the course Nurses' Humanistic Accomplishment in the first semester. Based on the teaching syllabus, the team systematically optimized the teaching content (Table 1). Regular teaching seminars and collective lesson preparation were carried out.

Table 1. Teaching content

Module	Item	Teaching form	Core ideological and political elements
I. First entry into hospital	1. Nurses' appearance and manners 2. Common postures in nursing work	Theory + Practice	Professional belief
	3. Nursing humanistic care 4. Outpatient service etiquette norms	Theory + Practice	Humanistic care
II. Healing companionship	1. Inpatient service etiquette norms	Practice	Humanistic care
	2. Nurse-patient relationship	Theory	Dedication
	3. Rights and obligations of nurses	Theory	Dedication
	4. Rights and obligations of patients	Theory	Respect for life
	5. Basic theories of nursing ethics	Theory	Critical thinking
	6. Nursing ethical decision-making	Theory	Critical thinking
	7. Nurse-patient communication skills	Theory + Practice	Critical thinking
	8. Therapeutic nurse-patient communication	Practice	Humanistic care
III. Discharge farewell	1. Discharge guidance	Practice	—
	2. Death education	Theory	Respect for life

2.4. Teaching methods

2.4.1. Control group

Taking Item 8 "Therapeutic Nurse-Patient Communication" in the Healing Companionship module as an example, the control group adopted a conventional online-offline blended theory-practice integrated teaching mode. Theoretical learning focused on classroom lectures, and practical training focused on analyzing and discussing typical cases. Students practiced independently after teachers' demonstration.

2.4.2. Experimental group

On the basis of consistent teaching content with the control group, the experimental group, under the background of population aging, implemented the "Four Thinking" education path: Guide Thinking, Integrate Thinking, Reflect Thinking, Practice Thinking, assisted by intelligent technology. The specific teaching process is shown in Table 2.

Table 2. Curriculum ideological and political design of therapeutic nurse-patient communication in the experimental group

Teaching process	Teaching activities	Entry point of ideological and political elements	Ideological and political theme
Pre-class Guidance	Release pre-class tasks on the Chaoxing Learning Platform: review nurse-patient communication skills; watch the CCTV documentary *The Aging China* and government documents; answer questions and complete pre-tests	*The Aging China*, *14th Five-Year Plan for Healthy Aging*	People-oriented, care for the elderly
In-class Introduction	Play a real clinical video of nurse-patient dispute caused by poor communication; group discussion on consequences and barriers; interactive questioning	*Essential Prescriptions for Emergency* by Sun Simiao: understanding of elderly emotions	Benevolent medical ethics, respect for the elderly
In-class Support	Theoretical teaching; case discussion on empty-nesters; scenario simulation; in-class summary and sharing	Empty-nester care, volunteer service stories	Filial piety culture, humanistic care spirit
After-class Expansion	Social practice in nursing homes; record "most touching communication moment" and upload to the platform	Volunteer service in elderly care institutions	Apply what you have learned, dedication spirit

2.5. Course implementation

2.5.1. Implementation of the BOPPPS teaching model

Both groups adopted the student-centered BOPPPS model (Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, Summary) based on Bloom's taxonomy of educational objectives, relying on the Chaoxing Learning Platform to integrate online and offline teaching.

2.5.2. Evaluation of teaching effect

(1) Course score

A comprehensive evaluation system was adopted: process evaluation (40%), summative evaluation (50%), and value-added evaluation (10%). Evaluation included online preview, pre-test, data collection, attendance, class participation, homework, and theoretical and practical tests.

(2) Communication ability of nursing students with the elderly

The Self-rating Scale of Communication Ability for Nursing Students with the Elderly compiled by Wang et al. was used, with a Cronbach's α coefficient of 0.869. The scale included 21 items in 4

dimensions [5].

2.5.3. Statistical methods

SPSS 28.0 was used for statistical analysis. Quantitative data conforming to normal distribution were expressed as mean ± standard deviation ($\overline{x}$ ± s), and the t-test was used for comparison between groups. Qualitative data were expressed as frequency and percentage [n(%)], and the χ^2 test was used. $p < 0.05$ was considered statistically significant [6,7].

3. Results

3.1. Comparison of general data

There were no significant differences in gender, ethnicity, family location, only-child status, or annual family income between the two groups ($p > 0.05$), indicating comparability [8]. (Table 3).

Table 3. Comparison of general information of two groups of nursing students

Item	Category	Test Group (n = 190)	Control group (n = 199)	χ^2	*p*
Gender	Male	28 (14.74%)	27 (13.57%)	0.109	0.931
	Female	162 (82.26%)	172 (86.43%)		
Ethnicity	Han	157 (82.63%)	152 (76.38%)	2.324	0.127
	Others	33 (17.3%)	47 (23.62%)		
Place of residence	Urban	52 (27.37%)	55 (27.64%)	0.004	0.953
	Rural	138 (72.63%)	144 (72.36%)		
Only child	Yes	109 (57.37%)	114 (57.29%)	0.146	0.704
	No	81 (42.63%)	85 (42.71%)		
Annual household income	Below ¥50k	98 (51.58%)	109 (54.77%)	0.845	0.839
	¥50k to ¥100k	68 (35.79%)	68 (34.17%)		
	¥100k to ¥150k	12 (6.32%)	13 (6.53%)		
	Above ¥150k	12 (6.32%)	9 (4.5%)		

3.2. Comparison of course scores

The comprehensive course score of the experimental group was (84.81 ± 4.15), and that of the control group was (81.40 ± 4.06). The difference was statistically significant ($p < 0.05$) [9].

3.3. Comparison of communication ability with the elderly

The scores of emotional supports, active contact, careful arrangement, and total score in the experimental group were higher than those in the control group ($p < 0.05$) [10]. There was no significant difference in information transmission between the two groups ($p > 0.05$) (Table 4).

Table 4. Comparison of communication ability scores with the elderly ($\overline{x}$ ± s) unit: score

Group	Sample size	Dimension			
		Emotional support	Active contact	Information transmission	Meticulous arrangement
Test group	190	37.09 ± 4.96	30.38 ± 3.68	8.72 ± 2.62	8.11 ± 1.40

Control group	190	35.39 ± 4.88	29.06 ± 3.70	9.18 ± 2.23	7.68 ± 1.29
t value		3.403	3.537	-1.857	3.136
p		< 0.001	< 0.001	0.064	0.002

4. Discussion

4.1. Curriculum ideology and politics improves academic performance

The integration of intelligent technology and the "Four Thinking" path into Nurses' Humanistic Accomplishment effectively improved the comprehensive course scores of nursing students.

4.2. Curriculum ideology and politics enhances communication ability with the elderly

The experimental group scored higher in emotional support, active contact, and careful arrangement. The BOPPPS model combined with ideological and political design helped students transform values into professional abilities. Intelligent technology enhanced emotional resonance with the elderly. The non-significant difference in information transmission may be due to basic mastery in traditional teaching.

4.2.1. Limitations

The blended teaching in the control group also included value guidance, which may weaken inter-group differences. There was no long-term follow-up of clinical behavior and value stability.

5. Conclusion

Future research can be deepened in three aspects: expanding to different majors and colleges for verification; tracking long-term effects on professional attitude and behavior; and exploring the integration model and evaluation system of intelligent technology and ideological and political education to improve nursing talent training programs.

Disclosure statement

The authors declare no conflict of interest.

References

[1] The Chinese Government, 2022, National Aging Development Bulletin 2021, visited on 2026-04-02, https://www.gov.cn/xinwen/2022-10/26/content_5721786.htm.

[2] Sharkiya S, 2023, Impact of Healthcare Service Quality on Older People's Satisfaction at Geriatric Medical Centers: A Rapid Review. Journal of Public Health in Africa, 14(8): 2685.

[3] Huo S, Li Q, Jian W, 2024, Investigation on Long-Term Care Service Utilization Among Elderly Receiving Institutional and Home Care. Chinese Nursing Management, 24(11): 1646–1650.

[4] Guo X, Zhu K, Huang X, et al., 2024, Latent Profile Analysis of Active Aging and Nursing Needs of Community-Dwelling Elderly. Chinese Journal of Nursing, 59(16): 2014–2020.

[5] Wang S, Fang X, Qin S, et al., 2024, Development and Psychometric Testing of the Self-Rating Scale of

Communication Ability for Nursing Students with the Elderly. Chinese Nursing Research, 38(16): 2821–2826.

[6] Deng J, 2025, Application of Scenario Teaching Based on AIDET Communication Model in Geriatric Nursing Needs Assessment Training, thesis, Nanchang University.

[7] Yao Y, 2025, Application of Humanism-Based "7E" Teaching Model in Clinical Nursing Teaching, thesis, Anhui Medical University.

[8] Huang Z, Liu Q, Hu C, et al., 2025, Development and Validation of the Knowledge-Attitude-Practice Questionnaire on Advance Care Planning Among Oncology Healthcare Workers. Journal of Bengbu Medical College, 50(7): 935–941.

[9] Wang S, Fang X, Qin S, et al., 2024, Development and Psychometric Testing of the Self-Rating Scale of Communication Ability for Nursing Students with the Elderly. Chinese Nursing Research, 38(16): 2821–2826.

[10] Zhang S, Nie A, Cai M, et al., 2025, Application of Integrated Teaching Method Integrated with Curriculum Ideology and Politics in Pre-Triage Teaching for Intern Nursing Students. Health Vocational Education, 43(13): 79–82.

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Research on Optimization Strategies for Family Rehabilitation Skills Training for Children with Cerebral Palsy under the "Internet +" Background

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Abstract: Rehabilitation treatment for children with cerebral palsy faces systemic challenges, including uneven distribution of medical resources concentrated in large cities, high long-term treatment costs imposing heavy financial burdens on families, and weak family support systems making sustained rehabilitation training difficult. This study proposes an optimized path for Internet-enabled family rehabilitation skills training. Through information technologies such as building a digital curriculum system and a remote guidance platform, it integrates resources from all parties to construct a three-level linked rehabilitation ecosystem of "hospital–community–family". Combining online learning with offline practice, the path systematically carries out training integrating theoretical explanation and operational demonstration. It aims to continuously strengthen parents' mastery of cerebral palsy rehabilitation knowledge, effectively improve their rehabilitation skills and professional quality, and provide timely and long-term psychological support and health education for families through online communities and psychological service modules. Ultimately, it promotes continuous optimization of family rehabilitation effects and substantial improvement in the quality of life of children.

Keywords: Internet +; Children with cerebral palsy; Family rehabilitation

Online publication: May 31, 2026

1. Introduction

Pediatric cerebral palsy is a common neurodevelopmental disorder that affects children's motor, cognitive, and language development. Currently, there is no effective cure for pediatric cerebral palsy worldwide, and rehabilitation treatment is an important way to improve children's functions, enhance their self-care ability and social participation [1]. However, traditional rehabilitation usually requires professional physicians or therapists in medical institutions, which generally has problems such as high service costs, long treatment cycles, and uneven distribution of high-quality resources. It not only brings heavy economic pressure to

children's families but also constitutes a sustained burden in time, energy and psychology, which has become an important factor affecting the universality and sustainability of rehabilitation for children with cerebral palsy.

With the increasing maturity of "Internet +" technology and its in-depth integration and wide application in the medical and health field, it provides innovative ideas and technical empowerment to solve these problems. Therefore, this study aims to explore how to systematically use Internet technology to optimize the practical path of family rehabilitation skills training for children with cerebral palsy. It focuses on exploring systematic, standardized and personalized rehabilitation skills training for parents through modes such as remote real-time guidance, structured online courses, virtual simulation training and intelligent feedback systems, as well as providing continuous professional support and dynamic tracking. The study expects to comprehensively improve families' care ability and the scientificity of rehabilitation management by building a "hospital–community–family" linked rehabilitation ecosystem, so as to achieve the overall goals of improving rehabilitation effects, reducing family and social burdens, and enabling more children to obtain effective rehabilitation support.

2. Current situation and existing problems of rehabilitation treatment for children with cerebral palsy

There are about 6 million cerebral palsy patients in China, with an annual increase of 40,000 to 50,000 [2]. The prevalence of cerebral palsy among children aged 0–6 is 0.23–0.246%, forming a large and growing group. The disease is mainly manifested as dyskinesia, with or without sensory, perceptual and intellectual defects, and is the most common cause of physical disability in children [3–5]. It not only seriously affects children's own growth and future social integration but also makes their families bear long-term heavy care burdens and mental pressure, becoming an urgent public health and social problem.

2.1. Insufficient and unbalanced rehabilitation medical resources, shortage of professional talents

The rehabilitation intervention system for children with cerebral palsy in China has problems of weak foundation and unbalanced development. From the supply side, rehabilitation medical resources are generally scarce. Data show that the human resources of rehabilitation therapists in China are generally scarce and unevenly distributed. According to the *China Health Statistics Yearbook 2023*, the ratio of rehabilitation therapists in China was about 4.57 per 100,000 population in 2022, a significant increase from 1.03 per 100,000 population calculated by Ren Yanping et al. in 2014 [6]. However, there is still a significant gap compared with the target of 12 per 100,000 population by 2025 proposed in the *Opinions on Accelerating the Development of Rehabilitation Medical Work* and the level of more than 30 per 100,000 population in developed countries. Among them, professional talents specializing in children, especially proficient in cerebral palsy rehabilitation assessment and treatment, are even scarcer. Existing practitioners generally have problems such as shallow professional qualifications, insufficient systematic training and limited clinical experience, which are difficult to meet the refined and individualized requirements of cerebral palsy rehabilitation.

More prominent is the structural contradiction in resource distribution. High-quality rehabilitation institutions, experts and technical equipment are relatively concentrated in large medical institutions in first-

and second-tier cities, while rehabilitation services are less accessible in vast rural areas, small and medium-sized cities and economically underdeveloped areas. This significant gap between urban and rural areas and regions leads a large number of children's families to travel to other places for medical treatment, further increasing time, energy and economic costs [7].

2.2. Long-term rehabilitation highlights economic pressure, gaps in the existing security system

Rehabilitation of cerebral palsy is essentially a long-term, even lifelong process throughout the entire growth and development cycle of children. Short-term and intermittent inpatient treatment is difficult to achieve and consolidate substantial functional improvement, making rehabilitation treatment characterized by continuous investment. However, limited by the current insufficient accessibility of rehabilitation resources and widespread family economic pressure, only a few children can receive early, standardized and uninterrupted institutional rehabilitation at present, and most children are actually in a home state lacking systematic professional support for a long time [8]. Ding Yiming et al. pointed out in a representative national multi-center study (covering 12 provinces) that the average annual direct economic burden of families with children with cerebral palsy is heavy, with a median of 40% of the family's annual income, and this proportion even exceeds 100% in some families, with rehabilitation treatment costs being the main component [9]. This sustained high economic factor increases the risk of "poverty due to illness" and "return to poverty due to illness" for families with children with cerebral palsy, and becomes the main reason for families to interrupt or abandon treatment [10].

This not only means that children lose precious opportunities for functional improvement but also causes losses in previous medical investment, and affects the overall rehabilitation effect from a social perspective. Therefore, exploring and establishing a sustainable service model that can not only guarantee rehabilitation effects but also effectively reduce long-term economic costs and improve the efficiency of public fund use has certain practical significance.

3. Analysis of family rehabilitation treatment needs and pain points

Many studies have shown that on the basis of rehabilitation treatment in medical institutions, strengthening family rehabilitation training plays an important role in the rehabilitation of pediatric cerebral palsy [11,12]. Through active and correct daily care and family rehabilitation training, parents can help children with cerebral palsy obtain partial functional recovery and self-care in daily life, reduce complications, and significantly reduce rehabilitation costs, relieving burdens for families and society. Therefore, family rehabilitation has now become an important part of the overall rehabilitation medical service for children.

A questionnaire survey of children's families found that 87.5% of parents believed that hospital rehabilitation had problems such as limited medical resources, long waiting times and high rehabilitation costs; 85.3% of parents were willing to carry out family rehabilitation training for their children; 74.3% of parents could insist on daily family rehabilitation training for their children for about half an hour to one hour; 81.2% of parents hoped to receive comprehensive family rehabilitation support such as rehabilitation training and real-time guidance.

The existence of this contradiction shows the importance of developing an innovative rehabilitation service model. In recent years, the rise of tele-rehabilitation models based on information technology has

provided new methods to solve the above problems. For example, Du Yanxuan et al. pointed out that tele-rehabilitation technology can break through geographical and time restrictions, enabling rehabilitation experts to conduct remote assessment, supervision and real-time feedback on training in the home environment, effectively improving the standardization and sustainability of family rehabilitation, thus forming an efficient rehabilitation closed loop of "professionals–parents–children" [11,12]. These explorations show that deeply integrating digital tools with traditional rehabilitation to build a professional ecosystem that supports, trains and connects families is an important development direction to make up for the shortcomings of the current service system and respond to the core demands of families.

4. Internet + family rehabilitation skills training path for children with cerebral palsy

As the most familiar and reassuring living space for children with cerebral palsy, the family is not only the core place for emotional support but also the best practical base to achieve rehabilitation goals. The advantage of family rehabilitation lies in its high personalization and contextualization. Family rehabilitation carried out under the continuous company and professional guidance of family members can design and implement the most practical intervention strategies according to children's specific functional disorders and family living environments, naturally integrating treatment into children's daily activities, from dressing and eating to daily walking. This life-oriented rehabilitation model can more effectively improve children's adaptability and independent living skills, thus promoting the transfer and consolidation of rehabilitation skills in real life [13].

Therefore, with the development of modern information technology and the popularization of electronic devices such as computers and mobile phones, it is of great significance to use Internet+ technology to carry out online + offline theoretical + practical training, strengthen parents' learning of cerebral palsy rehabilitation knowledge, improve their rehabilitation skills and professional literacy, and have rehabilitation therapists provide regular guidance, training and evaluation, and adjust training plans when necessary to improve the effect of family rehabilitation. The core of this integrated model is to break the time and space barriers of traditional rehabilitation services, extend professional resources to family scenarios through digital means, and build a continuous, dynamic and accessible support network, thus significantly enhancing the standardization, scientificity and sustainability of family rehabilitation.

4.1. Formulate online rehabilitation courses

Make full use of Internet + technology to systematically and modularly integrate family-applicable rehabilitation techniques into a series of teaching short videos with clear themes, clear steps and appropriate duration. The curriculum content should fully cover key areas of cerebral palsy rehabilitation, specifically including: occupational therapy training, such as activities of daily living training (correct sitting and standing posture adjustment, assisted eating skills, safe bathing methods, adaptive dressing training), game interaction training and crawling guidance; motor function training, such as promoting head and neck control, independent turning over, sitting balance, standing preparation and walking training, as well as sensory integration training; speech function training, such as oral muscle function exercise, auditory recognition games, articulation practice and oral proprioceptive stimulation; cognitive function training, covering

enlightenment of digital and spatial concepts, improvement of basic cognitive abilities such as attention and memory, as well as simple logical reasoning and item classification strategies. The curriculum system should establish a scientific advanced path, facilitating parents to learn and practice step by step according to the assessment results and rehabilitation stages.

4.2. Build community rehabilitation gyms

As an authoritative rehabilitation diagnosis and treatment institution, hospitals can provide professional medical services, but generally face practical dilemmas such as tight rehabilitation beds, limited therapist human resources and high long-term rehabilitation costs, which are difficult to meet the high-frequency and long-term rehabilitation needs of children. Community rehabilitation gyms can serve as an important supplement and extension of professional hospital treatment, building a comprehensive service model of "precision treatment in hospitals, continuous rehabilitation in communities and families". This can effectively alleviate the pressure on public medical resources, reduce family economic and time costs, and make rehabilitation services more accessible.

Through the three-dimensional linkage of "hospital–community rehabilitation gym–family", a three-dimensional and closed-loop rehabilitation support ecosystem is built. It can not only provide children with high-frequency, low-cost and nearby training opportunities but also effectively reduce their long-term social isolation at home, promoting the construction of an inclusive and supportive community environment.

4.3. Construct an internet + comprehensive rehabilitation support system

First, use online media such as WeChat official accounts, social media, video accounts and exclusive mini-programs to carry out expert live Q&A, special online lectures, series of micro-lessons and online guidance to achieve efficient and convenient knowledge dissemination. Timely collect user feedback through the background to dynamically optimize, accurately push and targeted adjust the online course package, and even prescribe customized "video prescriptions" for individual children and provide personalized family rehabilitation plans.

Second, rely on online platforms to provide e-commerce shopping guides, online leasing or second-hand replacement information services for small and safe family rehabilitation training aids (such as finger separators, orthotics), helping families obtain necessary resources in a more economical way and promoting the recycling of rehabilitation equipment.

Third, develop an integrated rehabilitation progress sharing and data management platform to realize the safe synchronization of key rehabilitation data (such as training frequency, completion degree, parents' observation notes, video records) generated by children in hospitals, community gyms and families, and open remote assessment and professional feedback functions, enabling therapists to understand the implementation of family rehabilitation in real time and provide accurate basis for follow-up guidance.

Fourth, improve the psychological resilience needed in the long-term rehabilitation process, coping methods for emotional fluctuations and daily mental health management, so as to improve the overall effect of children's rehabilitation. Build an online rehabilitation support community, set up functional sections such as rehabilitation diary sharing, training short video check-in and experience exchange forums, and embed modules such as online Q&A, peer encouragement, professional psychological counseling and regular health education.

5. Conclusion

In summary, as the most trusted living environment for children with cerebral palsy, the family is an irreplaceable key place in the rehabilitation process. Family rehabilitation under family support can significantly improve the treatment effect. This life-centered rehabilitation model, by integrating treatment into children's daily life and behavior habits, can more effectively improve children's life adaptability and self-care level. It is recommended that relevant departments actively promote the integration and optimization of "online + offline" rehabilitation skills training resources supported by Internet + technology. On the one hand, provide parents with scientific, professional and systematic theoretical courses and operational guidance through digital platforms; on the other hand, professional rehabilitation therapists conduct on-site or remote assessment and personalized program adjustment regularly, forming a closed-loop management of "knowledge imparting–skills training–effect feedback". It not only strengthens parents' professional rehabilitation ability but also ensures the scientificity and pertinence of training programs, promoting the continuous optimization of family rehabilitation effects.

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References

[1] Chen L, 2020, The Important Role of Family Rehabilitation Training in the Rehabilitation of Children with Cerebral Palsy. Capital Food and Medicine, 2020(4): 39–40.

[2] Fan T, Jiang Y, Dai J, et al., 2023, Construction and Effect Study of Remote Family Rehabilitation Model for Children with Cerebral Palsy Based on Internet Technology. Chinese Journal of Child Health Care, 31(11): 1202–1207.

[3] Feng Y, Pang W, Li X, et al., 2021, Meta-analysis of the Prevalence of Cerebral Palsy in Children Aged 0–6 Years in China. Chinese General Practice, 24(5): 603–607.

[4] Zhan T, Chen F, Wang Y, 2025, Clinical Study of the Trinity Rehabilitation Model of "Medical-Education-Family" for Children with Spastic Cerebral Palsy. Guizhou Medical Journal, 49(7): 1159–1162.

[5] Rehabilitation Group, Pediatrics Branch, Chinese Medical Association, 2019, Expert Consensus on Etiological Diagnosis Strategies of Cerebral Palsy. Chinese Journal of Pediatrics, 57(10): 746–751.

[6] Ren Y, Guo Q, Li Y, et al., 2014, Current Situation and Demand of Community Rehabilitation Medical Resources in China. Chinese Journal of Rehabilitation Medicine, 29(8): 757–759.

[7] Tang L, Wu Y, Li Y, et al., 2021, Discussion on Remote Family Rehabilitation Model for Children with Cerebral Palsy Based on Modern Information Technology. Chinese Journal of Rehabilitation, 36(12): 756–759.

[8] Li X, 2016, Current Situation, Challenges and Development Strategies of Cerebral Palsy Rehabilitation in China. Chinese Journal of Rehabilitation Medicine, 31(1): 6–8.

[9] Ding Y, Shi W, Jiang Z, et al., 2020, Multicenter Survey on Family Economic Burden of Children with Cerebral

Palsy in China. Chinese Journal of Rehabilitation Theory and Practice, 26(8): 879–884.

[10] Jiu J, 2008, Analysis of Reasons for Abandoning Treatment for Children with Cerebral Palsy. Chinese Journal of Practical Nervous Diseases, 2008(3): 81–82.

[11] Du Y, Li J, 2024, Application and Development Status of Tele-rehabilitation in Cerebral Palsy Rehabilitation. Chinese Journal of Rehabilitation, 39(9): 562–566.

[12] Huang Y, Sun X, 2018, Application Status of Family-centered Nursing Model in Cerebral Palsy Rehabilitation. Chinese Nursing Research, 32(21): 3348–3350.

[13] Song Y, Chen Y, Xu H, et al., 2025, Construction and Practice of Personalized Rehabilitation Nursing Model for Children with Cerebral Palsy Based on "Internet +" Platform. Heilongjiang Medicine and Pharmacy, 48(2): 91–93.

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Clinical Study on the Therapeutic Effect of Yiqi Huoxue Formula on Unstable Angina Pectoris with Qi Deficiency and Blood Stasis Syndrome

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Abstract: *Objective*: To analyze and evaluate the therapeutic effect of Yiqi Huoxue Formula on patients with unstable angina pectoris of Qi deficiency and blood stasis syndrome. *Methods*: A total of 95 patients with unstable angina pectoris admitted to our hospital from January to December 2025 were selected for the study. They were randomly divided into a control group (47 cases) and an observation group (48 cases) using a random number table. The control group received conventional Western medicine intervention, while the observation group was additionally treated with Yiqi Huoxue Formula. The changes in traditional Chinese medicine (TCM) syndrome scores, clinical efficacy, angina symptom scores, inflammatory markers, cardiac troponin I (cTnI), and the discontinuation or reduction rate of nitroglycerin tablets were compared between the two groups. *Results*: Compared with the control group, the TCM syndrome scores in the observation group significantly decreased after treatment ($p < 0.05$). The total effective rates in the observation and control groups were 93.75% and 76.60%, respectively ($p < 0.05$). Compared with before treatment, the angina symptom scores in both groups decreased after treatment, with a greater reduction observed in the observation group ($p < 0.05$). Compared with the control group, the observation group had lower levels of IL-6, hs-CRP, and cTnI after treatment ($p < 0.05$). The total discontinuation or reduction rates of nitroglycerin in the observation and control groups were 79.17% and 53.19%, respectively ($p < 0.05$). *Conclusion*: For patients with unstable angina pectoris of Qi deficiency and blood stasis syndrome, the addition of Yiqi Huoxue Formula to Western medicine treatment can effectively alleviate their clinical symptoms and reduce TCM syndromes, reduce inflammatory responses and myocardial injury levels, enhance clinical efficacy, and help reduce nitroglycerin usage, demonstrating good clinical application value.

Keywords: Yiqi Huoxue formula; Unstable angina pectoris; Qi deficiency and blood stasis syndrome; Clinical efficacy

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1. Introduction

Unstable angina pectoris is a common type of coronary heart disease, lying between stable angina pectoris and acute myocardial infarction. Its frequency and severity of attacks often progress or are difficult to predict, with relatively challenging symptom relief and a higher likelihood of progressing to myocardial infarction

or experiencing severe adverse cardiovascular events [1]. According to epidemiological data, the prevalence of coronary heart disease among individuals aged ≥ 18 in China was 758 per 100,000 from 2020 to 2022, with a continuous rise in mortality rates in recent years. In 2021, the mortality rate was 135.08 per 100,000 among urban residents and 148.19 per 100,000 among rural residents [2,3]. Currently, nitrate esters, β-blockers, and statins are commonly used clinically to treat unstable angina pectoris, aiming to improve coronary blood flow, regulate lipid metabolism, and enhance the stability of atherosclerotic plaques, thereby helping to control disease progression and alleviate symptoms [4]. Traditional Chinese medicine classifies unstable angina pectoris under the categories of "chest obstruction" and "heart pain", primarily caused by factors such as aging, dietary irregularities, and emotional imbalances. The disease is located in the heart and closely related to the dysfunction of the liver, spleen, and kidney. Pathologically, it is characterized by a combination of deficiency in the root and excess in the manifestation, with deficiency often involving insufficient heart, spleen, and kidney functions, and excess commonly presenting as blood stasis, phlegm turbidity, Qi stagnation, and cold pathogens obstructing the heart vessels [5]. Yiqi Huoxue Formula is derived from modifications of two classic formulas, Danggui Buxue Decoction and Buyang Huanwu Decoction, and is an empirical formula of Professor Guo Shuwen, a mentor in the seventh batch of national academic experience inheritance projects for senior traditional Chinese medicine experts. The formula combines multiple herbs, including *Astragalus membranaceus*, Ginseng, *Angelica sinensis*, and *Ligusticum chuanxiong*, to achieve the effects of replenishing Qi, activating blood, and unblocking meridians to relieve pain. Studies have indicated that the combination of Yiqi Huoxue Formula with conventional treatment can further reduce angina symptom scores, decrease angina attacks, reduce nitroglycerin tablet usage, and lower inflammatory levels in patients with unstable angina pectoris of Qi and Yin deficiency syndrome [6]. However, there are few studies on the application of Yiqi Huoxue Formula in unstable angina pectoris of Qi deficiency and blood stasis syndrome. Therefore, this study added Yiqi Huoxue Formula to conventional Western medicine treatment to observe its effects on TCM syndrome scores, angina symptom scores, inflammatory markers, and other aspects.

2. Materials and methods

2.1. General information

A total of 95 patients with unstable angina pectoris admitted to our hospital from January to December 2025 were included in the study and divided into a control group (47 cases) and an observation group (48 cases). There was no statistically significant difference in baseline data between the two groups ($p > 0.05$), as shown in **Table 1**.

Table 1. Comparison of baseline data [($\overline{x} \pm s$), cases (n)]

Group	n	Male/Female	Age (years)	NYHA cardiac function classification		
				Class I	Class II	Class III
Observation group	48	29/19	58.72 ± 8.83	23 (47.92)	21 (43.75)	4 (8.33)
Control group	47	25/22	59.26 ± 7.20	26 (55.32)	19 (40.43)	2 (4.26)
t/χ^2		0.505	0.326		0.940	
p		0.477	0.745		0.625	

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

(1) Meeting the diagnostic criteria for unstable angina [7];

(2) Conforming to the criteria for traditional Chinese medicine (TCM) diagnosis of chest pain due to Qi deficiency and blood stasis, with primary symptoms including chest pain or chest tightness; secondary symptoms including palpitations, shortness of breath, fatigue, insomnia, and spontaneous sweating; tongue appearance often showing pale purple tongue, and pulse condition characterized by weakness and astringency [8].

(3) Experiencing at least two episodes of angina within 15 days prior to enrollment, including episodes triggered by rest or mild activity;

(4) Having signed an informed consent form.

2.2.2. Exclusion criteria

(1) Patients with acute ST-segment elevation myocardial infarction or those already diagnosed with acute myocardial infarction;

(2) Patients with severe heart failure or severe arrhythmia;

(3) Patients with severe liver or renal dysfunction or failure of vital organs;

(4) Patients with coexisting malignant tumors or autoimmune diseases;

(5) Patients allergic to the components of the medications used in the study.

2.3. Methods

The control group received conventional Western medicine treatment, specifically: Isosorbide Mononitrate Sustained-Release Tablets (Qilu Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20065685, 40 mg/tablet) 40 mg orally once daily; Atorvastatin Calcium Tablets (Qilu Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H20193143, 10 mg/tablet) 20 mg once daily; Aspirin Enteric-Coated Tablets (Bayer HealthCare Co., Ltd., National Medical Products Administration Approval Number J20130078, 100 mg/tablet) 100 mg once daily; Metoprolol Tartrate Tablets (AstraZeneca Pharmaceutical Co., Ltd., National Medical Products Administration Approval Number H32025391, 25 mg/tablet) 12.5 mg twice daily, for a treatment duration of 4 weeks.

The observation group received additional treatment with a Qi-tonifying and blood-activating formula, consisting of: Raw *Astragalus* 30 g, *Angelica Sinensis* 15 g, Ginseng 10 g, Notoginseng Powder 6 g (dissolved in water before administration), *Ligusticum Chuanxiong* 15 g. The herbs were soaked in water and then decocted, with the dregs removed to obtain approximately 400 mL of medicinal liquid. This was taken warmly in two divided doses, morning and evening, 200 mL each time, one dose per day, for a continuous treatment duration of 4 weeks.

2.4. Observation indicators

(1) The TCM syndrome score was composed of five symptoms: chest pain (tightness), palpitations, shortness of breath, fatigue, and pale complexion. The scoring method is detailed in **Table 2**.

Table 2. TCM symptom scoring scale

Symptom	0 points	2 points	4 points	6 points
Chest pain (tightness)	Asymptomatic	Typical angina pectoris episodes, each lasting several minutes, occurring ≥ 2–3 times per week or 1–3 times per day, mild in severity, requiring occasional oral nitroglycerin.	Typical angina episodes several times daily, lasting from a few minutes up to about 10 minutes, with obvious pain, often requiring sublingual nitroglycerin.	Episodes multiple times daily, affecting daily activities (e.g., defecation, dressing), lasting longer, requiring repeated sublingual nitroglycerin.
Palpitations	Asymptomatic	Occasional palpitations, mild, with little impact on daily life.	Palpitations occur from time to time, last longer, and are accompanied by some discomfort.	Frequent palpitations, uneasy sensation, difficult to relieve, even interfering with daily life.
Shortness of breath	Asymptomatic	Shortness of breath after general activity.	Shortness of breath upon mild activity.	Shortness of breath or tachypnea even at rest.
Fatigue and weakness	Asymptomatic	Fatigue and weakness after exertion, reluctance to speak much.	Fatigue and weakness upon any movement, disinclination to talk.	Fatigue and weakness even at rest, no desire to speak.
Dull and dark complexion	Asymptomatic	Complexion slightly dark.	Complexion dull and dark.	Complexion markedly dull and dark.

(2) Clinical efficacy assessment

Marked effectiveness is defined as a significant improvement in clinical symptoms and signs, with a decrease in syndrome score of ≥ 70%. Effectiveness is indicated by an improvement in symptoms and signs compared to the previous state, with a reduction in syndrome score ranging from 30% to < 70%. Ineffectiveness is characterized by no significant improvement or worsening of symptoms and signs, with a decrease in syndrome score of < 30% and ≥ 0%. Aggravation is denoted by a deterioration in symptoms and signs compared to the previous state, with a decrease in syndrome score of < 0%. The overall effective rate is calculated as (marked effectiveness + effectiveness) / total number of cases × 100%.

(3) Angina symptom score

A comprehensive score is assigned based on the frequency of episodes, duration, and intensity of pain. Specific scoring criteria are detailed in **Table 3**.

Table 3. Evaluation method for angina symptom score

Angina pectoris	0 points	2 points	4 points	6 points
Attack frequency	None	About 2–6 times per week, on average less than once per day	About 1–3 times per day	Frequent daily attacks, ≥ 6 times per day
Duration	None	Each attack lasts a short time, no more than 5 minutes	Each attack lasts about 5–10 minutes	Each attack lasts a long time, ≥ 10 minutes
Pain intensity	None	Angina occurs only during high-intensity activities (e.g., brisk walking, jogging, or carrying heavy loads upstairs); daily activities are unaffected	Angina is induced by ordinary daily activities (e.g., normal walking or climbing stairs); mild reduction in exercise capacity	Angina occurs with minimal activity (e.g., short-distance walking or mild uphill walking); daily life is significantly limited

(4) Inflammatory markers and cardiac troponin I (cTnI)

Inflammatory markers include Interleukin-6 (IL-6) and high-sensitivity C-reactive protein (hs-CRP). For patients, 5 mL of elbow venous blood was collected in a fasting state in the early morning, placed

in an anticoagulant-free vacuum blood collection tube, allowed to stand at room temperature for 30 minutes, and then centrifuged at 3000 r/min for 10 minutes to separate the serum. IL-6 was detected using the enzyme-linked immunosorbent assay, hs-CRP was detected using the immunoturbidimetric assay, and cTnI was measured using the chemiluminescence immunoassay.

(5) Discontinuation and reduction of nitroglycerin

Compare the changes in nitroglycerin use before and after treatment in patients and calculate the discontinuation and reduction rate. Discontinuation and reduction rate = (number of patients who discontinued use after treatment + number of patients with reduced dosage) / total number of patients using the drug before treatment × 100%.

2.5. Statistical analysis

The study data were processed using SPSS 26.0 software. Count data were presented as the number of cases and percentages, and compared using the χ^2 test. Measurement data were expressed as ($\overline{x} \pm s$) after normality testing, and differences between groups were analyzed using the *t*-test. A difference was considered statistically significant when $p < 0.05$.

3. Results

3.1. Traditional Chinese medicine (TCM) syndrome scores

The TCM syndrome scores in the observation group were lower than those in the control group after treatment ($p < 0.05$). See **Table 4**.

Table 4. Comparison of TCM syndrome scores ($\overline{x} \pm s$, points)

Group	n	Before treatment	After treatment	*t*	*p*
Observation group	48	18.76 ± 1.28	9.42 ± 1.61	31.461	< 0.001
Control group	47	19.12 ± 1.47	13.01 ± 1.17	22.295	< 0.001
t		1.274	12.411		
p		0.206	< 0.001		

3.2. Clinical efficacy

The overall effective rates in the observation group and the control group were 93.75% and 76.60%, respectively ($p < 0.05$). See **Table 5**.

Table 5. Comparison of clinical efficacy [cases (%)]

Group	n	Markedly effective	Effective	Ineffective	Worsened	Effective rate
Observation group	48	28 (58.33)	17 (35.42)	3 (6.25)	0 (0.00)	45 (93.75)
Control group	47	16 (34.04)	20 (42.55)	10 (21.28)	1 (2.13)	36 (76.60)
χ^2						8.276
p						0.041

3.3. Angina pectoris symptom scores

Compared with before treatment, the angina pectoris symptom scores in both groups decreased after

treatment, with a greater reduction observed in the observation group ($p < 0.05$). See **Table 6**.

Table 6. Comparison of angina pectoris symptom scores ($\overline{x} \pm s$, points)

Group	n	Before treatment	After treatment	*t*	*p*
Observation group	48	11.03 ± 1.62	5.48 ± 1.05	19.918	< 0.001
Control group	47	10.75 ± 1.35	6.86 ± 0.88	16.549	< 0.001
t		0.914	6.935		
p		0.363	< 0.001		

3.4. Inflammatory indicators and cTnI

Compared with the control group, the observation group exhibited significantly lower levels of IL-6, hs-CRP, and cTnI after treatment ($p < 0.05$). See **Table 7**.

Table 7. Comparison of inflammatory indicators and cTnI ($\overline{x} \pm s$, points)

Group	n	IL-6 (pg/mL)		hs-CRP (mg/L)		cTnI (μg/L)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	48	16.15 ± 2.04	8.93 ± 1.53*	6.26 ± 0.82	3.73 ± 0.61*	0.058 ± 0.016	0.035 ± 0.014*
Control group	47	16.41 ± 2.37	11.19 ± 1.28*	6.07 ± 0.77	4.25 ± 0.34*	0.054 ± 0.020	0.041 ± 0.008*
t		0.573	7.800	1.164	5.117	1.078	2.557
p		0.568	< 0.001	0.248	< 0.001	0.284	0.012

Note: Compared with the pre-treatment within the same group, *$p < 0.05$.

3.5. Discontinuation and reduction of nitroglycerin

The total discontinuation and reduction rates of nitroglycerin in the observation group and the control group were 79.17% and 53.19%, respectively ($p < 0.05$). See **Table 8**.

Table 8. Discontinuation and Reduction of nitroglycerin [case (%)]

Group	n	Discontinued	Reduced	Unchanged	Increased	Total discontinued/reduced
Observation group	48	20 (41.67)	18 (37.50)	10 (20.83)	0 (0.00)	38 (79.17)
Control group	47	11 (23.40)	14 (29.79)	19 (40.43)	3 (6.38)	25 (53.19)
χ^2						8.897
p						0.031

4. Discussion

The occurrence of unstable angina is predominantly associated with the rupture or erosion of coronary atherosclerotic plaques, which subsequently triggers platelet aggregation and thrombus formation. This process may be accompanied by coronary artery spasm, leading to narrowing or even occlusion of the coronary lumen, resulting in acute myocardial ischemia and hypoxia. Clinically, unstable angina is characterized by unstable chest pain episodes, prolonged duration, and a higher risk of spontaneous onset, influenced by a combination of traditional cardiovascular risk factors. In traditional Chinese medicine (TCM), angina falls under the category of "chest impediment", a term first recorded in the Huangdi Neijing

(The Yellow Emperor's Classic of Internal Medicine). TCM posits that the occurrence of unstable angina is fundamentally rooted in deficiency of vital Qi, with dietary irregularities, emotional disturbances, or invasion by cold pathogens serving as predisposing factors. These factors lead to the obstruction of the heart vessels by pathogenic factors such as cold coagulation, Qi stagnation, and phlegm turbidity, resulting in impaired blood circulation and the onset of the disease [9]. The pathogenesis is characterized by a combination of deficiency in the root and excess in the manifestations, with various pathogenic factors intermingling. Therefore, treatment should focus on promoting blood circulation to remove blood stasis, unblocking the collaterals to alleviate pain, while also nourishing Qi to strengthen the body's resistance.

The results of this study indicate that, compared to the control group, the observation group exhibited lower scores in TCM syndrome and angina pectoris after treatment, along with a higher overall clinical response rate and nitroglycerin discontinuation/reduction rate ($p < 0.05$). This suggests that the Yiqi Huoxue Decoction can further alleviate the symptom burden in patients with Qi deficiency and blood stasis-type unstable angina, enhance clinical efficacy, and promote a reduction in nitroglycerin usage. Research by Li Zhengyu et al. also pointed out that the Yiqi Huoxue Decoction can effectively improve TCM syndrome manifestations in patients, particularly providing notable relief for symptoms such as chest pain, palpitations, and spontaneous sweating [10]. The analysis suggests that the raw astragalus and ginseng in the formula are both key herbs for replenishing Qi, nourishing and strengthening the heart and spleen, and promoting Qi circulation to enhance blood flow. *Angelica sinensis* nourishes and invigorates the blood, aiding Qi while promoting blood circulation to remove stasis. *Ligusticum chuanxiong* promotes Qi circulation and invigorates the blood, acting as a "blood-invigorating Qi medicine" that facilitates Qi movement to enhance blood flow. *Panax notoginseng* can both remove blood stasis to alleviate pain and stop bleeding without leaving stasis, possessing both blood-activating and vascular-protective effects. When combined, these herbs work synergistically to nourish Qi and strengthen the body, promote blood circulation to unblock the vessels, and remove blood stasis to alleviate pain. This results in improved blood flow to the heart vessels, alleviating chest pain, and replenishing Qi and blood, thereby improving symptoms such as palpitations, shortness of breath, and fatigue. Consequently, this is manifested as a decrease in TCM syndrome and angina symptom scores, an improvement in clinical efficacy, and a reduced need for nitroglycerin. Modern pharmacological studies have shown that *astragalus* primarily contains *astragalus* polysaccharides and astragalosides. The former possesses immunomodulatory and antioxidant effects, inhibiting platelet adhesion and reducing myocardial ischemic injury, while the latter participates in regulating calcium ion homeostasis, contributing to improved myocardial contraction and perfusion. Ginseng contains ginsenosides that can regulate myocardial energy metabolism and improve cardiac function. *Panax notoginseng* contains *Panax notoginseng* saponins, which inhibit platelet aggregation, improve blood rheology, and protect myocardial cells. *Ligusticum chuanxiong* contains ligustrazine, which dilates the coronary arteries and improves coronary blood flow. Angelica sinensis contains ferulic acid, which possesses antioxidant and microcirculation-improving effects. The synergistic action of these components helps inhibit inflammatory responses, improve blood viscosity and microcirculation perfusion, and reduce the severity of myocardial ischemia, thereby decreasing the frequency and duration of angina attacks and enhancing overall treatment efficacy. From the perspective of inflammatory responses, when coronary atherosclerotic plaques are in an unstable state, macrophages and vascular endothelial cells are activated, releasing pro-inflammatory factors such as IL-6. This promotes the synthesis of acute-phase reactant proteins like hs-CRP, enhances endothelial cell inflammatory responses

and platelet adhesion/aggregation, exacerbates local vascular inflammation and thrombotic tendencies, and further reduces myocardial blood supply. Under sustained ischemic conditions, some myocardial cells sustain minor damage, releasing cTnI into the bloodstream. Changes in cTnI levels can reflect the degree of myocardial injury and the risk of disease progression. This study showed that, compared to the control group, the observation group had lower levels of IL-6, hs-CRP, and cTnI after treatment ($p < 0.05$), indicating that the Yiqi Huoxue Decoction can effectively inhibit inflammatory responses and reduce myocardial injury, thereby improving the pathological state in patients with Qi deficiency and blood stasis-type unstable angina. An animal study indicated that *Panax notoginseng* saponins can regulate the cGAS/STING/NF-κB signaling pathway and downregulate the expression of inflammatory factors such as IL-6 and TNF-α, thereby exerting anti-inflammatory effects [11]. Research by Li Zhengyu et al. showed that *Astragalus* can improve myocardial cell ion homeostasis by regulating β-receptor expression in myocardial cells and inhibiting the activity of Na^+-K^+-ATPase and Ca^{2+}-ATPase, thereby reducing myocardial injury caused by ischemia and improving cardiac function [10].

5. Conclusion

In conclusion, the addition of the Yiqi Huoxue Decoction to conventional Western medicine treatment can further improve TCM syndromes and angina symptoms in patients with Qi deficiency and blood stasis-type unstable angina, enhance overall clinical efficacy, inhibit inflammatory responses, reduce myocardial injury, and promote a decrease in nitroglycerin usage, demonstrating good comprehensive therapeutic value.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xia H, Liu D, Zhang M, et al., 2025, Levels of Soluble Programmed Cell Death Ligand 1 in Patients with Unstable Angina and Its Correlation with Prognosis. Chinese Journal of Geriatric Heart Brain and Vessel Diseases, 27(2): 149–153.

[2] National Center for Cardiovascular Diseases, The Writing Committee of the Report on Cardiovascular Health and Diseases in China, 2024, China Cardiovascular Health and Disease Report 2023: An Overview. Chinese Circulation Journal, 39(7): 625–660.

[3] National Health Commission of the People's Republic of China, 2022, China Health Statistics Yearbook. Beijing: Peking Union Medical College Press.

[4] Cai N, Li Y, 2025, Efficacy Analysis of Simvastatin Combined with Xuesaitong Dropping Pills in the Treatment of Unstable Angina. China Prescription Drug, 23(9): 106–109.

[5] Ma Z, Wang F, Lu J, et al., 2026, Clinical Study on Xinnao Liantong Capsule Combined with Diltiazem Hydrochloride Tablets in the Treatment of Stable Angina. China Medicine, 21(1): 93–97.

[6] Nie H, Li Y, Lu P, et al., 2021, Efficacy of YiQi Huoxue Decoction Combined with High-Dose Atorvastatin in the Treatment of Unstable Angina with Qi-yin Deficiency Syndrome and Its Effect on Serum Inflammatory Factor Levels. Journal of Modern Integrative Traditional Chinese and Western Medicine, 30(24): 2689–2692 + 2736.

[7] Yu K, Zeng Q, 2024, Interpretation of the "Guidelines for the Diagnosis and Treatment of Non-ST-Segment Elevation Acute Coronary Syndrome (2024)". Journal of Clinical Cardiology, 40(9): 697–700.

[8] Zhang R, Su H, Huang X, et al., 2022, Expert Consensus on the Diagnosis and Treatment of Unstable Angina in Traditional Chinese Medicine. Journal of Traditional Chinese Medicine, 63(7): 695–700.

[9] Wei X, Lu J, Gu N, 2025, Comparative Study on the Clinical Efficacy of Different Dosage Forms of Wendan Decoction in the Treatment of Unstable Angina. Lishizhen Medicine and Materia Medica Research, 36(20): 3901–3908.

[10] Li Z, Wu Y, Cui J, et al., 2022, Retrospective Analysis of YiQi Huoxue Decoction in the Treatment of Unstable Angina After Percutaneous Coronary Intervention. World Journal of Traditional Chinese Medicine, 17(5): 731–735.

[11] Wu Y, Fu C, Luo C, et al., 2021, Effect of Panax Notoginseng Saponins on Inflammatory Response in Rats with Acute Cerebral Infarction by Regulating the cGAS/STING/NF-κB Pathway. Beijing Journal of Traditional Chinese Medicine, 40(10): 1061–1065.

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Research on the Impact of Cardiac Rehabilitation Nursing Based on Five-Level Early Activity on Cardiac Function, Exercise Tolerance, and Quality of Life in Patients with Coronary Heart Disease

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Abstract: *Objective*: To investigate the application effect of cardiac rehabilitation nursing based on five-level early activity in patients with coronary heart disease. *Methods*: A total of 86 patients with coronary heart disease admitted from January 2025 to January 2026 were selected and randomly divided into a control group receiving conventional nursing and a study group receiving cardiac rehabilitation nursing based on five-level early activity, with 43 cases in each group. The intervention effects of the two groups were compared. *Results*: After intervention, the cardiac function indicators in the study group were significantly better than those in the control group ($p < 0.05$); after intervention, the 6-minute walk test (6MWT) and peak oxygen uptake (VO_2 peak) in the study group were significantly higher than those in the control group ($p < 0.05$); after intervention, the quality of life score in the study group was significantly higher than that in the control group ($p < 0.05$). *Conclusion*: Cardiac rehabilitation nursing based on five-level early activity can effectively improve cardiac function, enhance exercise tolerance, and elevate the quality of life in patients with coronary heart disease.

Keywords: Coronary heart disease; Cardiac rehabilitation; Five-level method; Cardiac function

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1. Introduction

Coronary heart disease (CHD) is the leading cardiovascular disease-causing death and disability worldwide, with its incidence rate continuing to rise in China [1]. Percutaneous coronary intervention (PCI) can rapidly alleviate myocardial ischemia symptoms but cannot reverse the pathological process of coronary atherosclerosis or fully improve issues such as reduced cardiac function, decreased exercise tolerance, and

lowered quality of life after surgery [2]. Cardiac rehabilitation is a core component of secondary prevention for CHD, and early standardized activity is a key link in inpatient cardiac rehabilitation, effectively reducing bed-related complications and promoting the recovery of cardiac and physical functions in patients [3]. In traditional clinical interventions, activity guidance for patients after PCI for CHD often relies on the clinical experience of nursing staff, leading to problems such as delayed activity timing, imprecise intensity control, and homogeneous plans, which affect patient rehabilitation outcomes [4]. The five-level early activity model divides early activity into five progressive levels based on the patient's postoperative recovery process and develops personalized activity plans by considering the individual tolerance of patients, achieving precise and stepwise control of activity intensity. However, systematic application research on this model in cardiac rehabilitation nursing after PCI for CHD remains relatively insufficient. Based on this, this study explores the application effect of cardiac rehabilitation nursing based on five-level early activity in patients with CHD, providing evidence-based support for improving the quality of rehabilitation nursing for CHD in clinical practice.

2. Materials and methods

2.1. General information

A total of 86 patients with CHD admitted from January 2025 to January 2026 were selected and randomly divided into a control group and a study group, with 43 cases in each group. The general information of the two groups was comparable ($p > 0.05$), as shown in **Table 1**.

Table 1. Comparison of general information between the two groups

Group	Number of cases	Gender		Age (years)	Lesion type	
		Male	Female		Stable angina	Unstable angina
Control group	43	27 (62.79)	16 (37.21)	63.25 ± 6.18	20 (46.51)	23 (53.49)
Study group	43	26 (60.47)	17 (39.53)	62.84 ± 6.32	19 (44.19)	24 (55.81)
χ^2/t		0.049	0.311		0.047	
p		0.825	0.756		0.829	

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

(1) Meeting the diagnostic criteria for coronary heart disease [5];
(2) Undergoing PCI treatment for the first time;
(3) Aged between 40 and 75 years;
(4) Having clear consciousness and normal cognitive function, able to cooperate in completing rehabilitation training and research follow-up;
(5) Signing an informed consent form.

2.2.2. Exclusion criteria

(1) Complicated with acute myocardial infarction, cardiogenic shock, or severe malignant arrhythmia;
(2) Complicated with severe liver and kidney dysfunction, malignancy, coagulation dysfunction, or severe pulmonary disease;

(3) Complicated with mental illness, cognitive dysfunction, or limb movement disorders, unable to cooperate in rehabilitation training;
(4) Having a history of cardiac surgery or stroke.

2.3. Methods

The control group received routine cardiac rehabilitation nursing in the cardiology department: continuous electrocardiographic monitoring for 24 hours postoperatively, absolute bed rest for 24 hours postoperatively, assisting patients with turning over and defecating in bed during bed rest, and providing skin and oral care. Patients were informed about the effects, usage, dosage, adverse reactions, and precautions of medications. After 24 hours postoperatively, patients were guided to sit up in bed based on their subjective feelings, and from days 3 to 5 postoperatively, they were guided to stand and walk beside the bed, with the amount of activity adjusted according to the patient's comfort level. Routine discharge guidance was provided upon discharge.

The study group received cardiac rehabilitation nursing based on the five-level early activity method in addition to the control group's care: Level I (Bed Rest Period): Absolute bed rest, assisting patients with turning over and passive limb movements in bed, guiding patients in abdominal breathing training, avoiding strenuous activities, and focusing on preventing pressure ulcers and venous thrombosis. Level II (Bedside Activity Period): Patients primarily rested in bed; after stability, they were assisted to sit up with their legs dangling beside the bed, gradually transitioning to standing beside the bed. Vital signs were closely monitored during standing, and if dizziness, fatigue, or other discomfort occurred, patients were immediately assisted back to bed. Level III (Indoor Activity Period): After patients stood beside the bed without discomfort, they were guided to walk slowly indoors, gradually increasing walking time and distance. Simple limb stretching exercises could be incorporated, avoiding brisk walking and bending with heavy loads. Level IV (Outdoor Activity Period): After patients tolerated indoor activities well, they were guided to engage in walking training outdoors at a speed of 30 to 40 meters per minute. Activity intensity could be appropriately increased, such as alternating between slow and brisk walking, while guiding patients in simple aerobic exercises. Level V (Regular Exercise Period): Based on the patient's physical tolerance, a regular exercise plan was formulated, including brisk walking, jogging, and cycling, with exercise intensity controlled at 50% to 60% of the maximum heart rate, exercised 5 to 6 days per week. Patients were also guided in breathing and relaxation training to avoid overexertion.

Both groups of patients were followed up in the outpatient clinic 4 weeks postoperatively.

2.4. Observation indicators

2.4.1. Cardiac function indicators

Left ventricular ejection fraction (LVEF), left ventricular end-diastolic diameter (LVEDD), and cardiac output (CO) were measured using a color Doppler ultrasound diagnostic instrument.

2.4.2. Exercise tolerance indicators

The 6-minute walk test (6MWT) was conducted, and peak oxygen uptake (VO_2peak) was measured using a cardiopulmonary exercise testing instrument.

2.4.3. Quality of life

Assessed using the 36-Item Short Form Health Survey (SF-36), which includes 8 dimensions, each with a maximum score of 100. Higher scores indicate better quality of life in that dimension for the patient.

2.5. Statistical methods

Measurement data and count data were expressed as (mean ± standard deviation) (n, %) and analyzed using statistical software (SPSS 24.0) with *t*-tests and chi-square tests, respectively. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Cardiac function indicators

After intervention, the cardiac function indicators in the study group were significantly better than those in the control group ($p < 0.05$). See **Table 2**.

Table 2. Cardiac function indicators ($\overline{x} \pm s$)

Group	Number of cases	LVEF (%)		LVEDD (mm)		CO (L/min)	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Study group	43	52.36 ± 4.52	58.72 ± 3.85	56.83 ± 3.71	52.15 ± 3.24	4.25 ± 0.63	5.12 ± 0.71
Control group	43	51.89 ± 4.71	53.28 ± 4.12	57.12 ± 3.85	55.46 ± 3.52	4.31 ± 0.65	4.58 ± 0.68
t		0.483	6.472	0.364	4.641	0.445	3.685
p		0.630	< 0.001	0.717	< 0.001	0.658	< 0.001

3.2. Exercise tolerance indicators

After the intervention, both the 6MWT and VO_2peak in the study group were significantly higher than those in the control group ($p < 0.05$). See **Table 3**.

Table 3. Exercise tolerance indicators ($\overline{x} \pm s$)

Group	Number of cases	6MWT (m)		VO_2 peak (mL/(kg·min))	
		Before intervention	After intervention	Before intervention	After intervention
Study group	43	302.54 ± 45.28	456.82 ± 52.37	16.25 ± 2.34	22.36 ± 2.58
Control group	43	298.76 ± 43.65	382.45 ± 48.69	16.08 ± 2.29	19.12 ± 2.41
t		0.403	6.977	0.348	6.156
p		0.688	< 0.001	0.728	< 0.001

3.3. Quality of life scores

After the intervention, the quality-of-life scores in the study group were significantly higher than those in the control group ($p < 0.05$). See **Table 4** and **5**.

Table 4. Quality of life scores (Bodily pain, Physiological function and Role-physical) ($\overline{x}$ ± s, points)

Group	Number of cases	Bodily pain		Physiological function		Role-physical	
		Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Study group	43	45.63 ± 6.53	91.45 ± 7.35	47.35 ± 5.63	89.23 ± 7.33	43.32 ± 9.32	91.06 ± 5.52
Control group	43	45.62 ± 6.34	81.02 ± 8.32	47.53 ± 5.45	81.03 ± 6.35	43.63 ± 9.42	82.42 ± 6.42
t		0.007	6.161	0.151	5.545	0.153	6.692
p		0.994	< 0.001	0.881	< 0.001	0.878	< 0.001

Table 5. Quality of life scores (General health, Vitality social function, Role emotional, Mental health)

Group	No. cases	General health		Vitality		Social function		Role emotional		Mental health	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Study group	43	45.13 ± 6.23	90.11 ± 8.36	47.14 ± 6.62	92.02 ± 8.52	44.24 ± 6.73	93.52 ± 9.42	46.24 ± 8.35	93.22 ± 8.25	43.53 ± 9.42	92.89 ± 3.35
Control group	43	45.24 ± 6.35	82.78 ± 6.35	47.46 ± 6.21	83.25 ± 7.35	44.32 ± 6.35	85.01 ± 8.35	46.44 ± 8.31	85.62 ± 6.35	43.63 ± 9.22	84.98 ± 6.33
t		0.081	4.579	0.231	5.111	0.057	4.433	0.111	4.787	0.050	7.242
p		0.936	< 0.001	0.818	< 0.001	0.955	< 0.001	0.912	< 0.001	0.960	< 0.001

4. Discussion

Cardiac rehabilitation for patients with coronary heart disease (CHD) after percutaneous coronary intervention (PCI) is a long-term and systematic process, with early rehabilitation during hospitalization serving as the foundation of the entire rehabilitation process and directly influencing the patient's long-term prognosis [6]. As a crucial component of comprehensive CHD treatment, cardiac rehabilitation nursing can improve cardiac function, enhance exercise tolerance, and promote physical and mental rehabilitation in patients through scientific interventions [7]. Research by Pei Limin et al. has shown that early personalized aerobic exercise cardiac rehabilitation training after PCI can improve exercise capacity and skeletal muscle functional anti-sympathetic activity in patients [8].

The results of this study indicate that, after intervention, the cardiac function indicators in the study group were significantly better than those in the control group. The stepwise early activity program can improve myocardial microcirculation perfusion through moderate exercise load, promote the establishment of myocardial collateral circulation, reduce myocardial cell apoptosis, and inhibit the process of ventricular remodeling. Meanwhile, regular early activity can decrease sympathetic nervous system excitability, increase vagal nerve tone, improve autonomic nervous system dysfunction, reduce myocardial oxygen consumption, and alleviate cardiac load, thereby improving cardiac function in patients. Exercise tolerance is an important indicator for evaluating the rehabilitation effectiveness and long-term prognosis of CHD patients. The results of this study show that, after intervention, exercise tolerance was significantly higher in the study group than in the control group. The five-stage early activity program, through progressive exercise training, can effectively enhance skeletal muscle strength and endurance, improve skeletal muscle aerobic metabolism

capacity, reduce peripheral circulation resistance, and decrease cardiac load during exercise. Additionally, regular aerobic exercise can improve patients' pulmonary ventilation and gas exchange functions, enhance cardiopulmonary synergy, and thereby improve their cardiopulmonary reserve function and exercise tolerance. As a chronic cardiovascular disease, CHD not only impairs patients' physical function but also significantly affects their psychological state, social function, and quality of life [9]. Research by Ge Shuping et al. has shown that individualized early cardiac rehabilitation after surgery can improve cardiac function and quality of life in patients. The results of this study indicate that, after intervention, the quality-of-life scores in the study group were significantly higher than those in the control group [10]. The five-stage early activity program can effectively improve patients' cardiac function and physical exercise capacity, help them gradually regain daily activity abilities, and reduce the impact of the disease on their physiological function. Additionally, achieving goals provides patients with positive psychological feedback, effectively enhancing their self-efficacy and rehabilitation confidence. Furthermore, systematic rehabilitation nursing interventions can improve patients' disease awareness and self-management abilities, helping them establish healthy lifestyles and thereby improving their overall quality of life.

5. Conclusion

In summary, cardiac rehabilitation nursing based on the five-stage early activity program can effectively improve cardiac function, significantly enhance exercise tolerance, and improve quality of life in CHD patients after PCI, demonstrating clinical value. This study was a single-center, small-sample randomized controlled trial with a relatively short follow-up period and did not conduct long-term follow-up observations on patients' long-term prognosis. Future research should involve multi-center, large-sample, long-term follow-up clinical studies to further validate the long-term application effects of this intervention model.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xue D, Zhuang R, Lv D, et al., 2024, The Development History and Current Status of Cardiac Rehabilitation for Coronary Heart Disease. China Medicine, 19(8): 1241–1245.

[2] Chang Y, Li H, 2025, Bibliometric Analysis of Research Literature on Cardiac Rehabilitation for Coronary Heart Disease at Home and Abroad in the Past 10 Years Based on CiteSpace. Chinese Journal of Evidence-Based Cardiovascular Medicine, 17(12): 1409–1415.

[3] Liu Y, Wu J, Tang W, et al., 2025, Research Progress on the Role of Cardiac Rehabilitation in the Management of Coronary Heart Disease. Medical Recapitulate, 31(10): 1218–1222.

[4] He Y, Lu Q, Zhao H, et al., 2025, Research Progress on the Application of High-Intensity Intermittent Exercise in Cardiac Rehabilitation for Elderly Patients with Coronary Heart Disease. Chinese Journal of Modern Nursing, 31(1): 89–94.

[5] Writing Group of the Chinese Guidelines for the Prevention of Cardiovascular Diseases, Editorial Board of the Chinese Journal of Cardiovascular Diseases, 2018, Chinese Guidelines for the Prevention of Cardiovascular

Diseases (2017). Chinese Journal of Cardiovascular Diseases, 46(1): 10–25.

[6] Zhang N, Zhou T, Tang M, et al., 2024, Construction and Application of an Exercise Rehabilitation Program for Elderly Patients with Coronary Heart Disease Complicated by Frailty. Journal of Nursing Science, 39(23): 30–35.

[7] Su Y, Huang Y, Liu L, et al., 2025, Analysis of the Current Status and Influencing Factors of Perceived Barriers to Cardiac Rehabilitation in Patients with Coronary Heart Disease After PCI. China Medical Herald, 22(33): 28–33 + 46.

[8] Pei L, Liu G, Li Y, 2024, Effects of Early Personalized Aerobic Exercise Cardiac Rehabilitation Training on Skeletal Muscle Functional Anti-Sympathetic Activity and Exercise Capacity in Elderly Patients with Acute Coronary Syndrome After PCI. Chinese Medical Journal, 59(7): 784–789.

[9] He Q, Xu D, Wei L, et al., 2025, Risk Factors for Quality of Life in Elderly Hospitalized Patients with Coronary Heart Disease and Their Correlation with Exercise Tolerance. Chinese Journal of Multiple Organ Diseases in the Elderly, 24(3): 166–171.

[10] Ge S, Chen W, Jia X, et al., 2024, Effects of a Cardiac Rehabilitation Program Centered on Individualized Exercise Training on Rehabilitation Outcomes in Patients with Coronary Heart Disease After Percutaneous Coronary Intervention. Journal of Practical Medicine, 40(18): 2607–2611.

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Construction and Application of a Clinical Trial Quality Risk Control System Based on the Six Sigma DMAIC Model

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Abstract: According to the DMAIC method of Six Sigma, a quality risk control system for clinical trials at the large hospital should be built, and the main risk areas and governance paths need to be determined. According to the back-end data from a third-tier Grade A hospital in 2021–2025, both industry-sponsored trials (ISTs) and investigator-initiated trials (IITs) were chosen. A total of 937 problems has been identified so far, and among them, 715 will be the subjects of this study from 2023 to 2025. The 11 risk areas have been partitioned, and according to the Pareto analysis method, frequency-based sigma (σ) priority indicators and the DMAIC process model will be used for evaluation. The first seven kinds of risk were about 89.9 per cent. The first were source data and documentation (182 items, 25.5%, σ = 2.16), and next was informed consent and participant rights (102 items, 14.3%, σ = 2.57). IIT projects had a relatively high number of problems per project compared with IST projects in general; in 2024, it was 11.80 problems per project and dropped to 6.50 in 2025. During the pre-startup quality control, there were 52 defects, and about 98.1 per cent of them have been rectified. In short, there are two types of risks in clinical trials, and among them, "vital few" refers to a small number of aggregation points in some areas. Embedding DMAIC in all links of the clinical trial process and combining it with corrective and preventive actions (CAPA) and risk-based process management will build a quality risk control system based on a structured issue database, key risk indicator (KRI) early warning mechanism, proactive prevention and closed-loop rectification.

Keywords: Six sigma; DMAIC; Clinical trial; Risk management; Quality control; On-site inspection

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1. Introduction

Clinical trials are a necessary step in the development process of drugs, medical devices and other therapies that takes them from the laboratory to practice. Recently, the joint development of innovative drug and device research, real-world studies, investigator-initiated trials (IITs) and multicenter collaborative research has expanded the scope of hospital-based clinical trials beyond standardized registered studies, and these

complex research scenarios have many different protocols and various types of data. With the expansion of the scale and complexity of the project, more problems are likely to occur in all links of the operation; thus, the old model that is only based on experience and addresses problems after they arise is no longer suitable for high-quality development.

The first reason for the quality management of clinical trials is to protect the rights, safety and interests of the subjects of the trial, and at the same time ensure the reliability and completeness of the data from clinical trials. In accordance with the 2020 Good Clinical Practice (GCP) guidelines in China and the 2022 Good Clinical Practice for Medical Device Clinical Trials, full-process quality management should also be carried out. In accordance with ICH E6(R3) and the risk-based monitoring guidance of the FDA, the monitoring resources should be employed to protect the subjects and guarantee the quality of the data [1–5]. The management of the enterprise has started to control at all links and well in advance of any problems; it seems that a proactive and risk-averse attitude has begun to form in the company's operations.

Previous studies have made many valuable contributions to the identification of risks, assessment tools and indicator systems at all stages of clinical trials, some of which have integrated PDCA or Six Sigma concepts [6,7]. Most are still in the form of qualitative summaries and do not offer specific ways to prioritize problems, catch them at the source, and address them continuously. The five stages of the DMAIC model in Six Sigma are: Define, Measure, Analyze, Improve and Control; it is a closed-loop system that has been used to solve problems in infection control and improve the overall safety of hospitals [8]. Based on the on-site inspection data from the IST and IIT projects of a tertiary Grade-A hospital in 2021–2025, this paper will present the inspection results and build an iteratively sustainable DMAIC-based quality risk control system.

2. Materials and methods

2.1. Data sources

Collect the on-site inspection data of a tertiary Grade-A hospital during the clinical trials of the IST and IIT projects from 2021 to 2025 retrospectively, and then analyze this data in this paper. The scope of the inspection included informed consent, protocol execution, protection of participant rights, study documentation, operational quality control, pre-startup quality control, etc. A total of 937 identifiable issue records were obtained, and among them, the 715 from 2023 to 2025 served as the subject of risk domain consolidation, σ based priority ranking and DMAIC control rule design. All the data was anonymized before analysis.

2.2. Data processing and inclusion criteria

Data consolidation should be carried out in line with the rule of "preserving the original semantics of the issue, standardizing statistical criteria, and avoiding duplicate inflation" and "issue category count" is the number of categories in the data, and "issue frequency" is how often the same type of issue occurs; these two indicators are shown separately. A quality control ledger entry will only be added to the statistics if there is a clear quality control checkpoint and rectification information. All the items were given the same risk group in the combined analysis based on their original data source ID.

2.3. Risk domain classification

According to the demands of GCP and the structure of the quality control form for hospitals, all the original problems have been organized into eleven risk domains: informed consent and participant rights, source data

and documentation, trial documentation and archiving management, personnel qualification/authorization and training, protocol execution and deviation management, investigational product/device management, safety event reporting, regulatory compliance document management, biological sample management, facilities/equipment and supplies management, and other management issues. The three focuses of the CFDA data verification have been covered, and it is in line with the important quality attributes in ICH E6(R3) [9].

2.4. Six sigma measurement frameworks

Historical quality control ledgers did not systematically record the total number of inspection opportunities (that is to say, the denominator) for each risk indicator, and thus the manufacturing-derived DPMO metric could not be directly used. The proportion (p) of the frequency of an issue in a particular risk area relative to the total frequency is used to calculate a standardized risk priority index as via $\sigma = \Phi^{-1}(1 - p) + 1.5$; this value is for relative ranking of data from the same source and does not need to be employed in an absolute process capability comparison of different institutions.

2.5. Statistical analysis

Descriptive statistics were used to show the distribution and proportion of the problems. To find the causes of this, Pareto analysis was employed; then, σ values were used to rank the severity of risk at all levels, and according to them, a risk governance model in line with the DMAIC process was constructed. Excel and Python were used to analyze the data, and all the charts were drawn by hand.

3. Results

3.1. Introduction to the survey results

From 2023 to 2025, the hospital has been conducting regular on-site audits of all the clinical trials it is carrying out; by consolidation, a total of 715 problems has been identified in the 39 ongoing projects (23 IST and 16 IIT).

The number of problems per IIT project was relatively high compared with that of an IST project. The two were relatively close in 2023; that is to say, IST was 4.20 issues/project and IIT was 4.60 issues/project. According to the IIT forecast in 2024, the number of problems per project will reach 11.80 and exceed the concurrent IST rate of 3.00 significantly; the main reasons for these problems are the failure to complete the CRF, inconsistency between source documents and the database, and delayed update of investigator authorization records. By 2025, the IIT issue will be 6.50 per project; however, it will still be higher than the IST rate of 5.25 per project (**Table 1**). IIT projects do not have regular supervision and support from the sponsors and contract research organizations (CROs), and the investigators are required to be responsible for both the clinical care of patients and research activities at the same time; thus, there is a higher probability of defects in the upstream process. Thus, these projects are not easy, low-risk research on the first sight.

Table 1. Categories of projects and issue statistics from on-site inspections, 2023–2025

Year	Project type	Projects inspected	Issue categories	Issue frequency	Frequency /Project	Remarks
2023	Active IST	10	18	42	4.20	
2023	Active IIT	5	16	23	4.60	
2024	Active IST	5	7	15	3.00	

2024	Active IIT	5	32	59	11.80	Concentrated surge
2025	Active IST	8	29	42	5.25	
2025	Active IIT	6	23	39	6.50	
Total	—	39	125	220	5.64	

3.2. Distribution and pareto analysis of the consolidated risk domain

After the consolidation of unified risk domains (n = 715), source data and documentation ranked first with 182 issues (25.5%, σ = 2.16); therefore, it can be concluded that the problem of inconsistency between source data and CRFs is still very serious. Informed consent and participant rights made up for 102 problems (14.3%, σ = 2.57), and they mainly took the form of non-standardized signing time points, version inconsistencies, etc. The sum of the top seven risk areas was 89.9%, as shown in **Table 2**. Trial documentation and archiving management (94 cases), personnel qualification/authorization and training (80 cases), investigational product/device management (69 cases), facilities/equipment and supplies management (58 cases) and protocol execution and deviation management (58 cases) made up the second tier.

Table 2. Distribution of risk domains, σ values and management priority from on-site inspections, 2023–2025 (n = 715)

Risk domain	Freq.	Proportion (%)	Cumul. (%)	σ value	Management level	Primary control direction
Source data and documentation	182	25.5	25.5	2.16	Level I Targeted improvement	First-case data audit, source data/CRF consistency check, logic validation
Informed consent and participant rights	102	14.3	39.7	2.57	Level I Targeted improvement	ICF version tracking, signing process checklist, compensation clause verification
Trial documentation and archiving management	94	13.1	52.9	2.62	Level II Key monitoring	ISF catalog standardization, approval filing deadlines, electronic ledger alerts
Personnel qualification/ authorization and training	80	11.2	64.1	2.72	Level II Key monitoring	Authorization/role dynamic updates, certificate alerts, role segregation
Investigational product/ device management	69	9.7	73.7	2.80	Level II Key monitoring	Receipt/dispensing/return/destruction closed-loop, temperature and humidity control
Facilities, equipment, and supplies management	58	8.1	81.8	2.90	Level II Key monitoring	Calibration certificate alerts, storage environment audits, shelf-life management
Protocol execution and deviation management	58	8.1	89.9	2.90	Level II Key monitoring	Visit window alerts, deviation reporting deadlines, IIT pre-startup review
Regulatory compliance document management	23	3.2	93.1	3.35	Level III Ongoing control	Approval expiry dates, recruitment materials, HGR/filing document management
Biological sample management	22	3.1	96.2	3.37	Level III Ongoing control	Collection/processing/transport/retention record consistency audit
Safety event reporting	17	2.4	98.6	3.48	Level III Red-line management	AE/SAE identification, 24-hour reporting and follow-up closed-loop
Other management issues	10	1.4	100.0	3.70	Level III Ongoing control	Include in issue database for review; identify institutional blind spots

σ is a normalized priority index that shows the proportion of risks based on their frequency; it is only for the relative ranking of items in the same data set.

3.3. Upstream interception effect of pre-start quality control

By 2025, the new pre-startup quality control initiative had found 52 problems in the protocols, informed consent forms, insurance, agreements, approval documents, standard operating procedures (SOPs), emergency plans, storage facilities and instrument calibration certificates. Of these, 51 were corrected, and the rectification rate was 98.1%. To reduce the risk of non-compliance due to version errors or missing documents before the start of work, it is recommended that quality control be carried out earlier in the timeline, during the pre-startup stage; thus, later rectification costs will be reduced and the quality management concept of "prevention is better than cure" will be realized.

3.4. DMAIC control rules

According to the analysis above, control rules based on DMAIC have been set up (**Table 3**). At the management level of IST and IIT, determine the attributes required for the CTQ items related to the protection of participants and data security. A measure stage is employed to construct a single problem database, and the problems are organized into three tiers according to the "main risk domain", "secondary issue type" and "tertiary issue description". Pareto and root-cause analysis will be employed here to find the underlying reasons for the risks in this section. The improvement period will carry out the three forward shifts: pre-project review, pre-first-case training and post-first-case data audit. In the control period, the KRI dashboard will still monitor the closed-loop rectification rate and the recurrence rate; although the frequency of these indicators will be low, they are highly significant and will be listed as red-line management items.

Table 3. DMAIC-based clinical trial quality risk control rules

DMAIC phase	Findings from this study	Key indicators/Tools	Improvement and control rules
D (Define)	Risks concentrated along two main themes: participant rights and data quality; IIT risk exceeds IST	CTQ, project risk classification, KRI catalog	Set stratified management objectives by IST and IIT; add pre-startup review for IIT protocols, CRF, and statistical support; contract review to assess compliance and rationality
M (Measure)	Historical ledgers exhibit multiple coexisting statistical criteria	Unified issue database, frequency, project issue rate, σ priority	Establish three-tier issue classification to prevent duplicative inflation of the same issue; data entry should be completed within 7 calendar days
A (Analyze)	Top 7 risk domains cumulatively account for 89.9%; source data/documentation and informed consent are dual high-frequency risks	Pareto chart, fishbone diagram, recurrent issue tracking	Conduct root cause reviews for informed consent, CRF/source document, and IIT composite issues; evaluate impact of protocol deviations on result reliability
I (Improve)	Pre-startup QC identified 52 issues; 51 rectified	Pre-startup checklist, ICF process checklist, first-case data audit, CAPA system	Implement three forward shifts; establish CAPA closed-loop (identification → documentation → assessment → investigation → action plan → execution → closure)
C (Control)	Low-frequency issues (SAE, expired approvals, drug/device temperature control) carry severe consequences	KRI dashboard, closed-loop rectification rate, recurrence rate	Monthly or quarterly monitoring; recurrent issues trigger SOP revision, system alerts, or targeted training; red-line indicators are monitored continuously regardless of frequency

4. Discussion

4.1. From “issue frequency” to “risk priority”: The applicability boundary of six sigma in ledger-based data

Generally, quality management ledgers for clinical trials only list the problems that have been found and do not track the total number of inspection opportunities. To use the DPMO index of manufacturing and the other statistics arbitrarily is likely to be statistically overfitted. Based on the frequency composition of risks in this study, we have derived sigma values for relative ranking to help managers know which types of risks are concentrated in the data source and should be dealt with first. In this way, they will be more comparable and not mix up the count of inspection records, the count of issue categories, and the frequency of issues.

4.2. The enduring problem of informed consent and process-oriented control

Generally speaking, the proportion of problems in informed consent was 14.3% (102 cases), and it was one of the main compliance red-line risks. There were problems with the lack of a specific signing time, missing signatures or dates, version inconsistency, and insufficient explanation of the compensation clause. Informed consent should be considered a document, but it does not have the foundation of a process. We propose to divide the process of obtaining informed consent into five stages: disclosure of information, confirmation of understanding, exercise of free will, signing and saving of the version, and then construct an ICF process audit checklist based on these stages. Projects in the IIT should specify more clearly the compensation, insurance, damage liability and privacy protection of people to avoid compliance risks due to the vagueness of the template.

4.3. Source data and documentation are the core of operational quality control

The source data and documentation were mentioned in 182 cases (25.5%) the most frequently. A reliable basis for the results of the trial is the logical consistency of the source data, CRFs and databases; the design of the CRF and standardization of data collection directly affect statistical analysis and the interpretation of results [10]. Other typical reasons are that the lab test results were submitted late, there was no signature and date on the CRF correction, or it was done off-site without a deviation report. At the beginning of the registration for first-time and early-enrolled patients, hospitals should carry out source data/CRF consistency audits, and intervention tools such as audit checklists, logic checks in the electronic data capture (EDC) system and scenario-based training can be employed. Data entry should be completed within seven calendar days after the creation of the data.

4.4. Different quality support for IIT projects

According to the data from the on-site inspection, the proportion of problems per project in IIT projects was higher than in IST projects and was relatively concentrated in 2024. Based on this pattern, sponsors and CROs are not regularly supervised in the above studies; thus, there is a higher risk that investigators may have had defects in the up-stream stage of protocol design, CRF design, data management, document archiving, etc [11]. Establish a pre-start quality control system for the IIT project in the hospital, carry out an initial feasibility assessment of the protocol, check for CRF compatibility, and jointly plan how to manage and analyze the data. If they have the funds, the hospitals will set up a support station. Projects organized by IIT in cooperation with foreign institutions should also be covered by the regulations on the approval of human genetic resources.

4.5. Do not ignore low-frequency, high-consequence risks because they are ranked low in frequency

The number of times safety accident reports were filed (17 times), the management of regulatory compliance documents (23 times), and the handling of biological samples (22 times) were relatively small; however, had any of them happened, it would have been a very serious problem. The six-sigma model will be based on the main quality indicators and not only on how many times they occur [12]. The KRI framework should have a delay in the reporting of serious adverse events (SAEs), and the disposition rate of drug/device temperature control anomalies and the non-renewal rate of expired approvals are to be included in the red-line indicators and regularly monitored, irrespective of how frequently they occur. Projects that are for the export of human genetic resources should have a special person in charge of handling regulatory filings before the start of the project.

4.6. Implementation paths

Based on the above analysis, hospitals can carry out the five stages of DMAIC. First, establish a cooperative governance system comprising an institutional review office, clinical department, project team, quality control officer, etc., clarify the responsibilities of each link, and carry out regular on-site quality supervision of high-risk projects. Second, establish a complete life-cycle risk control process to carry out risk identification at all times, from the start of the project, construction, operation, site handover, archiving, etc. Thirdly, organization and digitization of the quality control ledger will be carried out; with the help of an advanced information system, hospitals can add quality control checkpoints to the CTMS to automate the tracking of closed-loop rectification. Fourthly, in terms of the training form of situation-based teaching, we will present de-identified historical problems in the form of real cases. Fifth, build an incentive and punishment system to address the long-standing problems and reward the low-risk team that has maintained a good record. The institutions and sponsors should work together to release information and adjust the management measures accordingly.

4.7. Limitations

As it is a single-center, retrospective quality management study, the results may not be the same in other circumstances. Some of the original problem descriptions are not detailed enough, and even after classification, there may still be subjective judgment bias. Historical ledgers did not have the full opportunity-count denominator, so the σ values can only be used as a risk priority reference in the same data source and are not strict process capability assessments. The 2025 data were subject to changes in the ledger version and had an incomplete statistical cycle, so they could not be directly compared with the full calendar year. In light of the future structure of this issue database, multicenter research will be carried out; the opportunity-count denominator for each type of risk will be recorded, and KRI dynamic early-warning systems and pre-post intervention-controlled designs can be added to further assess the actual improvement effect of the DMAIC mechanism.

5. Conclusion

According to the primary concentration results of the consolidated empirical analysis of on-site inspection data from 2021 to 2025, the main areas of quality risk in clinical trials are the source data and documentation, informed consent and participant rights, trial documentation and archiving management, and personnel

qualification/authorization and training at the tertiary Grade-A hospital. The two main risks of the source data and informed consent were mentioned, and together with the other six, they accounted for 89.9 per cent. Although the number of problems in the IIT project was relatively high compared with that of the IST project, they were corrected during the pre-start stage of quality control and reached a correction rate of 98.1%; thus, a "risk-forward" strategy can be used.

The DMAIC model of Six Sigma will be employed at all stages of the clinical trial, and in cooperation with corrective and preventive actions (CAPA) and risk-based process management, a risk management system for critical quality attributes will be established [13]. An organized issue database will be built, KRIs (key risk indicators) early warning mechanisms will be introduced, and proactive prevention and closed-loop rectification will be constantly carried out. Hospitals should stop using the old way of risk assessment for clinical trials in the aftermath and take proactive prevention measures; with the help of the five paths of organizational synergy, process reengineering, digitalized ledgers, capability construction and closed-loop control, data should be used for governance rather than intuition.

6. Data statement

Only the de-identified quality management ledgers of clinical trials and summary data from on-site inspections will be employed as the secondary statistics and quality improvement basis in this paper. No personal information of the participants, investigators, departments, sponsors or particular projects will be disclosed.

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Disclosure statement

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References

[1] National Medical Products Administration, National Health Commission, 2020, Good Clinical Practice for Drug Clinical Trials (Decree No. 57 of 2020).

[2] National Medical Products Administration, National Health Commission, 2022, Good Clinical Practice for Medical Device Clinical Trials (Decree No. 28 of 2022).

[3] International Council for Harmonisation, 2025, Guideline for Good Clinical Practice E6(R3).

[4] Food and Drug Administration, 2013, Oversight of Clinical Investigations: A Risk-Based Approach to Monitoring Guidance for Industry.

[5] Food and Drug Administration, 2023, A Risk-Based Approach to Monitoring of Clinical Investigations: Questions and Answers Guidance for Industry.

[6] Liu Y, Lu M, Zhang T, et al., 2018, Risk Management Across Various Stages of Drug Clinical Trials. Drug Evaluation Research, 41(11): 2113–2116.

[7] Cheng X, Yu L, Bai W, et al., 2022, Quality Management of Drug Clinical Trials Based on Risk Management Strategies. Herald of Medicine, 41(4): 584–587.

[8] An X, Huang W, Su Y, et al., 2021, Risk Identification and Assessment of Innovative Drug Clinical Trials under the New Regulatory Environment. China Pharmacy, 32(10): 1153–1157.

[9] Zeng L, Chu H, Tao L, et al., 2021, An Introduction to Clinical Research Risk Assessment Tools. Chinese Journal of Pediatrics, 59(11): 911.

[10] Cheng X, Yang M, Lv N, et al., 2014, Quality Management of Drug Clinical Trials Based on the PDCA Cycle. Herald of Medicine, 33(8): 1111–1113.

[11] Dai J, Sun S, Xie X, 2023, Research on Quality Management and Indicator Systems for Medical Device Clinical Trials. Chinese Journal of Clinical Pharmacology and Therapeutics, 28(1): 51–58.

[12] Chen J, Lou D, 2022, Design of Oncology Clinical Trial Case Report Forms Based on CDASH Standards. Chinese Journal of Clinical Pharmacology and Therapeutics, 27(7): 762–767.

[13] Li X, Liu Y, Wang X, 2018, Problems and Countermeasures in the Supervision of Medical Device Clinical Trials. Chinese Journal of Clinical Pharmacology and Therapeutics, 23(8): 841–845.

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Clinical Research on the Improvement of Hemiplegic Gait Function through Acupoint Injection Combined with Task-Oriented Training

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Abstract: *Objective*: To explore the effect of acupoint injection combined with task-oriented training on the gait function of patients with hemiplegia. *Methods*: From January 2024 to December 2025, 90 patients with post-stroke hemiplegia admitted to the Rehabilitation Medicine Department of our hospital were selected and randomly divided into the observation group and the control group, with 45 cases in each group. The control group was given conventional rehabilitation combined with task-oriented training, while the observation group was additionally treated with acupoint injection at the Zusanli, Yanglingquan, Sanyinjiao, and Xuanzhong acupoints on the affected side. The intervention lasted for 4 weeks. The clinical efficacy, 10-meter walking time, walking speed, stride length, FMA-LE score, Berg score, and Barthel index of the two groups were compared. *Results*: The total effective rate of the observation group was 93.33%, which was higher than that of the control group (77.78%) ($p < 0.05$); after the intervention, the 10-meter walking time of the observation group decreased to 18.26 seconds, the walking speed increased to 0.57 m/s, and the stride length increased to 51.86 cm. *Conclusio*n: Acupoint injection combined with task-oriented training can improve the gait function of hemiplegia, and enhance lower limb motor control, balance ability and life activity ability.

Keywords: Acupoint injection; Task-oriented training; Hemiplegia; Gait function

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1. Introduction

Paralysis is a common manifestation of motor dysfunction after stroke and brain injury, with patients often

experiencing decreased lower limb muscle strength, weakened joint control, insufficient trunk stability, and abnormal gait patterns [1]. Impaired gait function not only affects the patient's ability to walk independently but also increases the risk of falls, reduces the level of daily activities, and delays the overall rehabilitation process [2,3]. Therefore, how to further improve the walking stability, lower limb coordination, and functional mobility of patients with paralysis after stroke on the basis of conventional rehabilitation is an important content in clinical rehabilitation treatment [4].

Task-oriented training emphasizes repetitive and goal-oriented training around actual life actions. Through tasks such as standing, center of gravity shift, stepping, crossing obstacles, and walking adjustment, it promotes patients' active participation and the reconstruction of movement patterns [5]. This training method can enhance lower limb weight-bearing control and gait adaptation ability, but the training effect is easily limited by some patients due to abnormal muscle tone, pain, local circulatory disorders, or insufficient neuromuscular excitability [6,7]. In stroke gait rehabilitation research, comprehensive intervention targeting walking ability, balance control, and motor function has been proven to have certain application value [8]. Acupoint injection combines drug stimulation with meridian regulation, and through local stimulation, meridian conduction, and drug action, it can improve the functional state of the affected limb, creating more favorable physical conditions for movement training.

Based on this, this study combined acupoint injection with task-oriented training to apply it in the rehabilitation of gait function for patients with paralysis. The study observed the effects on clinical efficacy, gait function, lower limb movement ability, balance ability, and daily living activity ability, aiming to provide a safe, operable, and clinically valuable comprehensive intervention idea for gait rehabilitation of patients with paralysis.

2. Methods

2.1. Research subjects and inclusion criteria

From January 2024 to December 2025, 90 patients with post-stroke paralysis who received treatment in the rehabilitation department of our hospital were selected as the research subjects. All patients were diagnosed by head CT or MRI, had unilateral motor dysfunction and varying degrees of gait abnormalities, stable vital signs, and could complete standing or walking training with assistance, and signed an informed consent form.

2.1.1. Inclusion criteria

Age 40–75 years; meeting the diagnostic criteria for post-stroke paralysis; disease course 2 weeks to 6 months; lower limb muscle strength grade II or above; clear consciousness, able to understand and cooperate with rehabilitation instructions.

2.1.2. Exclusion criteria

Patients with severe heart, liver, or kidney dysfunction; those with severe cognitive impairment, mental disorders, or aphasia affecting cooperation; those with lower limb fractures, joint deformities, or severe pain affecting training; those with skin infection at the injection site, abnormal coagulation function, or allergy to related drugs.

2.2. Randomization method and intervention process design

Using the random number table method, 90 patients were divided into the control group and the observation group, with 45 patients in each group. Before grouping, a dedicated person registered the age, gender, disease course, paralysis side, and initial gait function of the patients. The grouping results were confirmed by the rehabilitation therapist after the patients were enrolled, to reduce selection bias. The control group received conventional rehabilitation treatment combined with task-oriented training, and the observation group received additional acupoint injection intervention on the basis of the control group. Both groups were treated for 4 weeks, with 6 days of treatment per week. The training plan was formulated and completed status was recorded by the same rehabilitation team. During the intervention process, the vital signs, fatigue degree of the lower limbs, local injection reactions, and training tolerance of the patients were closely observed. If obvious discomfort occurred, the treatment was suspended and appropriate treatment was given. Gait function, lower limb movement function, balance ability, and daily living activity ability assessments were completed before and after the treatment.

2.3. Intervention plan for acupoint injection combined with task-oriented training

The control group received conventional rehabilitation therapy and task-oriented training, including joint movement of the affected lower limb, muscle strength induction, sitting-to-standing transfer, standing balance, center of gravity shift, step control, and walking on flat ground. During the training process, different task difficulties were set according to the patient's motor ability, such as fixed-point stepping, crossing low obstacles, turning walking, and target-distance walking. Each training session lasted 40 minutes and was conducted once a day. The observation group was additionally treated with acupoint injection therapy, selecting acupoints such as Zusanli, Yanglingquan, Sanyinjiao, and Xuanzhong on the affected side. The acupoints were disinfected conventionally and then injected with 0.5 mL of vitamin B12 solution, once every other day. During the treatment period, the training intensity was adjusted according to the patient's muscle tone, fatigue level, and gait stability to avoid excessive stretching and fatigue training. Both groups were continuously intervened for 4 weeks.

2.4. Observation indicators and statistical analysis methods

The observation indicators included clinical efficacy, gait function, lower limb motor function, balance ability, and daily living activity ability. Clinical efficacy was determined based on walking ability, control of the affected lower limb, and training completion status; gait function was evaluated using the 10 m walking test and changes in gait parameters; lower limb motor function was assessed using the Fugl-Meyer lower limb motor function score; balance ability was evaluated using the Berg balance scale; daily living activity ability was evaluated using the Barthel index. All indicators were measured before treatment and 4 weeks after treatment. Data were processed using SPSS 27.0 software. Quantitative data were expressed as mean ± standard deviation, and comparisons between groups were performed using *t*-tests; count data were expressed as the number of cases and percentages, and were analyzed using the χ^2 test. A p value < 0.05 indicated statistically significant differences.

3. Results

3.1. Comparison of baseline data of patients in different intervention groups

Before treatment, the general data and functional status of patients in the two groups were compared,

including age, gender, disease duration, side of hemiplegia, type of stroke, gait function, lower limb motor function, balance ability, and daily living activity ability. The comparison of baseline data of patients in different intervention groups is shown in **Table 1**. There were no statistically significant differences in age, gender composition, disease duration, side of hemiplegia, and type of stroke between the observation group and the control group ($p > 0.05$); there were also no significant differences in 10 m walking time, FMA-LE score, Berg score, and Barthel index before treatment ($p > 0.05$), indicating that the baseline levels of the two groups were similar and comparable.

Table 1. Comparison of baseline data of patients in different intervention groups

Project	Observation group(n = 45)	Control group(n = 45)	t/χ^2 value	p value
Age (years)	61.42 ± 7.36	60.87 ± 7.81	0.344	0.732
Gender (male/female, cases)	26/19	24/21	0.178	0.673
Duration of illness (days)	48.26 ± 15.34	50.18 ± 16.07	0.580	0.564
Side of hemiplegia (left/right, cases)	22/23	24/21	0.178	0.673
Type of stroke (ischemic/hemorrhagic, cases)	31/14	29/16	0.198	0.656
10 m walking time (seconds)	28.64 ± 5.37	29.18 ± 5.62	0.466	0.642
FMA-LE score (points)	20.46 ± 4.28	19.97 ± 4.35	0.538	0.592
Berg score (points)	31.52 ± 5.46	30.84 ± 5.73	0.576	0.566
Barthel index (points)	53.18 ± 7.64	52.46 ± 7.82	0.442	0.660

Note: Quantitative data are presented as mean ± standard deviation, and comparisons between groups are conducted using *t*-test; Count data are expressed as the number of cases, and comparisons between groups are conducted using χ^2 test. $p < 0.05$ indicates statistically significant differences.

3.2. Clinical efficacy analysis of acupoint injection combined with task-oriented training

After 4 weeks of treatment, the clinical efficacy was determined based on the recovery of the patient's walking ability, improvement of the control of the affected lower limb, completion of training tasks, and participation in daily activities. Marked improvement indicated that the patient's gait stability significantly improved and could complete functional tasks such as continuous walking, turning, and center of gravity transfer well; Effective indicated that the walking ability and lower limb control improved compared to before treatment, but still required certain assistance; Ineffective indicated that the improvement of related functions was not significant. Comparison of clinical efficacy among different intervention groups is shown in **Table 2**.

Table 2. Comparison of clinical efficacy among different intervention groups

Group	Number of cases	Efficacy	Effective	Unresponsive	Total efficacy rate
Observation group	45	29 (64.44%)	13 (28.89%)	3 (6.67%)	42 (93.33%)
Control group	45	20 (44.44%)	15 (33.33%)	10 (22.22%)	35 (77.78%)

Note: Total effective rate = (marked improvement cases + effective cases) / total cases × 100%; Comparison of total effective rates between the two groups, $\chi^2 = 4.406$, $p = 0.036$.

From **Table 2**, it can be seen that the total effective rate of the observation group was 93.33%, higher than that of the control group (77.78%), and the difference was statistically significant ($p < 0.05$). This indicates that combining acupoint injection with task-oriented training can further improve the overall

treatment effect of gait rehabilitation in patients with hemiplegia.

3.3. Improvement of gait function in patients with hemiplegia before and after intervention

Before treatment, there were no significant differences in the main gait indicators such as 10 m walking time, walking speed, and stride length between the two groups, suggesting that the basic level of gait function of the two groups was similar. After 4 weeks of treatment, the gait indicators of both groups improved compared to before treatment, and the improvement in the observation group was more significant [9]. The 10 m walking time of the observation group decreased from 28.64 s to 18.26 s, a reduction of 36.24%; the control group decreased from 29.18 s to 23.74 s, a reduction of 18.64%. At the same time, the walking speed of the observation group increased from 0.35 m/s to 0.57 m/s, and the stride length increased from 38.42 cm to 51.86 cm, both better than the post-treatment level of the control group. This indicates that acupoint injection combined with task-oriented training can play an active role in improving the control of lower limb weight-bearing, gait rhythm, and continuous walking ability. **Figure 1** shows the changes in the main gait indicators of the two groups before and after intervention.

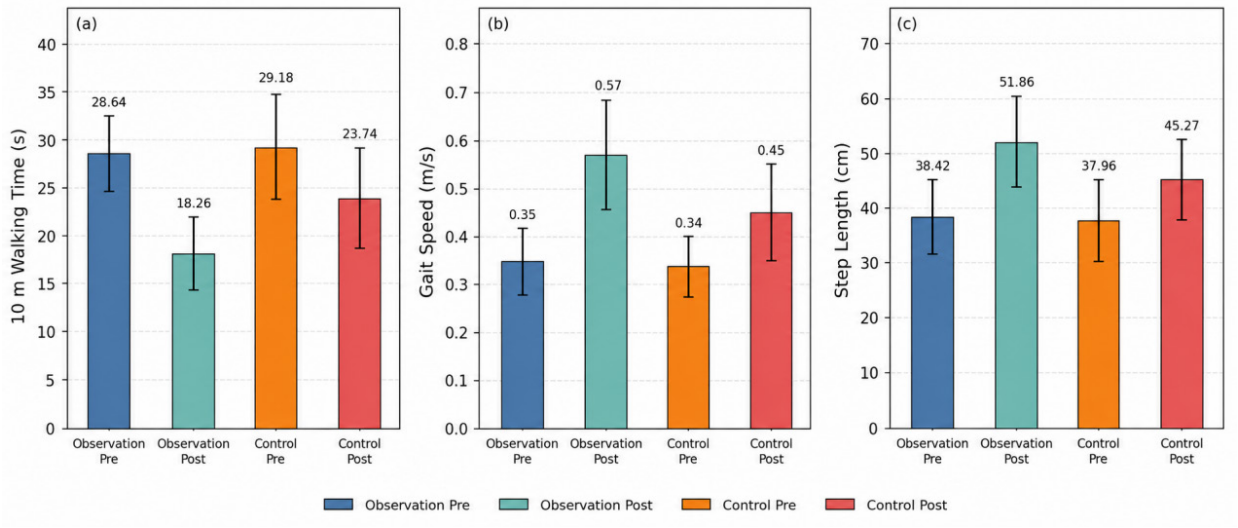


Figure 1. Changes in main gait indicators before and after intervention.

As shown in **Figure 1**, the observation group outperformed the control group in terms of shorter walking time of 10 meters, increased walking speed and increased stride length. This indicates that the combined intervention has a more significant promoting effect on the recovery of gait function in patients with hemiplegia.

3.4. Changes in lower limb motor function, balance ability and daily living activity ability

After 4 weeks of treatment, the lower limb motor function, balance ability and daily living activity ability of both groups improved compared to before treatment, but the improvement in the observation group was more significant. The FMA-LE score of the observation group increased from 20.46 ± 4.28 points to 33.28 ± 5.16 points, while that of the control group increased from 19.97 ± 4.35 points to 29.16 ± 5.02 points, suggesting that the combined intervention had a more significant effect on the recovery of separated movement, joint

control and coordinated activities of the affected lower limbs. In terms of Berg score, the observation group increased from 31.52 ± 5.46 points to 45.36 ± 6.18 points, while the control group increased from 30.84 ± 5.73 points to 39.25 ± 6.04 points, indicating that the observation group had more comprehensive improvements in standing stability, center of gravity transfer and dynamic balance control. In terms of Barthel index, the observation group increased from 53.18 ± 7.64 points to 76.42 ± 8.35 points, while the control group increased from 52.46 ± 7.82 points to 67.15 ± 8.06 points, indicating that after the improvement of gait function and lower limb control ability, patients gained more direct functional benefits in transfer, walking, toileting and daily self-care. To further present the differences in different outcome indicators between the groups, this study used a forest plot to display the improvement advantage of the observation group compared to the control group, as shown in **Figure 2**.

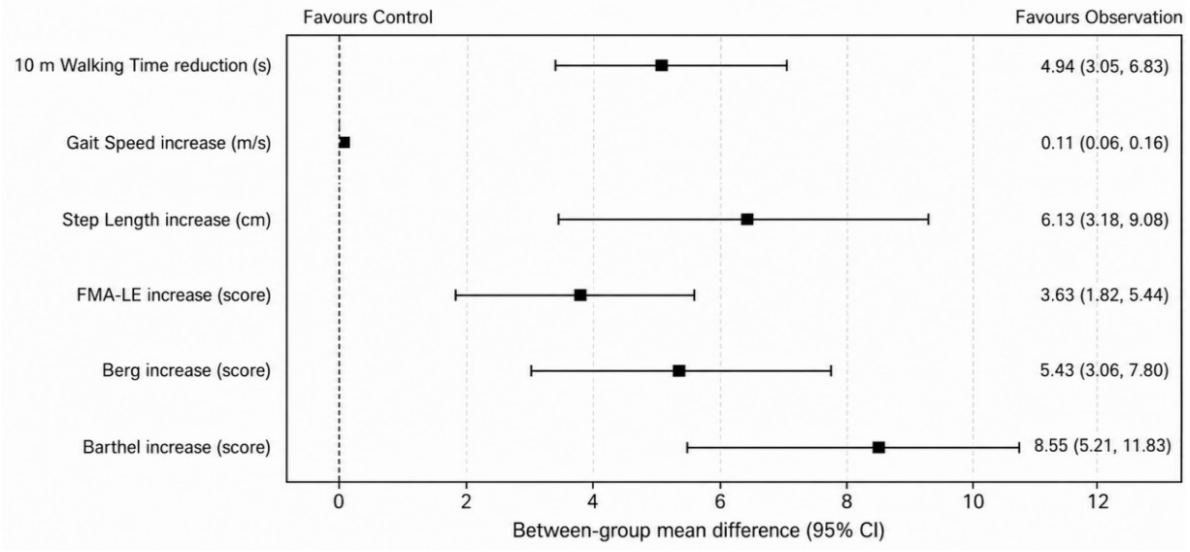


Figure 2. Forest plot of inter-group differences in the main outcome indicators.

As shown in **Figure 2**, the observation group performed better than the control group in terms of 10-meter walking time reduction, increased walking speed, increased stride length, improved FMA-LE score, improved Berg score, and improved Barthel index. The mean difference in Barthel index improvement between the groups was 8.55 points, with a 95% confidence interval of 5.21 to 11.83; the mean difference in Berg score improvement was 5.43 points, with a 95% confidence interval of 3.06 to 7.80. This suggests that the combined intervention not only improves gait performance but also promotes overall functional recovery.

To analyze the relationship between gait improvement and lower limb movement recovery, a scatter plot of the change values of FMA-LE score and the improvement values of walking speed was further drawn, as shown in **Figure 3**.

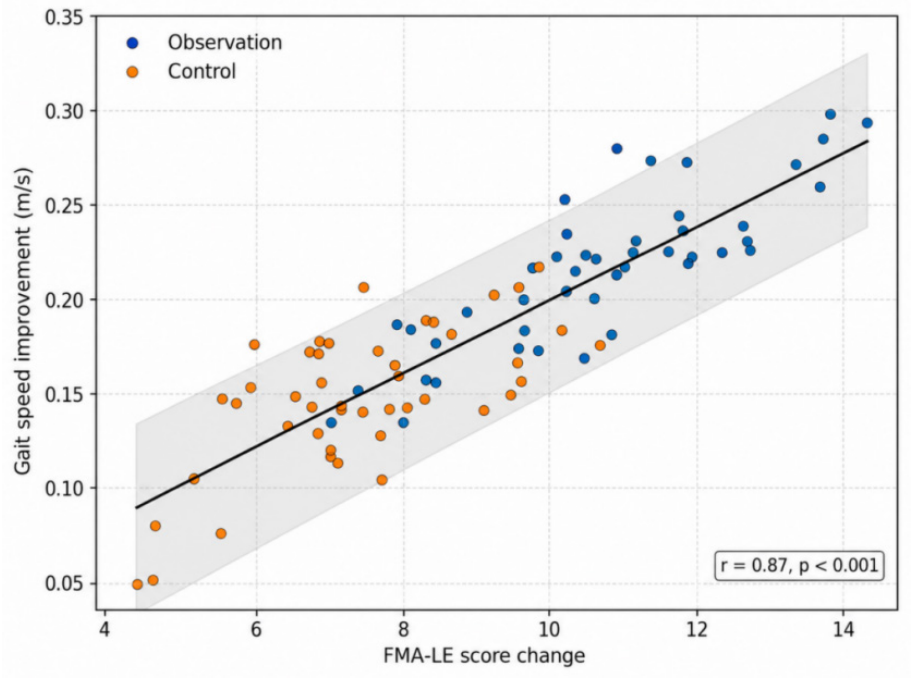


Figure 3. Scatter plot of the correlation between gait function improvement and lower limb motor recovery.

As shown in **Figure 3**, the change value of FMA-LE score was significantly positively correlated with the improvement value of gait speed, with a correlation coefficient of $r = 0.87$ and $p < 0.001$. This indicates that the more obvious the recovery of lower limb motor control, the more sufficient the improvement of gait speed. It also suggests that acupoint injection combined with task-oriented training may further promote the recovery of gait function in hemiplegic patients by improving the active control and balance regulation ability of the affected side lower limb.

4. Discussion

The gait dysfunction in hemiplegic patients is often related to decreased muscle strength on the affected side, abnormal muscle tone, insufficient joint control, and weakened balance regulation ability [10]. Although passive activities or conventional training can maintain joint range of motion and basic motor ability to some extent, they have limited improvement in walking rhythm, weight transfer, and walking adaptability in complex environments. The results of this study show that the total effective rate of the observation group is higher than that of the control group, and after treatment, the 10-meter walking time is shortened, gait speed is increased, and stride length is increased. This indicates that acupoint injection combined with task-oriented training can more effectively promote the recovery of gait function in hemiplegic patients.

Task-oriented training is based on actual gait movements as the core, integrating movements such as sitting-to-standing transfer, center of gravity control, stepping, turning, and continuous walking into the training process. This can enhance the patient's active participation and enable the affected side lower limb to gradually form a stable motor output in repetitive functional tasks. Acupoint injection improves the sensory input, muscle excitability, and local circulation state of the affected side limb through local stimulation of Zusanli, Yanglingquan, Sanyinjiao, and Xuanzhong acupoints, which helps alleviate stiffness and insufficient

movement control during training. The combination of these two methods forms a complementary effect between peripheral stimulation and active movement training, providing more continuous rehabilitation stimulation for gait pattern reconstruction.

From the comprehensive functional results, the FMA-LE, Berg score, and Barthel index of the observation group improved more than those of the control group, suggesting that gait improvement is not an isolated change but is closely related to the improvement of lower limb motor control, balance ability, and daily living ability [11,12]. Correlation analysis also shows that the change value of FMA-LE score is positively correlated with the improvement value of gait speed, indicating that the better the active control ability of the affected side lower limb, the more significant the improvement in walking efficiency. Thus, the combined intervention not only focuses on "whether one can walk" but also improves the stability and practicality of the patient's walking process [13].

This study still has certain limitations. The sample size is relatively small, and the observation period is only 4 weeks. The long-term effect on gait maintenance and recurrence risk have not been tracked. At the same time, there is still room for further optimization of the types of acupoint injection drugs, doses, and acupoint combinations. In the future, a larger sample size can be expanded, the follow-up time can be prolonged, and combined with three-dimensional gait analysis and electromyography detection, the mechanism of action can be further verified from the perspective of movement biomechanics.

5. Conclusion

The results of this study indicate that combining acupoint injection with conventional rehabilitation and task-oriented training can further improve the gait function of hemiplegic patients after stroke. The total effective rate of the observation group after treatment is 93.33%, the 10-meter walking time is shortened to 18.26 seconds, gait speed is increased to 0.57 m/s, and stride length is increased to 51.86 cm. The FMA-LE, Berg score, and Barthel index also improve more significantly. This indicates that the combined intervention can enhance the active control of the affected side lower limb, improve standing balance and walking stability, and promote the recovery of daily living ability. In the future, a larger sample size and longer follow-up can be conducted to further verify its long-term effect.

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References

[1] Feigin V, Brainin M, Norrving B, et al., 2022, World Stroke Organization (WSO): Global Stroke Fact Sheet 2022. International Journal of Stroke, 17(1): 18–29.

[2] Van Criekinge T, Heremans C, Burridge J, et al., 2024, Standardized Measurement of Balance and Mobility Post-stroke: Consensus-based Core Recommendations from the Third Stroke Recovery and Rehabilitation Roundtable. International Journal of Stroke, 19(2): 158–168.

[3] Sütçü G, Özçakar L, Yalçın A, et al., 2023, Bobath vs. Task-oriented Training After Stroke: An Assessor-blind Randomized Controlled Trial. Brain Injury, 37(7): 581–587.

[4] Ibrahim R, Abdullahi A, Salihu A, et al., 2025, Intensity of Task-specific Training for Functional Ability Post-stroke: Systematic Review and Meta-analysis. Clinical Rehabilitation, 39(9): 1133–1155.

[5] Ghrouz A, Guillen-Sola A, Morgado-Perez A, et al., 2024, The Effect of a Motor Relearning on Balance and Postural Control in Patients After Stroke: An Open-label Randomized Controlled Trial. European Stroke Journal, 9(2): 303–311.

[6] Do J, Lim W, Kim D, et al., 2024, Effects of High-intensity Interval Robot-assisted Gait Training on Cardiopulmonary Function and Walking Ability in Chronic Stroke Survivors: A Multicenter Single-blind Randomized Controlled Trial. Journal of Back and Musculoskeletal Rehabilitation, 37(5): 1309–1319.

[7] Tapp A, Griswold D, Dray D, et al., 2024, High-intensity Locomotor Training During Inpatient Rehabilitation Improves the Discharge Ambulation Function of Patients with Stroke: A Systematic Review with Meta-analysis. Topics in Stroke Rehabilitation, 31(5): 431–445.

[8] Tanaka N, Ebihara K, Ebata Y, et al., 2022, Effect of Gait Rehabilitation with a Footpad-type Locomotion Interface on Gait Ability in Subacute Stroke Patients. NeuroRehabilitation, 50(4): 401–407.

[9] Nindorera F, Nduwimana I, Thonnard J, et al., 2022, Effectiveness of Walking Training on Balance, Motor Functions, Activity, Participation and Quality of Life in People with Chronic Stroke: A Systematic Review with Meta-analysis and Meta-regression of Recent Randomized Controlled Trials. Disability and Rehabilitation, 44(15): 3760–3771.

[10] Moreno-Segura N, Martín-San Agustín R, García-Bafalluy S, et al., 2022, Effects of Core Training on Trunk Function, Balance, and Gait in Stroke Patients: A Systematic Review and Meta-analysis of Randomised Controlled Trials. Clinical Rehabilitation, 36(12): 1635–1654.

[11] Menezes-Oliveira E, Dos Anjos S, De Oliveira C, et al., 2024, Improvement of Gait and Balance Function in Chronic Post-stroke Patients Induced by Lower Extremity-Constraint Induced Movement Therapy: A Randomized Controlled Clinical Trial. Brain Injury, 38: 559–568.

[12] Nayak N, Mahendran N, Kuys S, et al., 2024, What Factors at Discharge Predict Physical Activity and Walking Outcomes 6 Months After Stroke? A Systematic Review. Clinical Rehabilitation, 38(10): 1393–1403.

[13] Khan M, Maag L, Harnegie M, et al., 2024, The Effects of Cycling on Walking Outcomes in Adults with Stroke: A Systematic Review. Topics in Stroke Rehabilitation, 31(3): 259–271.

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Nurse-Led Early Enteral Nutrition Tolerance Management Protocol for Patients with Severe Traumatic Brain Injury: A Quasi-Experimental Study

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Abstract: *Objective*: To evaluate the efficacy of a nurse-led early enteral nutrition (EN) tolerance management protocol in reducing feeding intolerance and improving nutritional outcomes among patients with severe traumatic brain injury (STBI). *Methods*: A total of 128 STBI patients admitted to the neurosurgical intensive care unit between June 2024 and June 2025 were enrolled. The control group received conventional EN care from June to December 2024, while the intervention group received the nurse-led protocol from January to June 2025. The primary outcomes were feeding intolerance incidence, target caloric achievement rate on day 4, nocturnal feeding prevalence, and ICU length of stay. *Results*: The incidence of feeding intolerance was significantly lower in the intervention group compared to the control group . The intervention group demonstrated higher target caloric achievement rates on day 4 and day 7 . Nocturnal feeding was significantly reduced , and ICU length of stay was shorter .*Conclusion*: The nurse-led early EN tolerance management protocol effectively reduces feeding intolerance, enhances early nutritional adequacy, minimizes nocturnal feeding disruptions, and shortens ICU stay for STBI patients.

Keywords: Severe traumatic brain injury; Enteral nutrition; Feeding intolerance; Nurse-led care; Tolerance management; Neurocritical care

Online publication: May 31, 2026

1. Introduction

Severe traumatic brain injury (STBI) represents a leading cause of mortality and morbidity in neurosurgical intensive care units, characterized by hypermetabolism and hypercatabolism that significantly increase energy expenditure [1]. Early enteral nutrition (EEN) is universally recommended by clinical practice guidelines to preserve gut barrier integrity, prevent bacterial translocation, and reduce infectious complications [2,3]. However, STBI patients frequently experience feeding intolerance (FI) due to intracranial hypertension,

autonomic dysfunction, and gastrointestinal dysmotility, with reported incidence rates ranging from 30% to 60% [4].

Conventional EN management typically follows a physician-directed, nurse-executed model that lacks systematic tolerance assessment protocols. This reactive approach often results in delayed recognition of FI and interruption of nutritional support, compromising patient outcomes [5]. Nurse-led management models have demonstrated promise in various critical care contexts, leveraging nurses' continuous bedside presence and clinical assessment capabilities [6]. Nevertheless, structured nurse-led protocols specifically designed for STBI patients remain underdeveloped [7].

This study aimed to develop and evaluate a nurse-led early EN tolerance management protocol tailored to the pathophysiological characteristics of STBI patients, hypothesizing that proactive nurse-led interventions would reduce FI incidence and improve nutritional delivery efficiency.

2. Methods

2.1. Study design and setting

This quasi-experimental study employed a historical control design conducted in a tertiary hospital's neurosurgical ICU in China. The study period spanned June 2024 to June 2025, with the control phase (June–December 2024) preceding the intervention phase (January–June 2025).

2.2. Participants

Convenience sampling was used to recruit 128 adult patients with STBI.

2.2.1. Inclusion criteria

(1) Diagnosis of severe TBI per the Chinese Guidelines for the Management of Traumatic Brain Injury with Glasgow Coma Scale (GCS) scores of 3–8 [8];
(2) Age ≥18 years;
(3) ICU admission ≥ 72 hours;
(4) Hemodynamic stability with EN indications;
(5) Informed consent from legal representatives

2.2.2. Exclusion criteria

(1) Contraindications to EN (e.g., gastrointestinal perforation, obstruction, active bleeding);
(2) Severe hepatic or renal dysfunction;
(3) Pre-existing malnutrition;
(4) Death or discharge within 24 hours.

2.3. Interventions

2.3.1. Control group

Patients received standard EN care per physician orders. Nasogastric or Naso-jejunal tubes were placed within 24–48 hours of admission, with continuous pump feeding initiated at 20–30 mL/h and titrated upward. Gastric residual volume (GRV) was assessed every 4 hours; feeding was paused and physicians notified when GRV exceeded 200 mL.

2.3.2. Intervention group

Patients received the nurse-led early EN tolerance management protocol comprising four components:

(1) Multidisciplinary nutrition management team

Led by the ICU nurse manager and comprising a certified critical care nurse specialist and eight senior staff nurses, the team developed standardized assessment tools and intervention algorithms based on current evidence and guidelines.

(2) Multidimensional FI dynamic assessment

A validated Enteral Nutrition Tolerance Scoring System was implemented, evaluating four domains: gastric retention (0–3 points), abdominal distension/intra-abdominal pressure (0–3 points), bowel motility/defecation (0–2 points), and nausea/vomiting/reflux (0–2 points), with total scores ranging from 0–10. Responsible nurses conducted assessments every 6 hours, classifying tolerance as: complete (0–2 points), mild intolerance (3–5 points), or severe intolerance (6–10 points).

(3) Nurse-led tiered intervention authorization

Nurses were empowered to implement interventions based on tolerance scores without awaiting physician orders: (a) Complete tolerance: maintain current rate with planned escalation (10–20 mL/h every 8–12 hours); (b) Mild intolerance: implement physical interventions (abdominal massage, warm foot baths), repositioning (30–45° head elevation, right lateral positioning), and reduce infusion rate by 50%; (c) Severe intolerance: suspend EN, aspirate GRV, and notify physicians immediately.

(4) Optimized GRV monitoring and nocturnal feeding management

A "blind Naso-jejunal tube placement first" strategy was adopted for high-risk patients. A "nocturnal feeding rest period" protocol was established: patients achieving ≥ 80% of daily caloric targets by 20:00 had EN paused or reduced to basal rates (10–15 mL/h) from 22:00 to 06:00 to preserve circadian rhythms and reduce aspiration risk.

2.4. Outcome measures

2.4.1. Primary outcomes

(1) Feeding intolerance incidence, defined by the presence of any: vomiting or visible reflux; GRV > 250 mL; abdominal distension with intra-abdominal pressure ≥ 20 mmHg; or diarrhea (≥ 3 loose stools/day totaling > 250 mL) [9].

(2) Target caloric achievement rate on day 4, defined as receiving ≥ 80% of target calories (25–30 kcal/kg/day) [10].

2.4.2. Secondary outcomes

(1) Nocturnal feeding prevalence (patients receiving therapeutic-rate EN between 20:00–06:00)

(2) ICU length of stay

2.5. Statistical analysis

Data were analyzed using SPSS 26.0. Continuous variables with normal distribution were expressed as mean ± standard deviation and compared using independent samples *t*-tests. Categorical variables were expressed as frequencies and percentages, compared using chi-square tests. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Baseline characteristics

The control group and intervention group were comparable in demographic and clinical characteristics (all $p > 0.05$). Mean ages were 52.46 ± 11.23 and 53.12 ± 10.85 years, respectively; GCS scores were 5.84 ± 1.42 and 5.76 ± 1.38; and surgical intervention rates were 65.1% and 66.2%.

3.2. Feeding intolerance incidence

Total FI incidence was significantly lower in the intervention group compared to the control group . Specifically, GRV > 250 mL occurred less frequently in the intervention group . Other FI components showed directional but non-significant reductions (**Table 1**).

Table 1. Comparison of feeding intolerance occurrence between groups [n (%)]

Variable	Control group(n = 63)	Intervention group(n = 65)	value	*p* value
GRV > 250 mL	15 (23.81)	6 (9.23)	5.063	0.024
Abdominal distension	10 (15.87)	4 (6.15)	3.114	0.078
Vomiting/Reflux	6 (9.52)	2 (3.08)	2.29	0.13
Diarrhea	8 (12.70)	3 (4.62)	2.731	0.098
Total FI	25 (39.68)	12 (18.46)	7.156	0.007

3.3. Nutritional adequacy

Target caloric achievement rates were significantly higher in the intervention group on both day 4 and day 7 (**Table 2**).

Table 2. Comparison of target caloric achievement rates [n (%)]

Timepoint	Control group(n = 63)	Intervention group (n = 65)	χ^2 value	*p* value
Day 4	28 (44.44)	46 (70.77)	9.098	0.003
Day 7	45 (71.43)	56 (86.15)	4.165	0.041

3.4. Nocturnal feeding and ICU stay

Nocturnal feeding prevalence was significantly lower in the intervention group compared to the control group . ICU length of stay was significantly shorter in the intervention group .

4. Discussion

This study demonstrates that a nurse-led early EN tolerance management protocol significantly reduces feeding intolerance, improves nutritional adequacy, minimizes nocturnal feeding disruptions, and shortens ICU stay for STBI patients [11,12]. The 21.22 percentage point reduction in FI incidence aligns with international studies implementing nurse-driven EN protocols.

The protocol's efficacy stems from three key innovations. First, the multidimensional assessment tool enables early FI identification beyond isolated GRV monitoring, capturing the complex gastrointestinal dysfunction characteristic of STBI [13]. Second, the tiered intervention authorization empowers nurses to implement timely, evidence-based modifications without awaiting physician orders, reducing decision-

to-action time and preventing nutritional interruptions [14]. Third, the circadian-conscious feeding strategy aligns with physiological gastrointestinal rhythms, potentially enhancing nutrient absorption while reducing aspiration risk during sleep periods [15].

The reduction in nocturnal feeding carries dual clinical significance. Physiologically, it allows gastrointestinal rest and preserves microbiome circadian patterns [16]. Clinically, it reduces nursing interventions during sleep periods, potentially improving sleep quality and reducing ICU-acquired delirium and weakness. The observed 3.4-day reduction in ICU stay likely reflects the combined benefits of reduced FI-related complications, improved nutritional status, and enhanced sleep quality [17].

The study has limitations. The quasi-experimental design without randomization may introduce selection bias, though consecutive sampling and comparable baseline characteristics mitigate this concern. The single-center setting limits generalizability, warranting multi-site validation. Additionally, long-term neurological outcomes were not assessed [18].

5. Conclusion

The nurse-led early EN tolerance management protocol represents an effective, scalable intervention for optimizing nutritional support in STBI patients. By leveraging nurses' continuous presence and clinical expertise through standardized assessment tools and tiered intervention authorization, this model enhances nutritional outcomes while reducing ICU resource utilization. Implementation of similar protocols in neurocritical care settings should be considered.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Chinese Society of Neurosurgery, 2022, Chinese Expert Consensus on Early Rehabilitation Management of Severe Traumatic Brain Injury (2022 Edition). Chin J Neurosurg, 38(6): 541–551.

[2] Li L, Wang X, Li C, 2020, Research Progress on Early Enteral Nutrition Support in Patients with Severe Traumatic Brain Injury. Chin J Nurs, 55(3): 456–460.

[3] McClave S, Taylor B, Martindale R, et al., 2016, Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: SCCM and A.S.P.E.N. JPEN J Parenter Enteral Nutr, 40(2): 159–211.

[4] Reintam Blaser A, Starkopf J, Alhazzani W, et al., 2017, Early Enteral Nutrition in Critically Ill Patients: ESICM Clinical Practice Guidelines. Intensive Care Med, 43(3): 380–398.

[5] Zhang Y, Yang L, Wang X, 2019, Meta-analysis of Risk Factors for Enteral Nutrition Feeding Intolerance in ICU Patients. Chin Nurs Manag, 19(8): 1181–1187.

[6] Xu L, Li Q, Han B, 2021, Application of Nurse-led Nutrition Support Management Model in ICU Patients. J Nurs Sci, 36(12): 97–100.

[7] Padar M, Uusvel G, Starkopf J, et al., 2019, Implementation of a Nurse-driven Enteral Nutrition Protocol in an Intensive Care Unit: A Before-and-after Study. J Clin Nurs, 28(23–24): 4384–4392.

[8] Zhou M, Zhang C, Tian Y, 2020, Development and Validation of a Feeding Intolerance Assessment Scale for

Critically Ill Patients. Chin Crit Care Med, 32(9): 1097–1101.

[9] Reintam Blaser A, Malbrain M, Starkopf J, et al., 2012, Gastrointestinal Function in Intensive Care Patients: Terminology, Definitions and Management. Recommendations of the ESICM Working Group on Abdominal Problems. Intensive Care Med, 38(3): 384–394.

[10] Liu F, Zhao H, Sun J, 2022, Application of Nurse-led Enteral Nutrition Tolerance Management in Neurocritical Patients. Chin J Pract Nurs, 38(15): 1145–1150.

[11] Wang Z, Zhang L, Chen W, et al., 2021, A Nurse-led Enteral Nutrition Tolerance Management Protocol for Critically Ill Patients: A Quasi-experimental Study. J Adv Nurs, 77(8): 3426–3435.

[12] Chen L, Wang F, Li P, 2020, Research Progress on Gastrointestinal Dysmotility Mechanism and Nursing Intervention in Severe Traumatic Brain Injury Patients. J Nurses Train, 35(14): 1276–1279.

[13] Sun Q, Wang X, 2019, Application Progress of Short-peptide Enteral Nutrition Formulations in Critically Ill Patients. Parenter Enteral Nutr, 26(5): 311–314.

[14] Yang X, Wu G, 2018, Biological Rhythms and Enteral Nutrition: From Basic to Clinical. Chin J Gastrointest Surg, 21(12): 1428–1432.

[15] Wei X, Day A, Ouellette D, et al., 2019, The Association Between Nutritional Adequacy and 28-day Mortality in the Critically Ill. Crit Care, 23(1): 323.

[16] Zhang H, Li L, Wang Y, 2020, Effect of Early Enteral Nutrition on Prognosis of Severe Traumatic Brain Injury Patients. Chin J Trauma, 36(5): 432–437.

[17] Voigt R, Forsyth C, Keshavarzian A, 2019, Circadian Rhythms: A Regulator of Gastrointestinal Health and Dysfunction. Expert Rev Gastroenterol Hepatol, 13(5): 411–424.

[18] Heyland D, Stephens K, Day A, et al., 2011, The Success of Enteral Nutrition and ICU-acquired Infections: A Multicenter Observational Study. Clin Nutr, 30(2): 148–155.

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Research Progress on Improving Chronic Inflammation and Endothelial Function of Coronary Atherosclerotic Heart Disease with Integrated Traditional Chinese and Western Medicine

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Abstract: The progression of coronary atherosclerotic heart disease (CAD) is closely associated with the persistent activation of chronic low-grade inflammation and vascular endothelial dysfunction. Although percutaneous coronary intervention (PCI) can effectively improve myocardial ischemia, patients often exhibit elevated inflammatory burden, insufficient endothelial repair, and impaired microcirculatory perfusion postoperatively, thereby contributing to a sustained residual cardiovascular risk. In recent years, integrated traditional Chinese (TCM) and Western medicine therapy have demonstrated advantages in multi-targeted, systematic, and comprehensive regulation to interrupt the vicious cycle of inflammatory responses and endothelial damage. This article reviews the modern pathological mechanisms of chronic inflammation and endothelial dysfunction in coronary atherosclerotic heart disease and explores the underlying pathogenesis from a TCM perspective. Within this framework, this article summarizes the foundational and clinical research progress on anti-inflammatory and endothelial protective effects of TCM through regulating inflammatory signaling pathways, protecting the endothelial glycocalyx, improving blood flow shear stress, and modulating immune metabolism. Finally, this article analyzes the limitations of current research in terms of the quality of evidence, the objectification of syndromes, and the elucidation of the material basis for efficacy of Chinese herbal medicine, and outlines future directions for translational medicine research, with the aim of providing a basis for optimizing integrated TCM and Western medicine prevention and treatment strategies for CHD.

Keywords: Coronary atherosclerotic heart disease; Integrated traditional Chinese and Western medicine; Chronic inflammation; Endothelial dysfunction; Residual risk; Microcirculation

Online publication: May 31, 2026

1. Introduction

Over the past two decades, significant advances have been achieved in the diagnosis and treatment of coronary atherosclerotic heart disease (CAD). Strategies including percutaneous coronary intervention (PCI), intensive lipid-lowering therapy, and antiplatelet therapy have effectively reduced the incidence of acute cardiovascular events, with marked improvements in revascularization rates and plaque stability [1]. However, revascularization does not mean the termination of the pathological process. A considerable proportion of patients still suffer from recurrent chest pain, reduced exercise tolerance, persistently elevated inflammatory markers, and impaired flow-mediated vasodilation postoperatively. This suggests that conventional treatments are insufficient to fully regulate the underlying pathological mechanisms of disease progression, and residual cardiovascular risk remains a key factor affecting long-term prognosis [2].

Recent studies have shown that the persistent activation of chronic low-grade inflammation and endothelial dysfunction mutually reinforce each other, jointly driving a series of pathological processes such as plaque formation, impaired microcirculatory perfusion, and reperfusion injury [3]. Among these, abnormalities such as NOD-like receptor protein 3 (NLRP3) inflammasome-mediated pro-inflammatory cytokine release, cascade amplification of the nuclear factor-kappa B (NF-κB) signaling pathway, disruption of the endothelial glycocalyx, and reduced nitric oxide (NO) bioavailability form an irreversible "inflammation–endothelial" dual-axis pathological framework [4].

Traditional Chinese medicine (TCM) recognizes the pathogenesis of chest impediment and cardiac pain as involving "toxin damaging the heart collaterals", "Qi deficiency and blood stasis", and "phlegm turbidity obstruction", which share some similarities with the chronic inflammation, energy metabolism disorders, and microcirculatory damage revealed by modern pathophysiology [5]. With the advancement of technologies such as metabolomics and single-cell sequencing, the molecular and biochemical bases of TCM syndromes have become increasingly elucidated, providing verifiable biological support for the holistic regulatory strategy emphasized in syndrome differentiation and treatment [6].

In recent years, TCM has demonstrated comprehensive, multi-targeted, and multi-level advantages in regulating inflammatory signaling, improving endothelial responsiveness, and stabilizing the cardiovascular microenvironment. Certain active components of Chinese materia medica can interfere with inflammasome assembly, inhibit oxidative stress, and modulate immune polarization; studies have also confirmed that they can upregulate the PI3K/Akt/eNOS signaling pathway, protect the endothelial glycocalyx structure, and improve microcirculatory perfusion [7]. These findings provide new therapeutic insights for regulating the "inflammation–endothelial" pathological axis and lay a theoretical foundation for repositioning TCM in the management of CAD.

2. Modern mechanisms of chronic inflammation and endothelial dysfunction in CAD

Coronary atherosclerosis is not merely a process of lipid deposition, but rather a persistent pathological event driven by immune activation and repeated vascular wall injury against a backdrop of lipid imbalance. Extensive research indicates that chronic low-grade inflammation and vascular endothelial dysfunction run throughout the entire course of atherosclerosis; together, they form a mutually reinforcing pathological axis that serves as the core driver of CAD progression [8].

2.1. Chronic inflammation: The sustained driver of atherosclerosis

Dyslipidemia marks the onset of atherosclerosis, yet the long-term immune response to intimal lipid deposits and cellular debris is what truly governs plaque evolution and vulnerability [9]. Key mechanisms include inflammasome activation and pro-inflammatory cytokine release, cascade amplification of inflammatory signals, and dysregulated macrophage polarization. The NLRP3 inflammasome serves as a critical danger signal recognition mechanism in atherosclerosis. Stimuli such as cholesterol crystals and oxidized low-density lipoprotein (LDL) can induce its assembly and activate caspase-1, thereby promoting the maturation and release of (interleukin-1 beta) IL-1β and interleukin-18 (IL-18) [10]. These factors not only amplify local inflammation but also drive smooth muscle cell migration, expansion of the necrotic core, and thinning of the fibrous cap, thereby increasing plaque vulnerability. The NF-κB signaling pathway is highly active in endothelial and immune cells, upregulating adhesion molecules such as vascular cell adhesion molecule-1 (VCAM-1) and intercellular adhesion molecule-1 (ICAM-1). This promotes monocyte adhesion and infiltration, forming a positive feedback loop of "infiltration–activation–re-infiltration" that underpins persistent plaque progression [11]. A high-lip microenvironment and pro-inflammatory stimuli drive macrophages migration toward the M1 phenotype, resulting in the excessive production of matrix metalloproteinases (MMPs) and the destruction of the fibrous cap structure, while the reparative M2 phenotype decreases, making it difficult to restore plaque homeostasis [12]. Landmark trials such as CANTOS have demonstrated that IL-1β blockade significantly reduces recurrent cardiovascular events, further highlighting the central role of inflammation in residual risk management [13]. In summary, the inflammatory response is not merely a concomitant phenomenon, but a critical basis driving plaque instability and clinical events.

2.2. Endothelial dysfunction: From structural damage to microcirculatory failure

The vascular endothelium is a highly active metabolic and signaling structure involved in regulating vasodilation, coagulation, inflammation, and permeability. Its functional decline plays a pivotal role in the progression of CAD [14]. Key processes include decreased NO bioavailability and endothelial nitric oxide synthase (eNOS) uncoupling, disruption of the endothelial glycocalyx and altered permeability, as well as a procoagulant state and increased susceptibility to microthrombosis. Under enhanced oxidative stress, eNOS shifts from a NO-producing coupled state to a superoxide-producing uncoupled state, resulting in reduced NO levels and elevated free radicals levels. This causes an imbalance in the NO/endothelin 1 (ET-1) ratio, resulting in decreased flow-mediated dilation (FMD), increased coronary microvascular resistance, and impaired vascular compliance [15]. The glycocalyx serves as a critical protective barrier on the endothelial surface, participating in shear stress sensing, anti-inflammation, and the regulation of permeability. Upon its disruption, endothelial adhesion molecules are exposed and leukocyte adhesion increases, thereby accelerating inflammatory cell the infiltration and forming a secondary feedback loop of "endothelial injury–inflammatory infiltration" [16]. Endothelial injury can promote increased expression of von Willebrand factor (vWF) and tissue factor, leading to a local hypercoagulable state. This not only aggravates microcirculatory dysfunction but also increases the risk of microembolism and reperfusion injury following percutaneous coronary intervention (PCI) [17]. Overall, endothelial dysfunction reflects impaired vascular regulatory capacity and serves as an important pathological basis for microcirculatory abnormalities and the persistence of symptoms.

3. Modern biological basis of TCM pathogenesis in CAD

Although traditional medical literature does not use modern terms such as "endothelial dysfunction" or "inflammasome", its understanding of the pathogenesis of conditions such as chest impediment and cardiac pain, embodied in TCM theories of "deficiency at the root and excess at the branch", "combined deficiency and excess" and "Qi-blood disharmony", aligns with modern understanding of the pathological processes of CAD at multiple levels. With the development of multi-omics technologies, systems biology, and network pharmacology, the biological basis of TCM pathogenesis has gradually been clarified, providing pattern differentiation with quantifiable and verifiable modern interpretations [18].

3.1. Qi deficiency pattern: Insufficient energy metabolism and mitochondrial dysfunction

TCM holds that "Qi is the commander of blood". Qi deficiency manifests as fatigue, shortness of breath, and palpitations, reflecting a diminished capacity to to propel blood circulation and generate essence and Qi. In animal models of Qi deficiency and some patients with CHD, reduced ATP synthase activity and decreased membrane potential have been observed, leading to low energy of cardiomyocytes [19]. Insufficient activity of the AMP-activated protein kinase (AMPK)/PGC-1α signaling axis leads to impaired regulation of mitochondrial biogenesis and autophagy [20]. Patients with Qi deficiency often present with reduced heart rate variability (HRV), which is associated with impaired myocardial tolerance to ischemia and oxidative stress [21]. Therefore, "Qi deficiency" can be regarded as a state of systemic downregulation of the myocardial energy metabolism network, making the heart vulnerable to injury and laying the foundation for subsequent inflammation and microcirculatory dysfunction.

3.2. Blood stasis pattern: A comprehensive manifestation of endothelial activation, blood viscosity, and coagulation-fibrinolysis imbalance

"Blood stasis" is one of the concepts in TCM pathogenesis that most closely resembles the pathological essence of atherosclerosis, manifesting as stabbing chest pain, purplish tongue, and hesitant pulse. Decreased eNOS activity and an imbalanced NO/ET-1 ratio predispose blood vessels to vasoconstriction [22]. Patients with blood stasis often show elevated ICAM-1 and VCAM-1 levels, which facilitate leukocyte and platelet adhesion and thereby establish an inflammatory microcirculatory environment [23]. Enhanced platelet activation and elevated levels of P-selectin and platelet activating factor (PAF) contribute to a hyperviscous and hypercoagulable state [24]. These changes collectively result in "vessel obstruction", which closely aligns with clinical characteristics of CAD, such as inadequate microcirculatory perfusion and worsening chest pain after exercise. These findings also provide a modern biological basis for elucidating the mechanism by which blood-activating and stasis-resolving medicinal improve endothelial function and reduce blood viscosity.

3.3. Phlegm turbidity pattern: Lipid metabolism disorders, lipotoxicity, and immune-metabolic imbalance

In TCM, "phlegm turbidity" refers to body fluid metabolism disorders and viscous obstruction; its modern biological basis centers on lipid metabolism abnormalities and metabolic inflammation. Patients with phlegm turbidity pattern often present with elevated small dense low-density lipoprotein (sdLDL) and triglycerides levels and are prone to macrophage lipid uptake via receptors including CD36, thereby promoting foam cell formation [25]. Obesity-related adipokine imbalance (e.g., elevated leptin and decreased adiponectin) can trigger systemic low-grade inflammation [26]. Abnormalities in metabolic pathways such as mammalian

target of rapamycin (mTOR) and peroxisome-proliferator-activated receptor (PPAR) make the cardiovascular system more susceptible to oxidative stress and lipotoxicity [27]. Consequently, "phlegm-turbidity" can be understood as a state of systemic metabolic stress and lipid accumulation, serving as a key contributing factor to the development and progression of atherosclerosis.

4. Molecular mechanisms of TCM in improving chronic inflammation and endothelial function

TCM is characterized by holistic regulation and multi-target intervention in the treatment of CAD. With advancements in molecular biology, systems pharmacology, and imaging technologies, the mechanisms by which TCM modulates inflammatory responses and maintains endothelial function are gradually shifting from empirical understanding to verifiable biological frameworks. Extensive research shows that active components of Chinese materia medica and classical formulas can act on multiple critical nodes, including inflammasomes, oxidative stress regulation, glycocalyx repair, NO synthesis, and immune-metabolic pathways, thereby intervening in the "inflammation–endothelial" pathological axis.

4.1. Precise regulation of inflammatory responses: Weakening the inflammatory amplification chain at its source

Inflammation is a key driver of the pathological progression of CAD. The core of TCM therapeutic approaches such as "clearing heat and removing toxins" and "activating blood circulation and unblocking collaterals" lies in suppressing abnormal inflammatory responses and excessive immune activation. Modern research reveals that various types of Chinese materia medica can exert inhibitory effects on the upstream stages of the inflammatory process. Inhibiting the overactivation of the NLRP3 inflammasome, an essential initiating node in the inflammatory amplification cascade of atherosclerosis, is particularly crucial, as its abnormal activation induces the sustained release of IL-1β and IL-18 [28]. Studies have shown that tanshinone IIA can reduce mitochondrial reactive oxygen species (ROS) production, thereby inhibiting NLRP3 assembly at its source; baicalin can downregulate the expression of caspase-1 and apoptosis-associated speck-like protein with CARD domain (ASC) proteins and reduce the level of inflammasome activation [29]. These effects are highly consistent with modern research and development strategies for identifying NLRP3-targeted inhibitors, suggesting that certain Chinese materia medica components have potential anti-inflammasome activity. Blocking the nuclear translocation and signal amplification of the NF-κB pathway: NF-κB serves as the central hub of the pro-inflammatory transcriptional network; its activation enhances the expression of adhesion molecules and promotes immune cell infiltration. Studies have shown that ligustrazine can inhibit IκBα phosphorylation, thereby blocking NF-κB/p65 nuclear translocation; *Panax notoginseng* saponins (PNS) can inhibit tumor necrosis factor-α (TNF-α) and interleukin-6 (IL-6) expression, forming a "negative feedback" regulation of the inflammatory response. Regulating macrophage polarization to restore immune homeostasis: Macrophage phenotypic transformation within plaques determines the inflammation progression. Certain compound formulations, such as Danhong Injection, have been confirmed to promote M1-to-M2 polarization, reduce the release of MMPs and pro-inflammatory cytokines; and enhance plaque stability [30]. The TCM therapeutic principle of "regulating without suppression" in maintaining immune homeostasis aligns with the current direction of modern immunomodulatory drug development.

4.2. Multilevel restoration of endothelial homeostasis: Reconstructing the vascular "defensive barrier"

The vascular endothelium is central to maintaining vascular vasodilation, anticoagulation, and inflammatory balance. TCM therapeutic approaches such as promoting blood circulation, tonifying Qi, and nourishing yin have demonstrated definite endothelial protective effects in modern research.

(1) Activating the PI3K/Akt/eNOS pathway and enhancing NO bioavailability. NO is a key factor in maintaining vasodilation and inhibiting platelet adhesion. Astragaloside IV can promote Akt phosphorylation, increase eNOS activity, improve eNOS uncoupling, and enhance NO production, which is consistent with clinical findings of improved fibromuscular dysplasia (FMD) and increased exercise tolerance.

(2) Activating the nuclear factor-erythroid 2-related factor 2 (Nrf2) antioxidant pathway and mitigating oxidative stress damage. Oxidative stress is a major contributor to endothelial injury and inflammation. Ginsenoside Rg1 can enhance Nrf2 nuclear translocation and upregulate antioxidant enzymes such as heme oxygenase-1 (HO-1) and quinone oxidoreductase 1 (NQO1) [31]. Quercetin can remove excess ROS and alleviate reperfusion injury. This mechanism provides a molecular basis for the application of TCM in endothelial repair following percutaneous coronary intervention.

(3) Inhibiting the expression of adhesion molecules and reducing the aggregation of inflammatory cells. Blood-activating and stasis-resolving medicinal, such as salvianolate, can downregulate the expression of ICAM-1 and VCAM-1, thereby reducing leukocyte adhesion and trans-endothelial migration; this effect is of significant importance for reversing the inflammatory burden in the microcirculation [32].

5. Conclusion

The development and progression of CAD are driven by a dual mechanism involving chronic low-grade inflammation and vascular endothelial dysfunction. This "inflammation–endothelial" pathological axis not only determines plaque formation, evolution, and vulnerability but also profoundly impacts the quality of microcirculatory perfusion and long-term prognosis following revascularization [33]. Although current standard treatments have achieved remarkable success in improving coronary patency, stabilizing plaques, and controlling risk factors, there remains an inadequate intervention targeting the mutually reinforcing processes between inflammation and endothelial function, resulting in residual cardiovascular risk that is difficult to eliminate.

Against this backdrop, TCM, characterized by holistic regulation and multi-pathway, multi-target interventions, can exert compensatory advantages in suppressing inflammatory responses, protecting endothelial structure, improving microcirculatory perfusion, and regulating metabolic homeostasis. In recent years, basic and clinical studies have continuously revealed the key molecular mechanisms underlying these effects, providing a biologically based explanation for TCM concepts such as "toxin damaging the heart collaterals" and "stasis obstructing the vessels". This also highlights the value of integrated TCM and Western medicine in the management of CAH.

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References

[1] Levine G, Bates E, Blankenship J, et al., 2011, 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention. Journal of the American College of Cardiology, 58(24): e44–e122.

[2] Serruys P, 2021, Coronary Syndromes After PCI. Lancet, 398(10294): 1233–1246.

[3] Libby P, 2021, Inflammation in Atherosclerosis. Nature, 592: 524–533.

[4] Toldo S, Abbate A, 2018, The NLRP3 Inflammasome in Acute Myocardial Infarction. Nature Reviews Cardiology, 15(4): 203–214.

[5] Hu D, 2020, Expert Consensus on the Diagnosis and Treatment of Coronary Atherosclerotic Heart Disease with Integrated Traditional Chinese and Western Medicine (2020). Chinese Journal of Internal Medicine, 59(4): 261–270.

[6] Zhang A, 2018, Metabolomics in TCM Syndrome Research. Journal of Ethnopharmacology, 213: 310–319.

[7] Li C, 2021, Herbal Compounds Targeting NLRP3 Inflammasome in Cardiovascular Diseases. Phytomedicine, 92: 153737.

[8] Moore K, Tabas I, 2011, Macrophages in the Pathogenesis of Atherosclerosis. Cell, 145: 341–355.

[9] Duewell P, Kono H, Rayner K, et al., 2010, NLRP3 Inflammasomes Are Required for Atherogenesis and Activated by Cholesterol Crystals. Nature, 464(7293): 1357–1361.

[10] Baker R, Hayden M, Ghosh S, 2011, NF-κB, Inflammation, and Metabolic Disease. Cell Metabolism, 13: 11–22.

[11] Murray P, 2017, Macrophage Polarization. Annual Review of Physiology, 79: 541–566.

[12] Ridker P, 2017, CANTOS Trial. New England Journal of Medicine, 377: 1119–1131.

[13] Deanfield J, 2007, Endothelial Function and Dysfunction. Circulation, 115: 1285–1295.

[14] Förstermann U, Sessa W, 2012, Nitric Oxide Synthases. European Heart Journal, 33: 829–837.

[15] Tarbell J, Cancel L, 2016, The Glycocalyx and Vascular Permeability. Journal of Internal Medicine, 280: 97–113.

[16] Choi B, 2010, Endothelial Dysfunction and Microvascular Obstruction. Journal of the American College of Cardiology, 55: 538–546.

[17] Zhang J, 2019, Mitochondrial Dysfunction in CHD Models with Qi Deficiency. Biomedicine & Pharmacotherapy, 118: 109282.

[18] Hardie D, 2016, AMPK: A Central Regulator of Metabolism. Nature Reviews Molecular Cell Biology, 17: 801–819.

[19] Shaffer F, 2017, HRV and Cardiac Function. Frontiers in Public Health, 5: 258.

[20] Weber C, Noels H, 2011, Cell Adhesion Molecules in Atherosclerosis. Nature Medicine, 17: 1112–1121.

[21] Ruggeri Z, 2002, Platelets in Atherothrombosis. New England Journal of Medicine, 347: 1130–1132.

[22] Moore K, Tabas I, 2011, Macrophages and Foam Cell Formation. Cell, 145: 341–355.

[23] Ouchi N, Parker J, Lugus J, et al., 2011, Adipokines in Inflammation and Metabolic Disease. Nature Reviews Immunology, 11(2): 85–97.

[24] Saxton R, Sabatini D, 2017, mTOR Signaling in Metabolism. Cell, 168: 960–976.

[25] Zhou Z, 2021, Tanshinone IIA Attenuates Atherosclerosis via Inhibiting ROS-Mediated NLRP3 Inflammasome Activation. Phytomedicine, 91: 153693.

[26] Li J, 2020, Baicalin Inhibits NLRP3 Inflammasome Activation. International Immunopharmacology, 81: 106195.

[27] Liu X, 2018, Ligustrazine Suppresses NF-κB Activation. Biomedicine & Pharmacotherapy, 103: 1415–1421.

[28] Fan Y, 2012, Panax Notoginseng Saponins Inhibit Inflammation via NF-κB Modulation. Journal of Ethnopharmacology, 141: 222–230.

[29] Hu X, 2020, Danhong Injection Modulates Macrophage Polarization. Frontiers in Pharmacology, 11: 582234.

[30] Zhang W, 2016, Astragaloside IV Improves Endothelial Dysfunction via PI3K/Akt/eNOS. Atherosclerosis, 247: 88–96.

[31] Yang L, 2016, Ginsenoside Rg1 Protects Endothelial Cells via Nrf2/HO-1. Free Radical Biology and Medicine, 97: 229–240.

[32] Boots A, 2008, Quercetin and Oxidative Stress. Mutation Research, 659: 47–52.

[33] Chen Y, 2019, Salvianolic Acids Protect Endothelium and Reduce Adhesion Molecule Expression. Phytomedicine, 62: 152940.

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Training Practice of Emergency Ultrasound Rapid Diagnosis Ability in Resident Physician Training

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Abstract: This study aimed to evaluate the application of the problem-based learning (PBL) teaching method in emergency ultrasound training, specifically its effect on improving rapid diagnostic ability and learning outcomes. From May 2020 to May 2025, 40 emergency ultrasound resident doctors were randomly selected and divided into a control group (n = 20, receiving conventional teaching) and an observation group (n = 20, receiving PBL teaching). After training, the observation group scored significantly higher than the control group in both rapid diagnostic ability for emergency ultrasound (including static image/dynamic video interpretation, standard section acquisition, rapid screening process and timeliness, quality of written diagnostic reports, and clinical decision support) and learning effect scores (learning interest, learning initiative, and self-confidence), with all differences showing statistical significance ($p < 0.05$). In conclusion, the application of the PBL teaching method in emergency ultrasound training for resident doctors effectively enhances their rapid diagnostic ability and learning outcomes.

Keywords: Emergency department; Ultrasound training; Rapid diagnosis ability; Resident physician; Learning effect

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1. Introduction

Ultrasound is an indispensable visual extension of modern emergency medicine, a “visual stethoscope” for clinicians, and a major tool for clinicians to quickly assess the condition of critically ill patients, and plays an irreplaceable role in treatment decision-making [1]. The ability of rapid diagnosis of emergency ultrasound determines the efficiency of emergency treatment. In the standardized training of residents, improving this ability is the key to shaping qualified emergency clinicians [2]. The conventional teaching method focuses on training the isolated technical operation and image recognition of resident doctors, which is difficult to meet the needs of highly integrated, time-critical and problem-oriented decision-making scenarios in emergency clinical practice, resulting in the difficulty of improving the ability of resident doctors from “drawing” to

"solving problems" [3]. The problem-based learning (PBL) teaching method can make up for the shortcomings of the conventional teaching method, focus on training the clinical competence of resident doctors, and be used in the standardized training of emergency ultrasound, starting from the real problems of clinical emergency, to guide resident doctors to integrate knowledge and refine diagnostic skills in independent exploration and collaborative discussion. In line with the connotation of emergency ultrasound rapid diagnostic capability, that is, to combine ultrasound examination with specific clinical problems in a limited time to form diagnostic ideas and guide emergency strategies [4]. The purpose of this study is to analyze the role of PBL teaching method in improving the rapid diagnosis ability and learning effect of emergency ultrasound in the training of resident doctors, which is described as follows.

2. Data and methods

2.1. General information

From May 2020 to May 2025, 40 emergency ultrasound resident training doctors were randomly selected and grouped according to different teaching methods. The control group (20 cases) was 21–30 years old, the average was (24.36 ± 2.27) years old, male/female (15/5); the observation group (20 cases) was 22–28 years old, the average was (23.89 ± 2.32) years old, male/female (14/6). Comparison of general data ($p > 0.05$).

2.1.1. Inclusion criteria

Resident doctors who received standardized ultrasound training in our hospital, who had the basic ability to deal with emergencies, and who had not received any systematic emergency ultrasound or bedside ultrasound training before enrollment. Participate voluntarily and sign the informed consent.

2.1.2. Exclusion criteria

Those who had studied systematically or could complete the key ultrasound assessment independently; those who withdrew from the training stage for various reasons; Due to visual acuity, hearing and other factors, ultrasound operators cannot be carried out normally.

2.2. Method

2.2.1. Control group

The control group was taught with conventional teaching method. At the beginning of the teaching, the centralized theoretical teaching centered on the technical module was carried out, and the physical principles of ultrasound, equipment operation and standardized image characteristics of key emergency examination items were systematically explained. Then, after the teacher's demonstration, the resident doctor repeatedly practiced the acquisition technique of specific sections on standardized patients or simulation teaching AIDS, and the teacher corrected the image quality and operation method immediately. Finally, the teacher leads the resident doctor to observe or practice, but the decision-making process is still dominated by the teacher.

2.2.2. Observation group

The PBL teaching method was used in the observation group.

(1) Design a streamlined, highly simulated emergency clinical scenario that provides critical history, vital signs, and limited physical examination, and embeds a clear "leading question".

(2) After identifying the problems, the resident doctors entered the individual learning stage and independently determined the ultrasound knowledge modules they needed to learn. The resident doctors used the standardized learning resource library and online resources to explore and learn the e-FAST process related to trauma and the key circulatory ultrasound assessment programs related to unexplained shock, such as heart, inferior vena cava, lung and deep vein. Starting from "what I need to know", Dr. Sumitomo builds a knowledge map directly related to clinical problems.

(3) Under the guidance of the teacher, the resident doctors shared their knowledge of verification in the group discussion around the initial case, and debated in depth how to plan ultrasound examination path, the possible positive signs of each section and their clinical significance. At the end of the discussion, the teacher corrects the obvious mistakes and timely raises advanced questions that can stimulate deep thinking, and then through collaboration, the group forms a preliminary, logical and clear ultrasound rapid assessment and diagnostic reasoning scheme.

(4) Translate written protocols into planned sonograms in high-end simulators or standardized patients in small groups. Teachers give real-time feedback on the "positive" or "negative" results found by the resident doctor. Resident doctors interpret the dynamically acquired image information while operating, and adjust the diagnostic ideas and follow-up examination focus according to the new findings at any time. For example, Dr. Sumipei found abdominal aortic aneurysm in shock cases as the primary problem and readjusted the priority of evaluation and treatment.

(5) After the simulation operation, each group summarized their own examination findings, final diagnostic reasoning and decision-making basis. The teacher systematically summarized each group and guided the group to review the core ultrasound diagnostic logic, key identification points and common traps of this type of clinical problems. The instructor issued a new question related to the topic of the initial case and asked the resident physician to independently complete a brief ultrasound evaluation plan.

2.3. Index observation

(1) Emergency ultrasound rapid diagnostic ability score

The improved scale of our hospital evaluated the emergency ultrasound rapid diagnostic ability of resident doctors from the aspects of static image/dynamic video interpretation ability, standard section acquisition ability, rapid screening process and timeliness, quality of written diagnostic reports, clinical decision support ability, etc., with 100 points for each item, and the score was positively correlated with the ability.

(2) Score of learning effect

The improved scale of our hospital evaluated the learning effect of resident doctors from the aspects of learning interest, learning initiative and self-confidence, with 10 points for each item, and the score was positively correlated with the effect.

2.4. Statistical analysis

SPSS26.0 processing data, ($\overline{x} \pm s$) and (%) represented the measurement and enumeration data, which were tested by t value and χ^2 respectively, and ($p < 0.05$) were statistically significant.

3. Results

3.1. Comparison of emergency ultrasound rapid diagnostic ability score

Before the training, the scores of emergency ultrasound rapid diagnosis ability of the two groups were compared ($p > 0.05$). After the training, the scores of static image/dynamic video interpretation ability, standard section acquisition ability, rapid screening process and timeliness, written diagnostic report quality and clinical decision support ability of the observation group were higher than those of the control group ($p < 0.05$), as shown in **Table 1**.

Table 1. Comparison of emergency ultrasound rapid diagnostic ability scores [$\overline{x} \pm s$ (minutes)]

Grouping	No. of cases	Still image/ motion video interpretation capability		Standard section acquisition capability		Rapid screening process and timeliness		Quality of written diagnostic report		Ability of clinical decision support	
		Before training	After training	Before training	After training	Before training	After training	Before training	After training	Before training	After training
Observation group	20	72.28 ± 7.15	90.12 ± 4.35*	71.13 ± 7.38	90.56 ± 4.52*	72.09± 7.28	90.87 ± 4.61*	71.25± 7.34	90.38 ± 4.46*	71.78± 7.46	90.61 ± 4.54*
Control group	20	71.86 ± 7.26	81.68 ± 8.43*	72.36 ± 7.41	81.27 ± 8.64*	71.26± 7.34	81.19 ± 8.52*	72.63± 7.29	81.52 ± 8.47*	72.39± 7.42	81.35 ± 8.56*
t-value	-	0.184	3.978	0.525	4.260	0.359	4.468	0.596	4.139	0.259	4.273
p value	-	0.854	0.000	0.602	0.000	0.721	0.000	0.554	0.000	0.796	0.000

Note: Compared with the group before training, *$p < 0.05$.

3.2. Scoring of comparative learning effect

Before the training, the scores of learning effect in the two groups were compared ($P > 0.05$). After the training, the scores of learning interest, learning initiative and self-confidence in the observation group were higher than those in the control group ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of learning effectiveness scores [$\overline{x} \pm s$ (minutes)]

Grouping	Number of cases	Interest in learning		Learning initiative		Self-confidence	
		Before training	After training	Before training	After training	Before training	After training
Observation class	20	6.15 ± 0.68	8.68 ± 0.84*	6.23 ± 0.64	8.71 ± 0.89*	6.13 ± 0.62	8.65 ± 0.86*
Control class	20	6.21 ± 0.65	7.26 ± 0.75*	6.18 ± 0.63	7.28 ± 0.74*	6.19 ± 0.66	7.23 ± 0.71*
t-value	-	0.285	5.639	0.248	5.525	0.296	5.694
p value	-	0.777	0.000	0.804	0.000	0.768	0.000

Note: Compared with the group before training, *$p < 0.05$.

4. Discussion

The results of this study showed that after the training, the score of the observation group was higher than that of the control group ($p < 0.05$), indicating that the application of PBL teaching method in the training of resident doctors is conducive to improving their ability of rapid diagnosis of emergency ultrasound. PBL teaching method comprehensively simulates and optimizes the real path of emergency clinical decision-

making from learning motivation, cognitive construction to behavioral output, thus laying the foundation for the cultivation of emergency ultrasound rapid diagnosis ability [5]. Conventional teaching methods treat knowledge and skills as isolated learning modules, which makes it difficult for resident doctors to diagnose emergency cases quickly. PBL teaching method takes clinical problems in real clinical situations as the initial driving force, and provides a learning situation integrating "knowledge gap" and "time pressure" for resident doctors, so that resident doctors can actively carry out targeted knowledge retrieval and screening to solve problems, and this process runs through a clear clinical goal orientation. Through the progressive mode of "independent inquiry-collaborative debate-simulation exercise" under the PBL teaching method, the resident doctors learned the physical principles of ultrasound, anatomical knowledge, image signs, specific pathophysiology, differential diagnosis logic and so on, and constructed a highly structured knowledge network centered on clinical problems from the cognitive level. PBL teaching method emphasizes repeated simulation decision-making exercises and dynamic feedback, so that resident doctors can complete image interpretation and disposal thinking while conducting ultrasound scanning, internalize the technical operation into an efficient clinical information collection and judgment behavior, and ultimately improve the rapid diagnosis ability of emergency ultrasound of resident doctors.

After the training, the learning effect score of the observation group was higher than that of the control group ($p < 0.05$), which confirmed that the application of PBL teaching method in the training of resident doctors was conducive to improving their learning effect. PBL teaching method is deeply in line with the cognitive law of adult learning, and can be used in emergency ultrasound learning to promote learners to actively optimize the learning path. The conventional teaching method is mainly to transfer knowledge, which leads to the superficial memory and mechanical operation of ultrasound knowledge learned by resident doctors. PBL teaching method is based on structured clinical problems, which transforms the learning motivation of external inculcation into active exploration driven by internal clinical needs, and ensures that resident training doctors change from "I want to learn" to "I want to learn", which can enhance the concentration and continuity of resident training doctors in acquiring knowledge. PBL teaching method focuses on specific problems, searches, screens and integrates fragmented ultrasound, anatomy, pathology knowledge and operation essentials independently, establishes a structured cognitive system, forms a "knowledge schema" connected with clinical decision-making path, and lays a foundation for improving the learning effect of resident doctors. The group discussion in PBL teaching method can not only deepen the understanding of relevant knowledge and skills of resident doctors, but also expose and correct their cognitive biases in the collision of views, and strengthen their differential diagnosis thinking. In the process of simulation exercise, residents extract and apply ultrasound-related knowledge and skills in a "quasi-actual combat" environment full of time pressure and dynamic feedback, which promotes the transformation of knowledge from declarative memory to procedural skills and conditional decision-making ability, and effectively copes with the disconnection between theory and practice. By constructing the cognitive cycle of "demand stimulation-active construction-collaborative correction-situational application", PBL teaching method can stabilize the learning results and ensure that the knowledge learned by resident doctors can be efficiently applied to complex emergency scenarios.

5. Conclusion

To sum up, PBL teaching method is used in the training process of emergency ultrasound for resident doctors,

which is conducive to better improve the rapid diagnosis ability and learning effect of emergency ultrasound.

Disclosure statement

The authors declare no conflict of interest.

References

[1] He M, Zhang X, Gao Y, 2022, Effect of Multidisciplinary Collaborative Teaching Mode on Course Comprehensive Evaluation and Personal Ability in Emergency Ultrasound Teaching. China Health Industry, 19(15): 174–177 + 231.

[2] Pang J, Chen Y, Zhao C, et al., 2023, Application of Bedside Ultrasound Visualization Technology Combined with Integrated Medical Teaching Mode in Practice Teaching of Emergency Resident Doctors. Snake Records, 35(1): 128–132.

[3] Li Y, Gao L, 2024, Application of Virtual Simulation Technology Combined with PBL Teaching Method in Standardized Training of Cardiac Ultrasound Residents. China Medical Education Technology, 38(1): 107–111.

[4] Mi Y, Chen T, Lu Y, et al., 2023, Problem-Oriented "Cluster" Training Model Helps Emergency Residents to Establish a Thinking System for Screening Fatal Chest Pain. Chinese Journal of Emergency Medicine, 32(12): 1724–1728.

[5] Ma Z, Qin D, Chen N, et al., 2023, Application of PBL Teaching Method Combined with Ultrasound Visualization Technology and Simulation Training in Brachial Plexus Block for Resident Doctors under Tutorial System. Chinese Journal of Multimedia and Network Teaching, 2023(2): 177–180.

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A Study on the Impact of Multidisciplinary Nursing on Radiation-Induced Skin Damage in Patients Undergoing Radiotherapy for Nasopharyngeal Carcinoma

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Abstract: Nasopharyngeal carcinoma is one of the common malignant tumors in China. Due to its high sensitivity to nasopharyngeal carcinoma cells, radiotherapy has gradually become one of the preferred clinical treatment options. However, during radiotherapy, high-energy rays are highly likely to damage the normal skin tissue of patients, which not only aggravates patients' pain and reduces their medical service experience, but also exerts a certain impact on the medical process and treatment effect. Multidisciplinary nursing can break the limitations of traditional nursing, integrate high-quality multidisciplinary resources, provide patients with more systematic and comprehensive nursing services, and plays an important role in improving radiation-induced skin damage. In this regard, this paper conducts an in-depth study on the impact of multidisciplinary nursing on radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma, aiming to provide some references for improving nursing quality and promoting clinical nursing reform.

Keywords: Multidisciplinary nursing; Nasopharyngeal carcinoma; Radiotherapy; Radiation-induced skin damage

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1. Introduction

Nasopharyngeal carcinoma is a malignant tumor originating from the anterior wall of the nasopharyngeal apex and the pharyngeal recess, with a high incidence in southern China. Its main clinical manifestations include blood-stained nasal discharge, nasal obstruction, cervical lymph node enlargement and other symptoms [1]. Compared with other diseases, nasopharyngeal carcinoma has a relatively hidden onset location and insignificant symptoms, and some patients are already in the middle and advanced stages when diagnosed. Radiotherapy can effectively kill nasopharyngeal carcinoma cells, effectively control the lesion, and prolong the survival period of patients. However, during radiotherapy, high-energy rays will inevitably

damage the surrounding normal skin tissue, leading to dry skin, pigmentation, erythema, and even blisters, ulceration and other symptoms in patients, which seriously affects patients' treatment compliance and quality of life. At present, there are certain limitations in the clinical nursing of such skin damage, resulting in poor nursing effect. Multidisciplinary nursing is an innovative nursing model that integrates resources from multiple disciplines, which can effectively break the limitations of traditional nursing, better meet the nursing needs of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma, and provide them with scientific and effective nursing services. Based on this, based on the needs of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma, this paper deeply analyzes the significance and existing problems of multidisciplinary nursing, and puts forward effective nursing strategies, so as to provide a reference for promoting the development of clinical nursing.

2. Application significance of multidisciplinary nursing in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma

Relying on high-quality resources from multiple disciplines such as psychology, nutrition and rehabilitation, multidisciplinary nursing constructs an integrated nursing system of "prevention-nursing-rehabilitation" guided by patients' needs. Its application in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma has important practical significance [2].

2.1. From the perspective of patients

Multidisciplinary nursing can effectively prevent and alleviate radiation-induced skin damage and improve patients' quality of life. Radiation-induced skin damage is directly related to patients' nutritional status, psychological state, skin condition and other factors. The traditional nursing model is relatively single and difficult to cover all influencing factors [3]. Multidisciplinary nursing can integrate multidisciplinary resources. Through the collaborative cooperation of nutritionists, rehabilitation therapists, psychologists and other professionals, it can not only provide targeted skin care for patients, but also enhance skin resistance through nutritional support; relieve patients' negative emotions such as anxiety and tension through psychological counseling, enable patients to better face the physical and mental changes during treatment, and improve their quality of life.

2.2. From the perspective of nursing work

Multidisciplinary nursing can get rid of the dilemma of traditional nursing, construct a more complete and scientific nursing system, and provide patients with high-quality nursing services. Traditional nursing work is mainly the sole responsibility of nurses, with single and incomplete nursing content and limited nursing effect. Under the multidisciplinary nursing model, multidisciplinary resources can be integrated, the responsibilities of each discipline can be clarified, and a collaborative nursing mechanism can be constructed, which not only enriches nursing content and expands nursing models, but also makes up for the deficiencies of traditional nursing work and improves the effectiveness and professionalism of nursing work [4].

2.3. From the clinical perspective

Multidisciplinary nursing can guarantee the smooth progress of patients' radiotherapy. If radiation-induced

skin damage is not controlled in time, symptoms such as blisters and ulceration may occur, leading to the interruption of radiotherapy and further affecting the tumor treatment process. Under the multidisciplinary nursing model, the degree of radiation-induced skin damage can be effectively reduced through multidisciplinary collaborative cooperation, avoiding the interruption of the tumor treatment process. At the same time, by adjusting patients' nutritional supply and improving nursing effect, it lays a foundation for the smooth progress of subsequent radiotherapy, helps patients recover better and prolong their life cycle [5].

3. Existing problems in the application of multidisciplinary nursing in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma

At present, the application of multidisciplinary nursing in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma is still in the initial stage, with some problems as follows:

3.1. Imperfect multidisciplinary collaboration mechanism

The core of multidisciplinary nursing is multidisciplinary collaborative cooperation to improve nursing effectiveness through resource integration and collaboration. However, at present, the multidisciplinary collaboration mechanism in some medical institutions is not perfect, there is a lack of effective collaboration among various disciplines, and the phenomenon of "each sweeping the snow in front of one's door" is serious. There is a lack of effective communication channels among nursing, nutrition, rehabilitation, dermatology and other disciplines, and personalized nursing plans cannot be provided for patients, thus seriously affecting the nursing effect [6].

3.2. Backward nursing concept

Some nurses still adopt the traditional nursing concept, focusing the nursing work on symptomatic nursing after skin damage, ignoring the pre-radiotherapy prevention work and post-radiotherapy rehabilitation work, resulting in poor overall nursing effect. At the same time, some nurses lack in-depth understanding of multidisciplinary nursing and insufficient collaborative awareness, making it difficult to give full play to the role of the multidisciplinary nursing model.

3.3. Insufficient professional competence of nurses

Multidisciplinary nursing puts forward higher requirements and standards for the professional competence of nurses. It requires nurses not only to master basic nursing knowledge and skills, but also to understand professional knowledge of related disciplines such as nutrition, rehabilitation and psychology, and possess interdisciplinary abilities. However, at present, some nurses have a weak professional knowledge system, single knowledge mastery and insufficient interdisciplinary abilities. Meanwhile, the training mechanism is not perfect, making it difficult to effectively cultivate the professional literacy of nurses [7].

3.4. Lack of personalized nursing plans

Patients undergoing radiotherapy for nasopharyngeal carcinoma have certain differences in skin condition, eating habits, psychological quality, radiotherapy dose and so on, and their nursing needs are also different.

However, at present, the multidisciplinary nursing plans in some medical institutions lack personalization and innovation, mainly adopting a unified nursing model, and no differentiated nursing plans are formulated according to the actual situation of patients, making it difficult for nursing to meet the actual needs of patients, thus affecting the improvement of nursing effect [8].

4. Strategies for optimizing the application of multidisciplinary nursing in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma

In view of the above problems, feasible and achievable optimization strategies can be put forward from four aspects: collaboration mechanism, nursing concept, personnel literacy and nursing plan, so as to give full play to the role of multidisciplinary nursing in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma.

4.1. Construct a multidisciplinary collaboration mechanism and strengthen resource integration and sharing

In the new era, it is necessary for hospitals to construct a multidisciplinary collaborative nursing mechanism, clarify the scope of responsibilities and division of labor of nutrition, rehabilitation, psychology and other disciplines, and lay a foundation for integrating high-quality medical resources. Meanwhile, a multidisciplinary nursing team should be established, a sound multidisciplinary communication mechanism and consultation mechanism should be built, regular consultation meetings should be held, all parties should share patients' condition information, and effective nursing plans should be jointly formulated through in-depth collaboration. In addition, a network platform can be used to build information communication channels to lay a foundation for information communication among various disciplines. In this way, the smooth development of multidisciplinary nursing work can be ensured, and higher-quality medical services can be provided for patients [9].

4.2. Timely transform nursing concepts and strengthen preventive nursing awareness

Nurses are the core force to promote the implementation of multidisciplinary nursing. In this regard, nurses should be guided to timely transform the traditional nursing concept, establish the advanced concept of "prevention first, whole-course nursing", and implement it throughout the whole process of radiotherapy. Hospitals can regularly organize special training and case sharing meetings, invite dermatologists, radiotherapy experts and others to give systematic lectures to nurses, and help nurses deeply understand the importance of prevention by analyzing the occurrence mechanism of radiation-induced skin damage, skin change characteristics at different radiotherapy stages and key nodes of preventive nursing. For example, before the start of radiotherapy, nurses need to conduct a comprehensive assessment of patients' skin condition, including skin elasticity, pigmentation, past skin disease history, etc., and formulate personalized skin protection plans according to the assessment results, guiding patients to avoid using irritating skin care products, wear loose and soft cotton clothes, reduce skin friction in the radiotherapy area, etc. During radiotherapy, closely observe patients' skin reactions daily, and once early symptoms such as slight erythema or dryness are found, immediately take interventions such as cold compress and applying medical moisturizer to prevent further aggravation of damage. Meanwhile, strengthen health education for patients and their

families, and enable them to master the key points of home skin care through distributing graphic manuals, demonstrating operation videos and other ways, such as keeping the skin clean and dry, avoiding direct sunlight, reasonable diet to supplement vitamins and protein, etc., so as to extend the prevention awareness to patients' daily life and form a "medical-nursing-patient" three-party linked preventive nursing model [10].

4.3. Strengthen nurse training and improve professional competence

Medical institutions need to establish and improve a nurse training mechanism, and regularly organize nurses to carry out training activities related to multidisciplinary nursing, covering nutrition, psychological intervention, skin care and other fields. Special lectures can be given by experts from nutrition, rehabilitation, psychology and other disciplines to share typical cases with nurses, so as to broaden nurses' horizons and improve their professional literacy. Meanwhile, information technology can be relied on to adopt online training, requiring nurses to learn relevant courses and help them build a complete knowledge system. In addition, targeted training plans should be formulated. A variety of training plans should be provided for nurses with different working years and professional levels to better meet their actual needs, thereby improving the training effect.

4.4. Formulate personalized nursing plans and enhance nursing effectiveness

When formulating personalized nursing plans, first of all, a comprehensive and detailed comprehensive assessment of patients should be carried out, including not only basic clinical data such as patients' age, gender, tumor stage, radiotherapy dose and irradiation site, but also in-depth understanding of patients' basic skin condition (such as whether there is eczema, allergy history, etc.), nutritional status (such as whether there is malnutrition), psychological state, living habits (such as whether smoking, drinking, spicy diet) and the cognitive degree and self-care ability of radiation-induced skin damage. Based on this assessment result, the multidisciplinary nursing team should participate together to formulate a "tailor-made" nursing plan for each patient. For example, for patients with poor nutritional status or poor skin condition, nutritionists should formulate targeted diet improvement plans according to their actual situation, such as providing high-protein and high-vitamin diet, and giving nutritional supplements if necessary to enhance skin repair ability; for patients with negative emotions such as anxiety and depression, psychologists need to intervene in a timely manner, and combine with the actual situation of patients to dredge negative emotions and relieve psychological pressure through cognitive behavioral therapy, mindfulness meditation, relaxation training and other ways, so that they can face radiotherapy with an optimistic attitude and actively cooperate with doctors. In terms of skin care, nursing measures should be dynamically adjusted according to the skin reaction grading of patients at different stages of radiotherapy (such as grade I erythema, grade II blisters, grade III ulcer, etc.). For patients with grade I reaction, focus on strengthening skin moisturizing and avoiding irritation, and guide them to use medical repair dressings containing ceramides, hyaluronic acid and other ingredients; for patients with grade II reaction with blisters, blister treatment should be carried out under strict aseptic operation, after extracting blister fluid, apply drugs to promote wound healing, and adopt exposure therapy or gently cover with sterile gauze; for patients with grade III ulcer, it is necessary to combine with wound specialist nurses for debridement and dressing change, and use growth factor drugs to promote granulation tissue growth if necessary. Meanwhile, the nursing frequency, observation points and effect evaluation criteria should be clearly defined in the plan, and the multidisciplinary team should regularly review and adjust according to

the actual reaction and recovery of patients, ensuring that the nursing plan always fits the individual needs of patients, so as to minimize the degree of radiation-induced skin damage, promote wound healing and improve patients' quality of life.

5. Conclusion

Radiotherapy is the preferred treatment for nasopharyngeal carcinoma. As a common acute complication of radiotherapy, radiation-induced skin damage seriously affects patients' physical and mental state, treatment compliance and quality of life, so it is of great clinical significance to do a good job in relevant nursing intervention. However, there are some problems in the application of multidisciplinary nursing at present, which seriously affect the improvement of nursing effect. In this regard, various methods and means should be adopted to solve the problems, improve nursing effect, and promote the standardized and effective application of multidisciplinary nursing in the nursing of radiation-induced skin damage in patients undergoing radiotherapy for nasopharyngeal carcinoma.

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References

[1] Zhou S, Yang H, Xu L, 2025, Visual Analysis of the Current Status and Trends of Multidisciplinary Collaborative Nursing Research in China. Contemporary Nurse (Mid-Monthly), 32(10): 10–17.

[2] Fang S, Zhang D, Liu M, et al., 2025, A Case Study of Perioperative Nursing of Ankle Fracture in Late Pregnancy Under Multidisciplinary Collaboration. Journal of Practical Clinical Medicine, 29(19): 128–130+135.

[3] Yang L, Yang F, 2025, Study on the Impact of Continuous Care Based on Multidisciplinary Team Collaboration on Hemiplegic Stroke Patients. Smart Healthcare, 11(28): 186–189.

[4] Qin K, Shang Y, Shan T, et al., 2025, Study on the Impact of Comprehensive Nursing Model Based on Multidisciplinary Collaboration on Medication Compliance and Health Behavior Ability of Diabetic Patients. Clinical Medicine Research and Practice, 10(28): 153–156.

[5] Liu C, 2025, Study on the Impact of Multidisciplinary Collaborative Nursing Model on Fracture Healing Time and Self-Care Ability of Patients with Lower Extremity Fractures After Surgery. Medical Information, 38(19): 165–169.

[6] Yan X, 2025, Study on the Impact of Narrative Nursing Combined with Multidisciplinary Collaborative Continuous Rehabilitation Nursing on Stigma and Functional Rehabilitation of Hemiplegic Stroke Patients. Baotou Medicine, 49(03): 121–123+128.

[7] Jiang G, Ning L, 2025, Application Study of Patient-Centered Multidisciplinary Collaborative Nursing Model in Elderly Frail Patients. Bingtuan Medicine, 23(03): 62–65.

[8] Hong Q, 2025, Multidisciplinary Collaborative Nursing Practice and Enlightenment of a Case of Multidrug-Resistant Tuberculosis Complicated with Severe Multi-System Infection Supported by ECMO. Proceedings of the 36th National Academic Conference of Chinese Antituberculosis Association and the 5th China Antituberculosis Science and Technology Award Ceremony (Clinical Volume): 115–118.

[9] Ding W, 2025, Effect Analysis of Multidisciplinary Pulmonary Rehabilitation Comprehensive Nursing in the Treatment and Rehabilitation of Tuberculous Pleurisy. Proceedings of the 36th National Academic Conference of Chinese Antituberculosis Association and the 5th China Antituberculosis Science and Technology Award Ceremony (Nursing Volume): 246–248.

[10] Wei X, Li H, Tan S, 2025, Application Effect of Optimized Non-Solid Multidisciplinary Diagnosis and Treatment Nursing Team in Rescuing Mass Casualty Patients. China Modern Medicine, 32(27): 144–148.

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Study on Herb Pairs for Breast Cancer Treatment Based on the Seven Emotions Compatibility Theory

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Abstract: The Seven Emotions constitute the original principle of traditional Chinese medicine (TCM) compatibility. Herb pairs, as the smallest unit of compatibility, connect single herbs and formulas, and their theory embodies the core of formula composition. Based on the medicinal properties of TCM, this paper sorts out herb pairs for breast cancer from the perspectives of mutual reinforcement and mutual assistance, and analyses their mechanisms via network pharmacology, so as to provide ideas for exploring the clinical value of herb pairs.

Keywords: Seven emotions; Breast cancer; Herb pairs; Network pharmacology

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1. Introduction

In 2020, breast cancer became the leading cause of cancer death among women worldwide. Its incidence in China has been rising year by year, accompanied by high recurrence rate, frequent drug resistance and numerous adverse reactions, which severely impair patients' quality of life. The core of TCM treatment for breast cancer is to regulate the "cancer state", achieve survival with tumor, and improve the body's microenvironment, rather than directly killing cancer cells.

Ancient TCM terms such as *ru yan* (breast rock), *shi yong* (stony abscess) and *fan hua shi liu* (blossoming pomegranate sore) correspond to modern breast cancer. Modern TCM holds that breast cancer is rooted in visceral deficiency and insufficient Qi and blood, marked by Qi stagnation, phlegm turbidity, blood stasis and heat-toxin, presenting a pathogenesis of intermingled deficiency and excess with mutual transformation. Treatment follows the principles of syndrome differentiation, holistic concept and Yin-Yang balance, with strengthening healthy Qi and eliminating pathogens as the core, and is implemented in stages: in the early stage with phlegm-stasis-toxin binding, eliminating pathogens is prioritized; after surgery, radiotherapy,

chemotherapy or in the metastatic stage, strengthening healthy Qi is essential.

Herb pairs are the smallest unit of TCM compatibility, a characteristic of TCM diagnosis and treatment, reflecting the pertinence and flexibility of syndrome-based treatment. Their compatibility takes "seeking by Qi and flavor" as the theoretical origin, aims at increasing efficacy and reducing toxicity, and relies on medicinal property theory and treatment thinking based on syndrome differentiation.

The Seven Emotions are the earliest criteria for TCM compatibility. Mutual reinforcement and mutual assistance can achieve synergistic efficacy enhancement, while mutual inhibition and mutual antagonism are contraindicated. Thus, herb pairs are mainly selected based on mutual reinforcement and mutual assistance [1]. Mutual reinforcement refers to the combination of herbs with similar effects to strengthen efficacy; mutual assistance means herbs cooperate to improve therapeutic effects. Modern herb pair compatibility follows a clear sovereign-vassal order. Summarizing breast cancer herb pairs based on the Seven Emotions and analyzing their mechanisms can provide evidence for clinical application.

2. Mutual reinforcement herb pairs of heat-clearing and detoxifying herbs

The main causes of breast cancer are "latent toxin from six exogenous pathogens" and "depressive toxin from seven emotions", leading to "endogenous cancer toxin". The key pathogenesis after surgery is "uncleared residual toxin", while recurrence and metastasis result from "spread of residual toxin". Studies have found that heat-toxin accumulation is a common syndrome of breast cancer with high malignancy, which is insensitive to chemotherapy, endocrine therapy and molecular targeted therapy, making TCM the main treatment. Therefore, mutual reinforcement herb pairs of heat-clearing and detoxifying herbs are widely used in clinical practice.

2.1. Dandelion (Pugongying)–Selfheal (Xiakucao)

Compendium of Materia Medica records: "For initial mammary abscess: equal parts of dandelion and selfheal, decocted with wine". The combination clears heat and detoxifies, purges liver fire, and reduces swelling and masses, and is now widely used in tumor treatment. *New Revised Materia Medica* states dandelion treats women's mammary abscess, which resolves when boiled in water. Studies show that dandelion-selfheal at a 4:3 ratio has strong anti-proliferative activity against breast cancer cells without obvious toxicity to normal mammary epithelial cells, and can intervene in breast cancer by regulating cell metabolism and apoptosis [2].

2.2. *Cremastra Pseudobulbus* (Shancigu)–Uniflower Swisscentaury Root (Loulu)

Cremastra pseudobulbus is cool-natured, sweet and slightly pungent in flavor, acting on the liver and spleen meridians; it clears heat, detoxifies, dissipates phlegm and reduces masses. Uniflower swisscentaury root is cold-natured, bitter in flavor, acting on the stomach meridian; it detoxifies, dissipates masses and treats abscesses. Their mutual reinforcement combination enhances the effects of clearing heat, detoxifying, dissipating stasis, reducing swelling, resisting tumors and diminishing inflammation. The clinical dosage is usually 12–15 g for *Cremastra pseudobulbus* and 15–30 g for uniflower swisscentaury root [3]. Network pharmacology confirms that the ethanol extract of this herb pair inhibits the PI3K/Akt pathway to induce breast cancer cell apoptosis and control tumor progression.

2.3. Barbed Skullcap Herb (Banzhilian)–*Hedyotis Diffusa* (Baihuasheshecao)

Barbed skullcap herb is cold-natured, pungent and bitter in flavor, acting on the lung, liver and kidney meridians; it clears heat, detoxifies, removes stasis and reduces swelling. *Hedyotis diffusa* is cold-natured, bitter and sweet in flavor, acting on the heart, liver and spleen meridians; it clears heat, detoxifies, drains dampness and reduces swelling. Their mutual reinforcement combination is suitable for tumors with excessive heat-toxin, resisting cancer without impairing healthy Qi, and is applicable to postoperative or advanced patients with deficient healthy Qi to prevent recurrence and metastasis. Clinical dosage is 12–15 g for barbed skullcap herb and 15–30 g for *Hedyotis diffusa* [3]. The dosage can be increased to 60–120 g when tumor markers are elevated. This herb pair induces cell apoptosis, enhances immunity, inhibits proliferation, acts on MYC and CASP3 targets, and participates in transcriptional regulation [4,5].

3. Mutual reinforcement herb pairs of blood-stasis-resolving herbs

Lingshu·Bing Bai Ji Sheng states: "When blood coagulates and accumulates without dispersing, body fluids seep stagnantly and adhere without leaving, leading to masses". In TCM, cancer mostly arises from prolonged illness entering the collaterals, latent pathogenic toxin, and intractable blood stasis, leading to cancer toxin formation. Eliminating turbid pathogens and blood stasis, resolving phlegm and detoxifying are critical in treatment.

3.1. *Frankincense* (Ruxiang)–Myrrh (Moyao)

Both *Frankincense* and myrrh act on the liver, spleen and heart meridians. *Frankincence* regulates Qi, while myrrh enters blood; their mutual reinforcement combination treats both Qi and blood, and strengthens blood circulation and stasis resolution. *Complete Collection of Surgical Diseases* records their combination promotes pus discharge and wound healing, and they are the core compatibility of Xihuang Wan. The total dosage of this pair does not exceed 6 g; the 1:1 and 2:1 ratio yield the optimal dissolution of components, with the 1:1 ratio most widely used [6,7]. This herb pair regulates breast cancer-related microRNAs and the MAPK pathway, inhibits angiogenesis, invasion and metastasis, and improves chemosensitivity [8].

3.2. Common Burreed Rhizome (Sanleng)−*Zedoary Turmeric* (Ezhu)

Both common burreed rhizome and *Zedoary turmeric* act on the liver and spleen meridians, dispersing cold, draining stagnation and unblocking collaterals, regulating both Qi and blood. They are derived from Sanleng Wan in *Experienced Prescriptions*. The clinical dosage for hyperplasia of mammary glands is 6–20 g at a 1:1 ratio; the 2:1 ratio achieves the highest dissolution of active components [9]. They induce tumor apoptosis and regulate the tumor microenvironment [10]. ESR1 is a key target for their anti-breast cancer effect, and its mutation causes endocrine therapy resistance [11].

4. Mutual assistance herb pairs of other categories

4.1. *Astragalus membranaceus* (HuangQi)−*Zedoary Turmeric* (Ezhu)

Replenishing Qi and activating blood is a common tumor treatment. The astragalus-zedoary pair is derived from Lichong Tang in *Records of Traditional Chinese and Western Medicine*, primarily treating Qi deficiency and blood stasis at a 1:1 ratio in the original formula. *Astragalus* invigorates the spleen, replenishes Qi,

dissipates phlegm and resolves stasis; zedoary turmeric moves Qi, breaks blood, eliminates accumulation and relieves pain. Their combination replenishes Qi without stagnation and breaks blood without impairing healthy Qi. For severe Qi deficiency, 30–60 g of *Astragalus* is used; for severe blood stasis, 10–15 g of *Zedoary turmeric* is applied [11]. The 3:1 ratio shows the best anti-tumor and anti-angiogenesis effects [12].

4.2. *Cremastra Pseudobulbus* (Shancigu)−Thunberg Fritillary Bulb (Zhebeimu)

Thunberg fritillary bulb is bitter and cold, clearing heat, resolving phlegm, dissipating masses and treating abscesses. *Cremastra pseudobulbus* is sweet, slightly pungent and cool, clearing heat, detoxifying, resolving phlegm and dissipating masses. Their combination disperses and drains with synergistic efficacy. The common component β-sitosterol inhibits the proliferation of breast cancer T47D cells [13].

5. Discussion

Herb pairs are a distinctive advantage of TCM treatment, reflecting the pertinence and flexibility of TCM syndrome differentiation. Proper compatibility achieves doubled results with half effort. For complex diseases like breast cancer, combining herb pairs with disease-specific formulas can resolve masses, detoxify and resist cancer, prevent recurrence and metastasis, and assist Western medicine to achieve optimal efficacy, providing new methods and ideas for breast cancer diagnosis and treatment worthy of further research and promotion.

However, the challenge of medication lies in herb selection and compatibility. Starting from TCM properties, this paper summarizes breast cancer herb pairs by mutual reinforcement and mutual assistance based on the connotation of herb pairs, and explains their anti-breast cancer mechanisms via network pharmacology, aiming to provide ideas for in-depth exploration of the academic and practical value of herb pairs. Further interpretation of herb pair connotation may be a path to TCM modernization.

In summary, the induction and analysis of the above herb pairs suggest that many clinically effective and frequently used herb pairs have not been systematically summarized. Meanwhile, discussions on mutual assistance herb pairs for breast cancer are scattered, and further research is needed to identify more effective herb pairs.

Many known herb pair combinations have not been studied by network pharmacology, and their main components, targets and mechanisms need to be clarified. Current theoretical research on breast cancer herb pairs is insufficient and unsystematic, mostly limited to formal examples without in-depth exploration of the internal laws of compatibility, which restricts the further development of herb pairs to some extent.

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References

[1] Liu C, Geng G, 2019, Discussion on Scorpion-Containing Formulas Based on Herb Pair Compatibility. Journal of Traditional Chinese Medicine, 60(18): 1563–1566.

[2] Yan Q, Zhang K, Li Q, et al., 2018, Screening of Optimal Compatibility Ratio of Selfheal and Dandelion Against Breast Cancer and In Vivo Anti-Tumor Study. Chinese Pharmaceutical Journal, 53(10): 776–782.

[3] Wang H, Xia L, Qi Y, 2023, Experience of Qi Yuanfu in Using Heat-Clearing and Detoxifying Herb Pairs to Treat Tumors. Shandong Journal of Traditional Chinese Medicine, 42(04): 376–380.

[4] Fallah Y, Brundage J, Allegakoen P, et al., 2017, MYC-Driven Pathways in Breast Cancer Subtypes. Biomolecules, 7(3): 53.

[5] Yadav P, Yadav R, Jain S, et al., 2021, Caspase-3: A Primary Target for Natural and Synthetic Compounds for Cancer Therapy. Chemical Biology & Drug Design, 98(1): 144–165.

[6] Miao X, 2020, Preparation Technology of Effective Parts of Frankincense-Myrrh Pair and Its Protective Effect on Ischemic Stroke, thesis, Nanjing University of Chinese Medicine.

[7] Zhang P, Ma J, Song W, et al., 2009, Protective Effect of Frankincense-Myrrh Pair at Different Compatibility Ratios on Anhydrous Ethanol-Induced Gastric Ulcer in Mice. Journal of Gansu University of Chinese Medicine, 26(01): 12–13.

[8] Yao H, Sun T, Xu J, 2021, Mechanism of Frankincense-Myrrh Pair in Treating Breast Cancer Based on Data Mining and Network Pharmacology. Natural Product Research and Development, 33(12): 2107–2118.

[9] Li Y, Ji F, Pan H, et al., 2017, Simultaneous Determination of p-Coumaric Acid and Ferulic Acid in Common Burreed Rhizome-Zedoary Turmeric Pair at Different Compatibility Ratios by HPLC. China Pharmacy, 28(27): 3859–3861.

[10] Li Y, Shen A, Zhang Y, et al., 2016, Determination of Curcumol and Curdione in Common Burreed Rhizome-Zedoary Turmeric Pair at Different Compatibility Ratios by GC. Guangdong Chemical Industry, 43(17): 187–188 + 171.

[11] Bartels S, Christgen M, Luft A, et al., 2018, Estrogen Receptor (ESR1) Mutation in Bone Metastases from Breast Cancer. Modern Pathology, 31(1): 56–61.

[12] Zhang Q, Qi C, Huang Z, 2007, Prognosis of Rats with Ovarian Cancer of Qi Deficiency and Blood Stasis Syndrome and Its Correlation with Tumor Neovascularization. Shanghai Journal of Traditional Chinese Medicine, 2007(06): 73–75.

[13] Xu M, Zhu M, Deng Q, et al., 2015, Expression of Three Heat Shock Proteins in Breast Cancer and Their Relationship with Prognosis. Journal of Tropical Medicine, 15(10): 1316–1320 + 1343 + 1456.

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Research on the Application of Precision Nursing in Pediatric Intravenous Infusion

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Abstract: *Objective*: To investigate the clinical effect of precision nursing in pediatric intravenous infusion. *Methods*: A total of 120 children who received intravenous infusion in The Second Affiliated Hospital of Guilin Medical University from October 2025 to December 2025 were selected and divided into a control group and an observation group, with 60 children in each group. The control group received routine nursing, while the observation group received precision nursing. The nursing effects of the two groups were compared. *Results*: The compliance of children during infusion in the observation group was higher than that in the control group, the incidence of adverse events was lower, the success rate of one-time puncture was higher, and the nursing satisfaction was higher than that in the control group. *Conclusion*: Precision nursing can eliminate children's resistance to intravenous infusion, make them cooperate better with nurses' operations, reduce children's pain, improve the success rate of one-time puncture in intravenous infusion, and increase parents' satisfaction with intravenous infusion nursing. It is worthy of promotion in clinical practice.

Keywords: Precision nursing; Pediatric intravenous infusion; Puncture success rate; Nursing satisfaction

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1. Introduction

Intravenous infusion is one of the most commonly used administration methods in pediatric clinical treatment. Its safety and standardization directly affect the clinical treatment effect and rehabilitation progress of children. Children are in the developmental stage, with thin blood vessels, delicate skin, and they are active and have low compliance, making it difficult for them to cooperate well with nurses during intravenous infusion. This easily leads to adverse events such as puncture failure, liquid medicine extravasation, and unplanned needle extraction, which not only aggravate children's pain but also may cause nurse-patient conflicts. Therefore, nursing staff should provide more humanistic care to children based on the physical and mental development characteristics of children of different ages, improve their compliance in intravenous infusion, standardize the operation details of pediatric intravenous infusion, pay close attention to

detailed management such as aseptic operation and puncture, further improve the nursing quality of pediatric intravenous infusion, and help children recover as soon as possible.

2. Materials and methods

2.1. General information

A total of 120 children who received intravenous infusion in The Second Affiliated Hospital of Guilin Medical University from October 2025 to December 2025 were selected as the research subjects, with the voluntary consent of their parents to participate in this study. The 120 children were randomly divided into a control group and an observation group, with 60 children in each group. In the control group, there were 30 boys and 30 girls, with an average age of (5.41 ± 2.06) years old. In the observation group, there were 28 boys and 32 girls, with an average age of (5.36 ± 1.16) years old.

2.1.1. Inclusion criteria

All 120 children were under 12 years old, with clear consciousness and basic communication ability; they needed intravenous infusion treatment due to infections, fever and other diseases.

2.1.2. Exclusion criteria

Children with severe coagulation disorders, organ diseases or congenital diseases; unconscious children [1].

2.2. Nursing methods

The control group received routine nursing. Nurses strictly checked the medical orders, prepared intravenous injection liquid and instruments, guided parents to comfort children's emotions, disinfected the intravenous puncture site of children, performed puncture with appropriate force, selected suitable blood vessels, controlled the needle insertion angle between 15–30°, quickly fixed the needle with sterile dressing after seeing blood return, and observed whether the administration was smooth [2]. During the intravenous infusion of children, nurses closely monitored whether there were adverse reactions such as swelling at the infusion site and bleeding at the puncture site, and interrupted the infusion immediately if any abnormality was found. After the infusion was completed, nurses removed the infusion set in time, and guided parents to gently press the puncture site of children for 5–10 minutes to avoid bleeding at the puncture site [3].

The observation group received precision nursing, and the pediatric intravenous infusion process was refined.

(1) Nurses regularly disinfected and ventilated the infusion room, pasted cartoons on the wall of the infusion room, and placed plush toys, building blocks and other toys to create a childlike and warm infusion environment, relieving children's tension, fear and anxiety during intravenous infusion.

(2) Nurses strictly implemented the checking system, prepared liquid medicine accurately, infused slowly for 15 minutes before the first infusion, and closely observed whether children had allergic reactions.

(3) Intravenous puncture nursing [4]. Before intravenous puncture, nurses patiently inquired about children's health conditions, used toys to divert children's attention, guided parents to adjust children's body positions to prepare for intravenous puncture, and selected suitable needles according to children's age. During puncture, nurses skillfully used medicine boxes, hand boards and other items to fix the children's hand to be punctured, carefully observed the blood vessels in children's hands to find the best

puncture position, inserted the needle at an angle of about 15–30°, fixed the needle with tension-free fixation after successful puncture, and individually controlled the infusion speed according to children's age, weight and condition: 1–2 mL/(kg·h) for ordinary drugs, ≤ 0.5 mL/(kg·h) for irritant drugs. After puncture, nurses encouraged and rewarded children through words, cartoon stickers and other ways to relieve their tension and anxiety.

(4) Nurses also provided good nursing care during children's infusion, closely observed whether there were redness, swelling, effusion, extravasation and other conditions at the puncture site of children to solve problems in time; for crying and irritable children, comfort toys were prepared to guide parents to comfort children's emotions and avoid needle displacement [5]. At the same time, nurses patiently answered parents' questions about intravenous injection and medication precautions to eliminate parents' anxiety.

(5) Nurses provided good health education, urging parents to let children drink more water after infusion treatment, maintain a light diet, eliminate adverse reactions in children, and help them recover soon.

2.3. Observation indicators

The infusion compliance, incidence of adverse events, success rate of one-time puncture and nursing satisfaction of the two groups were counted to evaluate the clinical application effect of precision nursing in pediatric intravenous infusion.

(1) Infusion compliance refers to that children can take the initiative to cooperate with nurses' various operations during infusion without crying.

(2) Incidence of adverse events refers to the probability of problems such as redness and swelling at the puncture site, effusion or needle shedding during intravenous infusion in children.

(3) Success rate of one-time puncture refers to that nurses successfully insert the needle at one time to ensure smooth administration.

(4) Nursing satisfaction refers to the satisfaction of children's parents with nurses' work such as intravenous puncture, psychological nursing, health education and infusion nursing.

2.4. Statistical methods

SPSS 20.0 statistical software was used to process the data. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$) and tested by *t*-test; enumeration data were expressed as percentage and tested by χ^2 test. $p < 0.05$ indicated that the difference was statistically significant.

3. Results

3.1. Comparison of infusion compliance between the two groups

The infusion compliance of children in the observation group was higher than that in the control group ($p < 0.05$), as shown in **Table 1**.

Table 1. Comparison of infusion compliance of children between the two groups (%)

Group	Number of cases	Complete compliance	Basic compliance	Non-compliance	Total infusion compliance
Observation group	60	38 (63.33)	20 (33.33)	2 (3.33)	58 (96.67)
Control group	60	28 (46.67)	24 (40.00)	8 (13.33)	52 (86.67)
Z/χ^2 value	-	-	2.111	-	3.927
p value	-	-	0.035	-	0.047

3.2. Comparison of Total Incidence of Adverse Events Between the Two Groups

The total incidence of adverse events in the observation group was significantly lower than that in the control group ($p < 0.05$), as shown in **Table 2**.

Table 2. Incidence of adverse events of intravenous infusion in children between the two groups (%)

Group	Number of cases	Needle shedding	Liquid extravasation	Subcutaneous hematoma	Total occurrence
Observation group	60	1 (1.67)	0	1 (1.67)	2 (3.33)
Control group	60	3 (5.00)	2 (2.33)	4 (6.67)	9 (15.00)
χ^2 value	-	-	-	-	4.904
p value	-	-	-	-	0.026

3.3. Comparison of one-time puncture success rate between the two groups

The one-time puncture success rate in the observation group was higher than that in the control group, as shown in **Table 3**.

Table 3. One-time puncture success rate of children between the two groups (%)

Group	Number of cases	Successful one-time puncture	One-time puncture success rate
Observation group	60	58	96.67
Control group	60	50	83.33
χ^2 value	-	-	5.925
p value	-	-	0.014

3.4. Comparison of nursing satisfaction between the two groups

The nursing satisfaction in the observation group was higher than that in the control group ($P<0.05$), as shown in **Table 4**.

Table 4. Comparison of nursing satisfaction between the two groups (%)

Group	Number of cases	Very satisfied	Satisfied	Dissatisfied	Total nursing satisfaction
Observation group	60	35 (58.33)	22 (36.67)	3 (5.00)	57 (95.00)
Control group	60	26 (43.33)	24 (40.00)	10 (16.67)	50 (83.33)
Z/χ^2 value	-	-	2.005	-	4.227
p value	-	-	0.045	-	0.039

4. Discussion

Children's thin blood vessels, hyperactivity and low compliance bring great challenges to intravenous infusion operations. Therefore, nurses should actively promote the precision nursing mode, adhere to the child-centered principle, closely integrate daily nursing with humanistic care, refine the pediatric intravenous infusion nursing process, carry out nursing work from the perspectives of environment, puncture, health education, etc., improve the one-time puncture success rate, avoid adverse reactions in children, and improve nursing quality. Based on the research data of this paper, the precision nursing mode can effectively improve the compliance of pediatric intravenous infusion, reduce the occurrence of adverse reactions in children, effectively improve the one-time puncture success rate and the satisfaction of children's parents with intravenous infusion nursing, which is worthy of promotion in clinical practice.

4.1. Prepare well before intravenous infusion and create a good nursing atmosphere

Nurses should optimize the preparation work before pediatric intravenous infusion, not only optimize the infusion room environment, but also do a good job in liquid preparation, inspection and verification to ensure accurate drug preparation, laying a good foundation for pediatric intravenous infusion puncture. Firstly, nurses should prepare liquid medicine strictly in accordance with medical orders, accurately control the drug dilution concentration and dosage, and select needles according to children's age and blood vessel thickness. Generally, 24–26 G needles are selected for newborns, 22–24 G for infants, and 20–22 G for children [6]. Rub children's hands and feet warm before puncture to promote blood vessel dilation, so as to accurately find the best puncture position. Secondly, nurses should formulate a precision nursing mode according to children's age, provide more psychological and emotional comfort to children, make them cooperate better with intravenous puncture, so as to improve the one-time puncture success rate. For infants under 1 year old, nurses can comfort children through gentle touching; for children aged 2–4 years old, nurses can prepare some cartoon fixation stickers and comfort toys to give more encouragement. At the same time, nurses should patiently explain the intravenous infusion process and precautions to parents, guide parents to cooperate in comforting children, eliminate parents' anxiety, and remind parents to let children urinate before infusion to reduce walking during infusion and avoid needle displacement, so as to avoid nurse-patient disputes [7].

4.2. Standardize the infusion nursing process and improve the comfort of children's intravenous infusion

The precision nursing in the process of pediatric intravenous infusion is reflected in three links: puncture operation, infusion inspection and medication safety. Firstly, nurses should carefully observe children's vascular conditions. For children with poor vascular conditions and high puncture difficulty, ultrasound guidance or light transmission can be used to assist puncture, accurately find the best needle insertion position, improve the one-time puncture success rate, and avoid children suffering from multiple punctures [8]. Secondly, head nurses should regularly organize pediatric intravenous infusion training, and key nurses should explain the essentials of pediatric intravenous puncture techniques and explain with models to help young nurses and intern nurses master puncture skills, so as to improve their pediatric intravenous infusion puncture ability. For example, key nurses can explain the essentials of neonatal intravenous puncture techniques, emphasizing that puncture actions should be gentle and rapid, and the needle should be fixed as soon as possible after successful puncture to avoid directly sticking adhesive tape on children's skin

and damaging the delicate skin of newborns. In addition, nurses should also master the skills of pediatric intravenous puncture with indwelling needles, find the puncture position accurately, select clearly visible blood vessels, prolong the service time of indwelling needles, reduce the number of intravenous punctures in children, and relieve their puncture pain. Thirdly, nurses should strengthen the inspection during children's intravenous infusion, focus on observing whether there are redness, swelling, effusion and other problems at the puncture site of children, observe the liquid dripping speed, ask children about their feelings during intravenous infusion, and reasonably adjust the intravenous infusion speed [9]. In this process, nurses should urge parents of children to comfort their emotions, avoid crying and frequent movement of the punctured hand, so as to improve the comfort of children's intravenous infusion.

4.3. Precision nursing after infusion to help children recover soon

Nurses should pay attention to the nursing work after pediatric intravenous infusion, formulate a precision nursing plan, and patiently urge parents of children to pay attention to the matters after infusion, which can not only help children recover soon, but also improve the nursing satisfaction of children's family members. For example, nurses should urge parents to gently press the puncture site of children for 5–10 minutes after infusion, avoid rubbing the puncture site, and tell parents to keep the puncture site dry within 24 hours to avoid contact with water sources. If there is bruising at the puncture site of children, nurses can advise parents to apply potato slices to the bruising area to avoid further expansion of the bruising range. At the same time, nurses should also ask children whether there are pricking, pain or burning sensations at the puncture site, make good nursing records, and give oral praise and small stickers to children to stimulate their enthusiasm for cooperating with infusion treatment; urge parents of children to provide a light diet for children, avoid spicy and irritating food, and urge young children to drink more water [10]. In addition, nurses should ask parents of children for suggestions on intravenous infusion nursing work, such as suggestions on the infusion room environment, nurses' puncture operations, humanistic care and health guidance, timely answer parents' questions about children's daily diet and activities after infusion, enhance parents' health awareness, build a harmonious nurse-patient relationship, so as to help children recover as soon as possible.

5. Conclusion

To sum up, the precision nursing mode has obvious advantages in pediatric intravenous infusion nursing work. It can not only relieve children's fear of intravenous infusion, make them cooperate better with nurses' puncture operations, so as to improve the one-time puncture success rate and reduce the incidence of adverse reactions, but also reduce children's discomfort during puncture and improve parents' satisfaction with nursing work. Therefore, hospitals should actively promote the precision nursing mode in pediatrics and emergency departments, do a good job in pediatric intravenous infusion publicity and education, and continuously improve nurses' pediatric intravenous infusion puncture ability to provide more humanized and professional nursing services for children and improve the quality of nursing services.

Disclosure statement

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References

[1] Li F, Xue D, 2025, Application of Precision Nursing in Pediatric Intravenous Infusion. Women and Children Health Guide, 4(12): 166–169.

[2] Xiong B, Hu L, 2024, Observation on the Effect of Precision Nursing on Compliance and Comfort of Children in Pediatric Intravenous Infusion. The Medical Forum, 28(24): 127–130.

[3] Zheng L, Wu X, Han M, 2023, Application Effect of Precision Nursing Measures in Pediatric Outpatient Intravenous Infusion. China Medical Innovation, 20(18): 116–120.

[4] Zhang C, 2023, Application of Precision Nursing in Outpatient and Emergency Intravenous Infusion Nursing. Famous Doctor, 2023(10): 135–137.

[5] Xu Y, 2023, Application of Precision Nursing Management Process in Patients with Intravenous Infusion Port Implantation. Evidence-Based Nursing, 9(02): 374–377.

[6] Dong M, Wang Y, 2022, Application Effect of Precision Nursing in Children with Intravenous Infusion. Clinical Medicine Research and Practice, 7(14): 150–152.

[7] Zhou Q, 2022, Analysis on the Application Effect of Precision Nursing in Pediatric Intravenous Infusion and Its Influence on Children's Compliance and Comfort. Heilongjiang Journal of Traditional Chinese Medicine, 51(02): 328–330.

[8] Qi X, Zhang W, 2020, Application Effect of Precision Nursing in Pediatric Intravenous Infusion and Its Influence on Children's Compliance and Comfort. Clinical Medicine Research and Practice, 5(35): 187–189.

[9] Zhang B, Liu D, 2020, Application Value of Precision Nursing in Emergency Infusion Safety Nursing Management. Jilin Medical Journal, 41(08): 2017–2019.

[10] Sun Y, 2020, Analysis on the Application of Precision Nursing Management in Outpatient Intravenous Infusion of Elderly Patients. Electronic Journal of Practical Clinical Nursing, 5(19): 174.

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Research Progress on Integrated Continuous Management of Chronic Non-healing Wounds

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Abstract: Chronic non-healing wounds are common and intractable clinical conditions with long healing cycles and high treatment difficulty, which impose heavy physical and psychological burdens on patients and increase pressure on the medical system. Integrated continuous management is a new medical management model that integrates prevention, assessment, intervention, rehabilitation and follow-up of chronic non-healing wounds. It emphasizes multidisciplinary collaboration, connection between diagnosis, treatment and nursing, and linkage between in-hospital and out-of-hospital care, providing systematic and comprehensive guarantee for wound healing. This paper reviews the connotation, significance, clinical practice points, current research status, existing problems and future development directions of integrated continuous management of chronic non-healing wounds, sorts out the field of chronic non-healing wound management, provides reference for clinical relevant management, and promotes the improvement and perfection of chronic non-healing wound management modes.

Keywords: Chronic non-healing wounds; Integrated management; Continuous management; Wound care; Multidisciplinary collaboration

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1. Introduction

With the intensification of population aging and the rising prevalence of chronic diseases, the incidence of chronic non-healing wounds remains high. The traditional fragmented management model can no longer meet the requirements of clinical diagnosis, treatment and nursing [1]. The integrated continuous management model breaks through disciplinary barriers and the division of diagnosis and treatment links, integrates multidisciplinary resources, whole-process intervention and in-hospital and out-of-hospital linkage, providing new ideas and methods for the treatment and nursing of chronic non-healing wounds. In recent years, scholars at home and abroad have carried out many studies on the connotation, implementation approaches and clinical application of this management model and made progress. Based on relevant research results,

this paper reviews the research progress of integrated continuous management of chronic non-healing wounds to provide reference for clinical practice and follow-up research.

2. Connotation and significance of integrated continuous management of chronic non-healing wounds

2.1. Core connotation

Integrated continuous management of chronic non-healing wounds focuses on the whole process, multi-dimension and collaboration, overcomes the fragmentation in traditional diagnosis and treatment, and organically connects all links of wound management to form a complete management chain from prevention to rehabilitation and from in-hospital to out-of-hospital [2]. The core connotation includes two aspects: integration means multidisciplinary collaboration, combination of diagnosis, treatment and nursing, combination of local and systemic conditions, integrating resources of medical treatment, nursing, rehabilitation, nutrition, psychology and other aspects to provide all-round and personalized comprehensive intervention for patients; continuity means continuous and sustainable management throughout the whole process of wound occurrence, development, healing and rehabilitation, ensuring seamless connection between in-hospital diagnosis and treatment and out-of-hospital follow-up, acute intervention and long-term rehabilitation, and preventing management gaps [3].

2.2. Management significance

For patients, this management model can integrate various medical resources to provide standardized and systematic diagnosis, treatment and nursing services, promote wound healing, reduce complications and wound recurrence rate, relieve pain, improve limb function and quality of life, reduce the frequency of hospital visits, and alleviate patients' economic and psychological pressure [4].

Integrated continuous management can improve the allocation of medical resources, avoid repeated examinations and excessive treatment, thereby improving the efficiency of medical services, reducing medical costs and alleviating the shortage of medical resources. In addition, standardizing medical quality control management processes and unifying diagnosis and treatment service standards can improve medical service quality and reduce the probability of doctor-patient disputes [5].

For disciplinary development, integrated continuous management promotes mutual penetration of multiple disciplines, coordinates the development of wound repair, nursing, rehabilitation and other disciplines, promotes the innovation of management concepts and technical methods, endows new ideas for the research of chronic non-healing wounds, helps to enrich the theoretical framework and operating guidelines of wound management, and supports the development of the wound repair field [6].

3. Key points of clinical practice of integrated continuous management of chronic non-healing wounds

3.1. Practice of multidisciplinary collaboration model

Multidisciplinary collaboration is an important support for integrated continuous management. In clinical practice, a sound multidisciplinary collaboration system should be established to clarify the responsibilities and division of labor of each discipline, so as to achieve resource sharing and collaborative work [7]. Generally, the multidisciplinary team consists of personnel from wound repair department, nursing department, rehabilitation department, nutrition department, psychology department, endocrinology

department, vascular surgery and other related departments, forming a personalized multidisciplinary collaboration group according to the patient's condition. In clinical practice, the multidisciplinary team conducts comprehensive evaluation of the patient's condition through regular consultations and case discussions, formulates a management plan in line with the patient's actual situation, and determines the intervention priorities and time nodes of each discipline. The wound repair department is responsible for local wound treatment and diagnosis; the nursing department provides wound care and health guidance; the rehabilitation department carries out functional rehabilitation training; the nutrition department provides nutritional support; the psychology department conducts psychological intervention; the endocrinology department controls the patient's underlying diseases. Through multidisciplinary cooperation , all-round and comprehensive care for patients is achieved, solving problems that cannot be solved by a single discipline, and improving management outcomes [8].

3.2. Practice of local wound management

Local wound management is the focus of intervention for chronic non-healing wounds, with the core of creating a good local environment for wound healing and promoting wound tissue repair. In clinical practice, standardized local treatment measures should be implemented according to the specific conditions of the wound, including debridement, infection control and dressing selection [9]. Debridement is the basis of local wound treatment, removing necrotic tissue, foreign bodies and secretions on the wound, reducing the risk of infection and promoting granulation tissue growth. The debridement method should be selected according to the wound condition, emphasizing appropriate debridement to avoid excessive damage to healthy tissue. Infection control is an important guarantee for wound healing. It is necessary to strengthen the observation of wound secretions, detect signs of infection in time, take appropriate anti-infection measures, pay attention to wound cleaning and care, maintain a dry or moist wound state, select appropriate dressings according to wound exudation, and promote wound healing.

3.3. Practice of systemic condition regulation

The healing of chronic non-healing wounds is greatly affected by the patient's systemic condition, so systemic condition regulation is an important part of integrated continuous management [10]. In clinical practice, attention should be paid to the patient's nutritional status, underlying diseases, psychological state and other aspects, and corresponding regulation measures should be taken. Nutritional support is an important guarantee to promote wound healing. A personalized nutrition plan should be formulated according to the patient's nutritional status to ensure that patients obtain sufficient protein, vitamins, minerals and other nutrients, improve the patient's nutritional status, enhance the body's resistance, and promote wound tissue repair. Controlling underlying diseases is the key. For patients with diabetes, hypertension, vascular diseases and other underlying diseases, the monitoring and control of underlying diseases should be strengthened to stabilize the patient's condition and reduce the impact of underlying diseases on wound healing. Psychological intervention is part of systemic condition regulation. Patients with chronic non-healing wounds often have negative emotions such as anxiety and depression due to long course of disease, obvious pain and easy recurrence. Negative emotions affect the body's immune function and thus wound healing. Therefore, it is necessary to conduct psychological assessment on patients, detect negative emotions in time, and use psychological counseling, emotional comfort, health education and other methods to relieve patients' negative emotions and enhance their compliance with treatment and nursing.

3.4. Practice of transitional care

Transitional care is an important link to ensure the continuity of management, which can realize the seamless connection between in-hospital treatment and out-of-hospital management and provide long-term nursing assistance for patients [11]. In clinical practice, a complete transitional care system should be established to clarify the content, form and process of transitional care, ensuring the standardization and effectiveness of transitional care. The content of transitional care mainly includes wound care guidance, health education, condition observation and complication prevention and treatment. Guide patients and their families to master wound care methods such as dressing change, wound cleaning and self-monitoring to improve patients' self-care ability; popularize knowledge about wound rehabilitation and recurrence prevention to patients and their families through health education to enhance their health awareness; regularly check the patient's wound healing and systemic condition and deal with abnormalities in time; strengthen guidance on complication prevention to avoid complications. Transitional care can be carried out in the forms of telephone follow-up, online follow-up, home visits, community nursing and so on. Appropriate follow-up methods should be selected according to the patient's actual situation to ensure the timeliness and effectiveness of follow-up.

4. Current research status of integrated continuous management of chronic non-healing wounds

4.1. Foreign research status

Foreign research on integrated continuous management of chronic non-healing wounds started relatively early and has formed a relatively complete integrated continuous management system and practice model. Foreign research pays more attention to the standardization and refinement of multidisciplinary collaboration, establishes specialized wound management centers, integrates resources of various disciplines, and provides one-stop diagnosis, treatment and nursing services for patients. In addition, attention is paid to the diversification and intelligence of transitional care. Information technology is used to build an online management platform to implement remote monitoring and guidance for patients, improving the efficiency and quality of transitional care. Foreign research focuses on the innovation and improvement of management methods, constantly improving management processes and intervention measures based on evidence-based medical evidence, emphasizing personalized management and prevention-oriented concepts, and cultivating patients' self-management ability, forming a complete management chain of prevention, evaluation, intervention, rehabilitation and follow-up with good management effects. At present, the focus of foreign research is mainly on the improvement of multidisciplinary collaboration models, the application of intelligent management technology, and the innovation of transitional care models, so as to make management more scientific and effective [12].

4.2. Domestic research status

In recent years, domestic attention to integrated continuous management of chronic non-healing wounds has continued to increase, and relevant research has become more and more abundant with fruitful results. Domestic research mainly starts from the establishment and implementation of multidisciplinary collaboration models, the improvement of transitional care systems, and the exploration of integrated traditional Chinese and Western medicine management models, shaping a management model with Chinese characteristics according to China's medical conditions and patient characteristics. Many hospitals in China have set up

wound repair centers and established multidisciplinary-led wound repair teams to conduct multidisciplinary consultations and case discussions for patients, providing comprehensive treatment and nursing services. In terms of transitional care, an in-hospital and out-of-hospital linked transitional care system has gradually been formed, and diversified transitional care methods such as telephone follow-up, online follow-up and community nursing have been tried, improving the continuity of management. The integrated traditional Chinese and Western medicine management model has also become a research hotspot in China, combining traditional Chinese medicine theory with modern medical technology to improve intervention measures and increase the wound healing rate. In addition, domestic research also pays attention to health education and the cultivation of patients' self-management ability, popularizing knowledge about wound management to patients in various ways to improve patients' self-care ability and treatment compliance. However, on the whole, compared with mature foreign management models, domestic research lacks the establishment of multidisciplinary cooperation mechanisms and the implementation of continuous nursing, with problems such as inconsistent management standards and large regional development differences, which still need further research and improvement [13].

5. Future development directions of integrated continuous management of chronic non-healing wounds

Improve the multidisciplinary collaboration mechanism, establish standardized multidisciplinary collaboration systems, clarify the responsibilities and division of labor of each discipline, strengthen communication and collaboration among disciplines, establish professional multidisciplinary collaboration teams, equip dedicated team coordinators, and improve collaboration efficiency and quality. In addition, promote the standardization of the multidisciplinary cooperation model, formulate unified collaboration processes and evaluation standards, and carry out multidisciplinary cooperation in a standardized manner [14].

Promote the intelligence and diversification of transitional care. Use information technology and Internet technology to build an online transitional care platform to complete remote monitoring, online guidance and health notification for patients, so as to optimize the quality and efficiency of transitional care. Strengthen the construction of community health service systems, improve the professional literacy of community nurses, promote transitional care to go deep into communities, achieve seamless connection between in-hospital and out-of-hospital management, and strengthen health education for patients and their families to enhance their awareness and participation in transitional care.

Establish unified management standards and norms. Based on evidence-based medical evidence, formulate standard processes, intervention methods and evaluation indicators for integrated continuous management of chronic non-healing wounds, achieve standardized and normalized management, improve management quality and homogeneity, and facilitate quality control and effect evaluation [15].

Strengthen the research and practice of personalized management. Establish personalized management models according to patients' actual conditions and formulate precise management plans to improve the targeting and effectiveness of management. At the same time, pay attention to the innovation and improvement of the integrated traditional Chinese and Western medicine management model, and use the advantages of traditional medicine and modern medicine to provide better comprehensive intervention services for patients.

6. Conclusion

Integrated continuous management of chronic non-healing wounds is a scientific and systematic management model covering the whole process of wound prevention, assessment, intervention, rehabilitation and follow-up. It emphasizes multidisciplinary collaboration, connection between diagnosis, treatment and nursing, and linkage between in-hospital and out-of-hospital care, which can promote wound healing, improve patients' quality of life, save medical resources, and is of great significance to the development of the wound repair field. At present, this management model has achieved certain development in clinical practice, but there are still deficiencies such as imperfect multidisciplinary collaboration mechanisms, inadequate implementation of transitional care, and low standardization of management. In the future, we should continuously improve the management model through improving the multidisciplinary collaboration mechanism, promoting the intelligence of transitional care, establishing unified management standards, and strengthening personalized management, improve management quality and effectiveness, and provide better, more efficient and continuous services for patients with chronic non-healing wounds.

Disclosure statement

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References

[1] Su M, 2025, Research on Integrated Continuous Management of Chronic Non-healing Wounds. Journal of Shandong Second Medical University, 47(06): 462–468.

[2] Zhang J, Zhai Y, Li S, et al., 2025, Construction of Wound Treatment Center System Based on Integrated Medical and Nursing Model. Hainan Medical Journal, 36(22): 3323–3326.

[3] Guo J, Jia H, Lu X, 2025, Application Effect of Special Integrated Medical and Nursing Management Model in Nursing of Chronic Refractory Wounds. Nursing of Integrated Traditional Chinese and Western Medicine, 11(07): 138–141.

[4] Li H, 2025, Effect of Integrated Medical and Nursing Care Combined With Diet Regulation on Postoperative Wound Healing Time and Defecation Pain Score of Anorectal Surgery Patients. Proceedings of Life Care and Wisdom Health Care Series Academic Seminars on Caring for Life Lecture Hall (Volume 2)—Special Topic on Challenges and Opportunities of Elderly Nursing Under the Silver Wave: 416–418.

[5] Huang J, Li S, Yang R, 2025, Study on the Effect of Hospital-Community-Family Integrated Rehabilitation Nursing Model Intervention on Quality of Life and Wound Healing of Patients with Chronic Wounds. Guangzhou Medical Journal, 56(05): 694–700.

[6] Xia L, 2024, Effect of Integrated Medical and Nursing Management Model on Wound Recovery and Nursing Satisfaction of Patients with Chronic Wounds. Chinese Health Care, 42(01): 84–87.

[7] Jin G, 2023, Preparation of Hydrogel Dressing Containing Cationic Polymer and Integrated Treatment of MRSA Infected Wounds, thesis, Jilin University.

[8] Long L, Xu Y, Liu H, 2023, Observation on the Curative Effect of Integrated Medical and Nursing Model in the Treatment of Chronic Wounds of Hand Injuries. Journal of Navy Medicine, 44(07): 739–742.

[9] Peng J, 2023, Preparation and Performance Study of Fluorescence Monitoring and Wound Treatment Integrated Hydrogel Dressing, thesis, Xiangtan University.

[10] Xia D, Weng Y, Wu L, et al., 2022, Integrated Management of Outpatient Chronic Wound Patients from the Perspective of Integration. Journal of Nursing Science, 37(23): 60–62.

[11] Zhong L, Chen X, Wang H, et al., 2021, Application of Special Integrated Medical and Nursing Management Model in Nursing of Patients with Chronic Wounds Repaired by Perforator Flap. Chinese Journal of Aesthetic Medicine, 30(08): 171–174.

[12] Han H, Zhao Q, Liu Z, et al., 2021, Application of Integrated Medical and Nursing Treatment Model in Refractory Wounds. Journal of Henan University (Medical Science), 40(03): 225–229.

[13] Han X, 2025, Clinical Study on Integrated Diagnosis and Treatment Mode of Integrated Traditional Chinese and Western Medicine in the Treatment of Deep Hand Burn Wounds, thesis, Nanjing University of Chinese Medicine.

[14] Wang D, Peng Y, Zhang Y, et al., 2024, Analysis on the Effect of Early Treatment and Rehabilitation Integrated Nursing Model on Wound Healing of Deep Second-Degree Burns. Chinese Journal of Aesthetic Medicine, 28(11): 130–133.

[15] Yan R, Yan R, Zhang A, 2023, Application of Integrated Medical and Nursing Work Model in Wound Treatment of Diabetic Foot Patients. Journal of Qilu Nursing, 24(13): 112–114.

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Research Progress on Acupuncture Therapy for Myocardial Ischemia-Reperfusion Injury

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Abstract: In recent years, with the deepening research on the pathogenesis of myocardial ischemia-reperfusion injury (MIRI) and the continuous development of acupuncture-moxibustion medicine, acupuncture, as a safe and effective non-pharmacological therapy, has shown unique advantages and promising prospects in the prevention and treatment of MIRI. MIRI refers to the pathophysiological process in which myocardial cell structural damage and dysfunction are aggravated when blood perfusion is restored after a period of myocardial ischemia, and it is one of the key factors affecting the clinical prognosis of acute myocardial infarction and other diseases. This paper first expounds the methodological innovation and standardization of acupuncture for MIRI, and then proposes the optimization of clinical application of acupuncture for MIRI, aiming to provide new ideas and practical evidence for improving the clinical prevention and treatment effect of MIRI, and promote the standardized application and popularization of acupuncture therapy in the field of cardiovascular disease rehabilitation.

Keywords: Acupuncture therapy; Myocardial ischemia-reperfusion injury (MIRI); Cardiovascular disease

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1. Introduction

Myocardial ischemia-reperfusion injury (MIRI) is a critical pathophysiological process that aggravates myocardial damage upon blood flow restoration, posing a major challenge to the clinical prognosis of acute myocardial infarction. Acupuncture, a key non-pharmacological therapy of traditional Chinese medicine, has shown unique advantages in preventing and treating MIRI due to its multi-target regulatory effects. However, issues such as methodological heterogeneity, lack of standardization, and ambiguous clinical indications still limit its widespread application. This paper systematically reviews recent advances in acupuncture for MIRI, focusing on methodological innovations, optimization of electroacupuncture and characteristic therapies, as well as clinical application strategies including individualized treatment, standardized timing, clear indications or contraindications, and the integrated traditional Chinese and Western medicine collaborative model, aiming to

provide practical evidence for improving clinical efficacy and promoting standardized application.

2. Methodological innovation and standardization of acupuncture for myocardial ischemia-reperfusion injury

2.1. Optimization and innovation of acupuncture therapy

On the one hand, in terms of acupoint selection, in addition to classic acupoints such as Neiguan (PC6), Danzhong (CV17) and Xinshu (BL15), clinical practice and research have shown that special acupoints including Ximen (PC4), Jianshi (PC5) and Jueyinshu (BL14) exert special effects in improving myocardial microcirculation and regulating myocardial energy metabolism. For example, studies comparing different acupoint combinations in rat models of myocardial ischemia-reperfusion have demonstrated that the combination of Neiguan and Ximen more significantly reduces serum levels of creatine kinase isoenzyme (CK-MB) and lactate dehydrogenase (LDH), and alleviates the degree of myocardial histopathological injury. The mechanism may be related to inhibiting inflammatory response and reducing the production of oxygen free radicals [1].

On the other hand, stimulation parameters are no longer fixed but adjusted according to the patient's condition, constitution and treatment stage. For patients in the acute ischemic stage, continuous wave and high-frequency (50–100 Hz) electroacupuncture are mostly used to rapidly relieve angina pectoris and improve myocardial blood supply. For patients in the recovery stage, sparse-dense wave or intermittent wave with low frequency (2–5 Hz) is applied to mainly regulate autonomic nerve function and promote myocardial repair [2].

In addition, the combined use of acupuncture with other therapies has become a new research direction. For instance, acupuncture combined with medication—electroacupuncture at Neiguan combined with nitroglycerin, can enhance the anti-myocardial-ischemia effect and reduce the dosage and adverse reactions of nitroglycerin. Acupuncture combined with stem cell transplantation improves the myocardial microenvironment through acupuncture pretreatment, increases the colonization rate and survival rate of stem cells in myocardial tissue, and promotes myocardial regeneration [3].

2.2. Promotion and optimization of electroacupuncture therapy

In terms of waveform selection, apart from the commonly used continuous wave and sparse-dense wave, studies on special waveforms such as sawtooth wave and triangular wave have increased in recent years. Sawtooth wave electroacupuncture exerts a stronger inhibitory effect on cardiomyocyte apoptosis in rabbit models of myocardial ischemia-reperfusion by upregulating the expression of anti-apoptotic protein Bcl-2 and downregulating the expression of pro-apoptotic protein Bax.

Regarding frequency combination, single high or low frequency stimulation can no longer meet the needs of complex conditions, and electroacupuncture protocols such as "alternating high and low frequency" and "multi-frequency superposition" have gradually become new research hotspots. For example, sparse-dense wave electroacupuncture with alternating 2 Hz and 100 Hz stimulation at Xinshu and Jueyinshu can more effectively improve left ventricular ejection fraction (LVEF) and left ventricular fractional shortening (LVFS) in rats with myocardial ischemia-reperfusion. The mechanism may involve synergistically regulating intracellular calcium homeostasis and improving mitochondrial function [4].

Furthermore, the timing of treatment has evolved. Electroacupuncture is no longer limited to post-ischemia-reperfusion intervention; "preconditioning" and "postconditioning" modes have gradually emerged. Electroacupuncture preconditioning refers to delivering electroacupuncture stimulation before myocardial

ischemia to activate endogenous protective mechanisms and reduce reperfusion injury. Electroacupuncture postconditioning is performed immediately or shortly after the onset of ischemia-reperfusion, which effectively inhibits oxidative stress and inflammatory response during reperfusion [5].

2.3. Application and exploration of other characteristic acupuncture-moxibustion therapies

Moxibustion therapy improves myocardial ischemia-reperfusion injury by warming and unblocking meridians, dispelling cold and promoting blood circulation. Ginger-partition moxibustion or mild moxibustion at Guanyuan (CV4) and Qihai (CV6) can enhance the body's antioxidant capacity, inhibit platelet aggregation, improve blood rheology, and thereby alleviate myocardial ischemia-reperfusion injury. Moxibustion preconditioning significantly reduces the myocardial infarct size in rat models, possibly by upregulating heat shock protein 70 (HSP70) to improve the tolerance of cardiomyocytes to ischemia and hypoxia [6].

Auricular acupuncture is an important part of acupuncture-moxibustion science. Featuring simple operation, non-invasiveness and painlessness, it is used as adjuvant therapy for myocardial ischemia-reperfusion injury. Clinically, auricular points including Heart, Shenmen, Sympathetic and Subcortex are selected and stimulated with Vaccaria seeds or magnetic beads. Auricular stimulation regulates autonomic nerve function, reduces myocardial oxygen consumption, relieves anxiety, and thus improves clinical symptoms and cardiac function indicators in patients with myocardial ischemia-reperfusion injury, effectively enhancing their quality of life [7].

3. Optimization of clinical application of acupuncture for myocardial ischemia-reperfusion injury

3.1. Formulation and implementation of individualized treatment plans

In clinical practice, different acupuncture plans are formulated based on the patient's age, gender, constitution, disease severity and course. For elderly patients, who often have underlying diseases and declining physical function, acupoints with tonifying effects such as Guanyuan and Qihai are appropriately added, while strong stimulation is reduced to avoid discomfort. For patients in the acute stage, the primary goal is to rapidly relieve symptoms and improve myocardial ischemia; first-aid acupoints such as Neiguan, Shanzhong and Ximen are selected with reducing or even reinforcing-reducing manipulation, and the needle retention time is appropriately shortened. For patients in the recovery stage, the focus is on regulating qi and blood and promoting cardiac function recovery; acupoints such as Xinshu, Jueyinshu and Zusanli (ST36) are selected with reinforcing manipulation or mild moxibustion, and needle retention time can be prolonged [8].

In addition, patients with hypertension, diabetes and other underlying diseases require corresponding adjustments in acupoint selection and treatment parameters. For hypertension, Taichong (LR3) and Quchi (LI11) are added to lower blood pressure; for diabetes, Sanyinjiao (SP6) and Taixi (KI3) are added to nourish yin and tonify the kidney. During implementation, the patient's response is closely observed, and the plan is adjusted timely according to therapeutic effect to ensure safety and efficacy [9].

3.2. Standardization of treatment timing and course protocols

Accurate timing of treatment directly affects acupuncture efficacy. For myocardial ischemia-reperfusion injury, acupuncture should be initiated as early as possible. After reperfusion, acupuncture can be started

once the patient's vital signs are stable and there are no contraindications such as severe bleeding tendency or malignant arrhythmia, so as to alleviate reperfusion injury and protect cardiomyocytes.

For patients undergoing emergency percutaneous coronary intervention (PCI), the first acupuncture treatment is administered after postoperative recovery from anesthesia and stabilization of vital signs. For patients receiving thrombolytic therapy, acupuncture is performed after vascular recanalization and exclusion of bleeding risk [10].

The course of treatment is adjusted according to the patient's recovery. In the acute stage, treatment is given once daily for 30–45 minutes per session for 5–7 consecutive days to rapidly control disease progression. In the subacute stage, treatment is switched to once every other day or three times weekly for 2–4 weeks to promote myocardial repair and cardiac function improvement. In the recovery stage, the treatment interval is gradually extended to once or twice weekly for 1–3 months to consolidate efficacy and prevent recurrence.

The course should consider the patient's tolerance and compliance to avoid fatigue or resistance caused by excessive treatment. After each course, efficacy is comprehensively evaluated using electrocardiogram, myocardial enzyme spectrum, cardiac function indicators and clinical symptom scores to determine whether to continue the next course or adjust the plan [11].

3.3. Clear definition of indications and contraindications

Defining the indications and contraindications of acupuncture for myocardial ischemia-reperfusion injury is a prerequisite for safe and effective treatment.

Indications mainly include patients with stable vital signs presenting clinical symptoms such as chest distress, chest pain, palpitations, shortness of breath and fatigue after myocardial ischemia-reperfusion injury, including patients after emergency PCI, thrombolytic therapy or coronary artery bypass grafting, and patients with old myocardial infarction complicated by reperfusion injury-related complications such as cardiac insufficiency and arrhythmia [12]. Acupuncture serves as an important adjuvant therapy for patients with poor response to Western medicine or contraindications to medication.

Contraindications are divided into absolute and relative. Absolute contraindications: acute myocardial infarction complicated by cardiogenic shock; severe heart failure; severe hemorrhagic diseases or patients under anticoagulant therapy with obvious coagulation abnormalities and bleeding tendency; infection, ulcer, tumor or severe skin injury at puncture sites; patients with extreme fear of acupuncture. Relative contraindications: fever over 38.5 ℃; pregnant women (acupoints with meridian-unblocking and blood-activating effects such as Hegu (LI4) and Sanyinjiao should be used with caution); severe hypertension with blood pressure persistently over 180/110 mmHg and uncontrolled. In clinical application, indications must be strictly observed and contraindications carefully checked. For patients with relative contraindications, acupuncture may be considered after disease improvement or stabilization with weighing of risks and benefits. Close monitoring of vital signs, symptom changes and puncture site reactions is required during treatment; treatment should be stopped immediately and corresponding measures taken if abnormalities occur [13].

3.4. Promotion of integrated traditional chinese and western medicine collaborative treatment model

The integrated traditional Chinese and Western medicine collaborative model for myocardial ischemia-reperfusion injury emphasizes the organic combination of acupuncture with modern medical treatments to

achieve complementary advantages and improve overall efficacy.

To promote this model, a multidisciplinary collaboration mechanism should be established, and a combined treatment team composed of cardiovascular physicians, acupuncturists and pharmacists should be formed to jointly participate in patient condition assessment, plan formulation and efficacy follow-up [14].

Meanwhile, acupuncture can serve as a beneficial supplement to routine Western medicine treatment. For angina patients with poor response to nitrates or intolerance due to side effects, additional electroacupuncture enhances analgesia and reduces medication dosage. For arrhythmias such as ventricular premature beats and atrial premature beats after reperfusion, auricular point pressing or acupuncture at Shenmen and Jueyinshu combined with Western antiarrhythmic drugs improves the control rate of arrhythmia and patients' quality of life.

In addition, acupuncture should be integrated with key nodes of Western medicine treatment. Electroacupuncture preconditioning before PCI improves myocardial microcirculation and alleviates oxidative stress, creating a better myocardial environment for surgery. In the postoperative rehabilitation stage, acupuncture combined with cardiac rehabilitation training regulates autonomic nerve function, improves exercise tolerance and promotes cardiac function recovery. To ensure the standardized promotion of the integrated model, standardized clinical pathways and efficacy evaluation systems need to be established [15].

4. Conclusion

In summary, acupuncture demonstrates unique advantages and broad application prospects in the treatment of myocardial ischemia-reperfusion injury. It not only directly improves myocardial ischemia and alleviates reperfusion injury through various innovative therapies, but also combines organically with routine Western medicine treatment to play a positive role in enhancing efficacy, reducing adverse drug reactions and improving patients' quality of life.

With the formulation of individualized treatment plans, standardization of treatment timing and courses, clear definition of indications and contraindications, and continuous promotion of the integrated traditional Chinese and Western medicine collaborative model, acupuncture will play an increasingly important role in the comprehensive prevention and treatment of myocardial ischemia-reperfusion injury.

In the future, further basic research is needed to elucidate the molecular mechanisms of acupuncture, and standardized clinical pathways and efficacy evaluation systems should be continuously improved. This will promote the more scientific, standardized and extensive application of acupuncture, a treasure of traditional medicine, in the field of modern cardiovascular disease treatment, bringing greater benefits to patients.

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References

[1] Tang Y, Lu M, Che H, et al., 2026, Exploring the Mechanism of Acupuncture in the Treatment of Myocardial Ischemia-Reperfusion Injury from the Perspective of "Regulating Qi" Based on Mitochondrial Quality Control. Acta Chinese Medicine, 1–13.

[2] Tang Y, 2025, Effect of Electroacupuncture Preconditioning on the MG53/RIPK1/RIPK3/MLKL Necroptosis Signaling Pathway in Mice with Myocardial Ischemia-Reperfusion Injury, thesis, Hunan University of Chinese Medicine.

[3] Chen A, 2025, Effect of Electroacupuncture Preconditioning on Pyroptosis in Mice with Myocardial Ischemia-Reperfusion Injury via MG53 Protein-Mediated NF-κB/NLRP3 Pathway, thesis, Hunan University of Chinese Medicine.

[4] Xiong J, Huang X, Zhao H, et al., 2025, Research Status and Hotspot Analysis of Acupuncture for Myocardial Ischemia-Reperfusion Injury. Modernization of Traditional Chinese Medicine and Materia Medica—World Science and Technology, 27(01): 179–194.

[5] Wang G, 2024, Preliminary Study on the Effect and Mechanism of Acupuncture at "Neiguan" in Preventing and Treating Acute Myocardial Infarction Reperfusion Injury, thesis, The Fifth Affiliated Hospital of Xinjiang Medical University.

[6] Li D, 2024, Role of PI3K/Akt/mTOR-Mediated Autophagy in Electroacupuncture Preconditioning Against Myocardial Ischemia-Reperfusion Injury in Rats, thesis, Hunan University of Chinese Medicine.

[7] Wang X, 2024, Mechanism of Electroacupuncture Preconditioning in Alleviating Myocardial Ischemia-Reperfusion Injury by Regulating Neuronal Activity in the Fastigial Nucleus, thesis, Anhui University of Chinese Medicine.

[8] Zhou J, 2024, Mechanism of CRH Neurons and CRHR1 in the Paraventricular Nucleus of the Hypothalamus in Electroacupuncture Preconditioning to Alleviate Myocardial Ischemia-Reperfusion Injury, thesis, Anhui University of Chinese Medicine.

[9] Liu Q, Ji B, Ge Y, et al., 2024, Animal Experimental Analysis of Acupuncture for Myocardial Ischemia-Reperfusion Injury From 2012 to 2022. Journal of Basic Chinese Medicine, 30(02): 290–296.

[10] Shu Q, 2023, Mechanism of Glutamate Neural Pathway in the Lateral Hypothalamic Area-Fastigial Nucleus in Electroacupuncture Preconditioning to Alleviate Myocardial Ischemia-Reperfusion Injury, thesis, Anhui University of Chinese Medicine.

[11] Tang Q, Wang Y, Li Y, et al., 2022, Research Progress of Acupuncture in the Treatment of Myocardial Ischemia-Reperfusion Injury. China Medical Herald, 19(14): 36–39.

[12] Xu X, 2022, Protective Mechanism of Cyclic Mechanical Pressing of "Neiguan" Point at Different Times During Reperfusion on Myocardial Ischemia/Reperfusion Injury, thesis, Nanjing University of Chinese Medicine.

[13] Zhang X, 2022, Therapeutic Effect of Acupuncture at Neiguan on Ischemia-Reperfusion Injury in Patients with Acute Myocardial Infarction, thesis, Xinjiang Medical University.

[14] Bai H, 2021, Mechanism of Electroacupuncture Preconditioning Against Myocardial Ischemia-Reperfusion Injury Based on Dynamic Changes of Inflammatory Response, thesis, Nanjing University of Chinese Medicine.

[15] Li J, Wang Y, Hu X, et al., 2021, Research Progress of Traditional Chinese Medicine Intervention on Myocardial Ischemia-Reperfusion Injury. Journal of Liaoning University of Traditional Chinese Medicine, 23(02): 4–7.

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Current Status of Humanistic Education for Undergraduate Nursing Students and Strategies for Cultivation

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Abstract: Driven by the evolution of the medical model and the widespread adoption of patient-centered care, higher demands are now placed on the humanistic qualities of nursing professionals. Humanistic competence in nursing encompasses the knowledge, caring behaviors, and abilities required in clinical practice; it is intrinsically linked to the quality of nursing services and the overall patient experience. However, deficiencies exist in current undergraduate nursing curricula regarding humanistic education, which hinders the cultivation of competent nursing professionals. This paper systematically analyzes the status quo of humanistic education for undergraduate nursing students and explores existing challenges. Accordingly, it proposes feasible training strategies and practical approaches from multiple dimensions. This study aims to promote the reform of humanistic education, enhance the professional competence of nursing personnel, and provide a reference for future professional education.

Keywords: Nursing education; Undergraduate students; Humanistic competence; Status quo; Cultivation strategies

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1. Introduction

Nursing science integrates science, art, and the humanities. Proficient technical skills serve as the foundation of nursing practice, while profound humanistic competence constitutes its essence. In the context of the "Healthy China" strategy, the public demand for personalized and diversified health services is growing, imposing new standards for nurses' humanistic care and communication competencies. Undergraduate nursing students constitute the backbone of the future nursing workforce; therefore, cultivating their humanistic competence is crucial to the development of the entire nursing profession. The undergraduate education stage is a critical period for nursing students to shape their professional values, spirit, and humanistic qualities. Consequently, conducting an in-depth analysis of the dilemmas in humanistic education for undergraduate nursing students and developing scientific, effective training models have become urgent

priorities in the field of nursing.

2. Current status of humanistic education for undergraduate nursing students

2.1. Deficiencies in humanistic care competence among undergraduate nursing students

First, the humanistic knowledge structure of nursing students is fragmented, with poor internalization. Although many colleges offer humanities and social science courses, such as nursing psychology, nursing etiquette, and nursing aesthetics, there is a lack of organic integration among them, as they are typically taught as isolated topics [1]. Nursing students often engage in exam-oriented learning, failing to internalize humanistic knowledge into their personal values, which leads to a disconnection between theory and practice. Second, humanistic care competence is often disconnected from practice. During clinical rotations, some students focus excessively on mastering operational procedures and completing technical tasks, paying insufficient attention to patients' emotional needs. In terms of communication, they tend to rely on medical jargon, lack the skills to proactively provide emotional support and spiritual comfort, and struggle to establish therapeutic relationships with patients [2]. Third, professional identity and values are weakening. Affected by academic pressure and employment competition, some students lack a sense of professional identity and pride. They often possess only a superficial understanding of nursing, lack an appreciation of core humanistic values such as caring and support, and are prone to job burnout [3].

2.2. Deficiencies in faculty teaching philosophies and competencies

First, teaching philosophies are relatively outdated. Some faculty members adhere to the traditional biomedical model and inadvertently prioritize technical skills in their teaching practice [4]. They focus heavily on explaining disease pathology and demonstrating operational skills but lack awareness of the need to integrate the humanistic spirit into professional teaching and cultivate students' empathy and caring abilities. Second, competence in humanistic education requires enhancement. Faculty teaching humanities courses may lack a nursing background and a sufficient understanding of specific ethical dilemmas in nursing practice, leading to teaching that is overly theoretical. Conversely, nursing faculty may find it difficult to naturally integrate humanistic elements into professional courses due to an insufficient humanistic knowledge base and lack of pedagogical training. This "two-track system" weakens the overall effectiveness of humanistic education. Third, teaching methods are dominated by traditional didactic instruction. Current humanistic education still relies primarily on classroom lectures, leaving students as passive recipients [5]. There is a lack of interactive and experiential teaching methods, such as case analysis, role-playing, group discussions, narrative pedagogy, and reflective writing, that can stimulate emotional engagement and promote value clarification. Consequently, the teaching lacks appeal and fails to provide sufficient intellectual enlightenment.

2.3. Inadequacies in the educational system and evaluation mechanisms

First, curriculum design and weighting are suboptimal. Compared with professional courses, humanities and social science courses account for a small proportion of total class hours. Most are offered in the early academic years and lack close connection with advanced professional courses and clinical practice, making it difficult to establish a continuous humanistic education framework [6]. Second, humanistic goals in clinical education are vague. Clinical practice guidelines and evaluation standards usually specify operational skills

clearly, but the requirements for students' humanistic care behaviors and communication skills remain relatively general. The lack of observable and measurable indicators easily leads to insufficient attention from both faculty and students [7]. Third, the educational function of the campus humanistic environment is underutilized. Some colleges have not effectively extended humanistic education from the formal curriculum to extracurricular activities [8]. The integration of professional characteristics and humanistic connotations in campus cultural activities is weak, and the promotion of the Nightingale spirit and role models is neither normalized nor contextualized. The cultivating influence of the overall humanistic atmosphere needs to be strengthened.

3. Correlation analysis of humanistic competence and related factors in undergraduate nursing students

To further clarify the internal structure of humanistic competence in undergraduate nursing students and its correlation with cognition, attitude, and practice intention, Pearson correlation analysis was employed to examine the linear relationships between variables ($p < 0.05$, $*p < 0.01$). Results indicated highly significant positive correlations among the cognition, courage, and patience dimensions of the CAI scale ($r = 0.52$–0.71, $p < 0.01$), demonstrating good internal consistency, structural stability, and reliability. Additionally, significant positive correlations were observed among cognition, attitude, and practice intention ($r = 0.58$–0.75, $p < 0.01$). This aligns with the theoretical "cognition-attitude-behavioral intention" framework, further validating the scale's structural validity.

Regarding inter-variable correlations, the CAI-patience dimension showed significant positive correlations with cognitive level ($r = 0.45$, $p < 0.01$), attitude orientation ($r = 0.31$, $p < 0.05$), and practice intention ($r = 0.50$, $p < 0.01$), suggesting it has the strongest association with humanistic performance. The CAI-cognition and CAI-courage dimensions were significantly correlated only with cognitive level ($r = 0.41$, 0.38, respectively; $p < 0.05$) and practice intention ($r = 0.35$, 0.44; $p < 0.05/0.01$). No statistically significant correlation was found with the attitude dimension.

In summary, the overall CAI level is positively correlated with cognitive level and practice intention, with patience emerging as a key variable influencing attitude formation. These findings provide a robust empirical basis for subsequent regression analyses, the exploration of influence pathways, and the development of targeted training strategies.

Table 1. Correlation analysis of humanistic competence and related factors in undergraduate nursing students

Dimension / Dimension	CAI-cognition	CAI-courage	CAI-patience	Cognitive level	Attitudinal level	Behavioural intention
CAI-cognition	1	0.68**	0.52**	0.41*	0.23	0.35*
CAI-courage	0.68**	1	0.71**	0.38*	0.29	0.44**
CAI-patience	0.52**	0.71**	1	0.45**	0.31*	0.50**
Cognitive level	0.41*	0.38*	0.45**	1	0.63**	0.58**
Attitudinal level	0.23	0.29	0.31*	0.63**	1	0.75**
Behavioural intention	0.35*	0.44*	0.50**	0.58**	0.75**	1

4. Strategies and practical approaches for enhancing humanistic competence in undergraduate nursing students

4.1. Establishing a scientific and comprehensive humanistic curriculum system and innovating pedagogical approaches

First, institutions should dismantle disciplinary barriers and construct a modular, progressive humanistic curriculum cluster. By integrating courses such as medical ethics and health regulations, and establishing modules on nursing practice norms and ethical decision-making, educators can concurrently weave humanistic care strategies into clinical nursing instruction. This approach assists undergraduates in systematically mastering professional knowledge while cultivating humanistic competence. Second, implement student-centered experiential learning and reduce reliance on didactic lecturing. Incorporate real-world clinical cases and organize group discussions on ethical boundaries and the equitable allocation of medical resources. Enhance communication, empathy, and counseling skills through simulated nurse-patient conflict scenarios and Standardized Patient (SP) methodologies, reinforced by video debriefing. Furthermore, promote Problem-Based Learning (PBL) and Team-Based Learning (TBL) to guide students in independently exploring and collaboratively solving practical issues, such as hospice care and chronic disease management, thereby deepening their understanding and application of humanistic values [9,10].

4.2. Affirming student agency and stimulating intrinsic motivation for humanistic development

First, facilitate the role transformation of students into active constructors of knowledge. Guide them to conduct independent pre-class research to identify issues, engage actively in in-class discussions, and build a nursing knowledge system through post-class projects and practical activities, while teachers transition into the roles of facilitators and collaborators [11]. Second, cultivate students' capacity for self-directed learning and career planning awareness. Encourage them to read humanistic classics and biographies of eminent figures, and view high-quality films to cultivate humanistic literacy [12]. Closely link the enhancement of humanistic competence with career development, helping students realize that humanistic care is a core competency of distinguished nurses. Third, promote peer learning groups. Encourage students to form study circles to regularly share clinical experiences, provide mutual emotional and academic support, and solidify the foundation of humanistic practice through peer exchange and shared empathy.

4.3. Transforming faculty pedagogical philosophies and enhancing educational competence

First, establish the philosophies of "holistic education" and "ethical integration in curriculum". Both professional and humanities faculty must clarify their fundamental responsibility of educating and nurturing students, deeply understanding the role of humanistic competence in nursing. In both curriculum and practical teaching, it is essential to consciously and strategically embed humanistic and scientific values, promoting the seamless integration of knowledge transmission and ability cultivation. Second, strengthen faculty development and team building. Institutions should regularly organize workshops and seminars on humanistic education, inviting senior experts in education, psychology, and ethics to provide systematic training [13]. Furthermore, encourage the formation of interdisciplinary teaching teams comprising both nursing and humanities faculty. Promote in-depth exchange and disciplinary complementarity through collaborative lesson planning, team teaching, and joint clinical supervision. Additionally, institutions should

identify and mentor distinguished educators who possess solid professional expertise and a profound spirit of care. By leveraging their exemplary role and influence in teaching practice and ethics, the overall quality of nursing humanistic education can be comprehensively improved [14].

4.4. Optimizing evaluation systems and cultivating a humanistic environment

First, actively construct a diversified evaluation system for humanistic competence, focusing on the learning process. Faculty should shift from purely summative evaluation methods, paying attention not only to test scores but also to students' ongoing learning performance [15]. For instance, curriculum evaluation should appropriately weigh performance in case analysis, communication skills during role-playing, and attitudes demonstrated in service learning. Simultaneously, develop specific scales for evaluating nursing humanistic competence to facilitate progressive assessment. Second, leverage the evaluative function of clinical practice. By revising clinical practice manuals, clearly define key behavioral indicators for humanistic care, such as initiating self-introductions, prioritizing patient comfort, and delivering effective health education. Faculty must regularly observe, document, and provide feedback on student behaviors. Finally, actively cultivate a positive campus humanistic environment. Institutions can organize a series of activities, such as "5.12" International Nurses Day celebrations, Nightingale exhibitions, medical humanities lectures, speeches by distinguished nursing alumni, nursing etiquette competitions, and humanities reading clubs. These initiatives aim to create a humanistic campus culture characterized by nursing professionalism, subtly influencing and immersing students in these values.

5. Conclusion

In summary, cultivating humanistic competence in undergraduate nursing students is a complex and systematic endeavor that aligns with the strategic goals of the "Healthy China" initiative. Current challenges in undergraduate education, such as insufficient internalization of humanistic values among students and outdated pedagogical concepts, can be addressed through strategic educational planning and the innovation of teaching methodologies. Future nursing humanistic education should evolve towards an integrated, whole-process approach to better foster the humanistic spirit and optimize the training of nursing professionals. Educators must take greater initiative and secure support from colleges, the healthcare sector, and other relevant stakeholders. Through the refinement of professional education, a workforce of nursing professionals proficient in clinical skills can be cultivated, contributing to safeguarding public health and well-being while demonstrating the profound professional value of nursing.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Yang X, Wang E, 2025, Exploration on the Integration Path of Ethical Education and Humanistic Care in Ideological and Political Education of Nursing Professional Courses. Xinxiang Daily, May 9: 008.

[2] Liao S, Xia Q, Liu X, 2025, Qualitative Research on the Transformation of Professional Degree Postgraduate

Education in Medicine: Taking Nursing as an Example. Hunan Journal of Traditional Chinese Medicine, 41(4): 81–85.

[3] Huang Z, Zhao Q, Li Q, 2025, Research on the Construction of "Four-in-One" Professional Quality Education Evaluation System for Higher Vocational Nursing Majors. Journal of Hubei Open Vocational College, 38(5): 65–68.

[4] Gao Z, 2025, Research on the Cultivation of Clinical Practice Ability of Undergraduate Nursing Interns in Higher Vocational Nursing Education. University, 2025(1): 148–151.

[5] Kong L, Li J, 2024, Exploration and Practice of Five-Year Higher Vocational Nursing Teaching Model Based on the Concept of Interprofessional Education (IPE). Technology Wind, 2024(28): 25–27.

[6] Tang J, Zhang Z, Du X, 2024, Analysis on the Integration Path of Innovation and Entrepreneurship Education and Nursing Professional Education from the Perspective of Symbiosis Theory. Theory and Practice of Innovation and Entrepreneurship, 7(17): 82–84.

[7] Wei H, 2023, On the Necessity of Humanistic Quality Education in Secondary Vocational Nursing Education. Proceedings of the 2023 Academic Annual Conference of Chinese Tao Xingzhi Research Association, 8: 440–443.

[8] Zhang Q, Yao D, Yang L, 2022, Application and Exploration of New Media Integrated Humanistic Quality Education in Fundamentals of Nursing. China Continuing Medical Education, 14(23): 165–170.

[9] Tang Q, Yang L, Li J, 2021, Investigation on the Current Situation and Influencing Factors of Humanistic Quality of Higher Vocational Nursing Students. Journal of Harbin Vocational & Technical College, 2021(06): 80–82.

[10] Luo X, Liu Y, Luo Y, et al., 2021, Research on the Cultivation Path of Humanistic Quality of Undergraduate Nursing Interns from the Perspective of "Three-Wide Education". Modern Vocational Education, 2021(33): 72–73.

[11] Yue F, Li Y, Liang C, 2021, Research on the Cultivation of Humanistic Quality of Undergraduate Nursing Interns. Heilongjiang Science, 12(15): 132–133.

[12] Li S, Zhang H, 2021, Research and Practice on Innovative Medical Humanistic Quality Cultivation Education Mode—Taking Nursing as an Example. Smart Healthcare, 7(22): 191–193 + 196.

[13] Hu X, Long S, Lai X, 2021, Research on Humanistic Quality Education for Undergraduate Nursing Interns in Basic Nursing Experimental Teaching. Modern Vocational Education, 2021(24): 78–79.

[14] Li J, 2021, Research on Ways to Strengthen Humanistic Quality Education in Clinical Nursing Teaching. Comparative Study of Cultural Innovation, 5(14): 37–40.

[15] Zhang T, 2021, On the Humanistic Quality Education of Modern Nursing Major—Taking Zunyi Vocational and Technical College as an Example. Modern Vocational Education, 2021(14): 212–213.

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Research on the Upgrading Path of Pre-Hospital Emergency Medical Services from the Perspective of Healthy China 2030

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Abstract: Under the strategic background of Healthy China 2030, this paper conducts a systematic study on the policy-driven upgrading path of pre-hospital emergency medical services. Combined with practical cases of pre-hospital emergency services in various regions, this paper sorts out the core concepts of pre-hospital emergency services and the key policy points of Healthy China 2030. It deeply discusses the mechanism of policies on the allocation of pre-hospital emergency resources and the improvement of service quality, and reveals the internal logic of policy-driven development of pre-hospital emergency services. A policy-oriented framework for the upgrading of pre-hospital emergency services is proposed, which specifically covers three dimensions: resource integration and sharing, information system construction, and talent training and team building. Finally, the study puts forward targeted countermeasures to improve the policy system related to pre-hospital first aid, and defines the optimization direction of future research, so as to provide referable theoretical basis and practical guidance for the upgrading of pre-hospital emergency services under the background of Healthy China construction.

Keywords: Healthy China 2030; Pre-hospital emergency medical services; Policy-driven; Resource allocation; Service quality

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1. Introduction

With the further implementation of the Healthy China 2030 strategy, pre-hospital emergency medical services, as the frontline of medical care and emergency rescue, are closely related to people's life and health. The Healthy China 2030 Plan Outline calls for improving the pre-hospital emergency system, ushering in policy-supported high-quality development for this sector. China's pre-hospital emergency services now face both opportunities and challenges. Accelerated urbanization, aging population and frequent public health emergencies raise higher demands for emergency capabilities, while emerging technologies like 5G, AI and IoT fuel its digital upgrading. It is urgent to solve problems such as unbalanced resource distribution, slow response and uneven service quality, and build a modern pre-hospital emergency system in line with

national policies. Based on the Healthy China 2030 strategy and policy orientation, this paper explores ways to optimize pre-hospital emergency services. By sorting out policies and practical experiences, it establishes an upgrading system involving resources, information, talents and policies, offering theoretical and practical support for its standardized, intelligent and coordinated development.

2. Core connotation of pre-hospital first aid from the perspective of healthy China 2030

The *Healthy China 2030 Planning Outline* clearly includes the construction of pre-hospital emergency service system into the national strategy, proposing to build a city and countryside-covered emergency network by 2030. In terms of emergency resource allocation, it requires one ambulance per 50,000 people, with priority on the construction of emergency stations in rural and remote areas [1]. In terms of service capacity building, it emphasizes the establishment of a unified dispatch and command system to achieve the goal of emergency response time of 10 minutes in urban areas and 15 minutes in rural areas. In terms of information construction, it promotes the application of 5G, Internet of Things and other technologies in the emergency field to build an intelligent first-aid platform. In terms of emergency personnel training, it requires no less than 20 emergency physicians per 100,000 people by 2025, and improves the professional level of practitioners through continuing education [2].

Pre-hospital first aid refers to the emergency medical treatment for critically ill patients outside medical institutions, whose core characteristics include three key links: rapid response, on-site treatment and transfer monitoring. The pre-hospital emergency system is a networked service system composed of emergency communication command centers, emergency stations and transport tools, aiming to provide professional medical intervention within the "golden hour" for patients with sudden diseases or accidental injuries. From the perspective of operation process, pre-hospital first aid covers standardized procedures such as alarm dispatch, on-site assessment, basic life support, trauma treatment, drug intervention and medical monitoring [3,4].

China's *Administrative Measures for Pre-Hospital Medical First Aid* clearly stipulates that pre-hospital emergency services shall follow the transfer principle of "nearest, urgent, professional needs and patients' willingness" [5]. Modern pre-hospital first aid has evolved from simple transfer services to a comprehensive treatment system including telemedicine guidance, mobile ICU monitoring and other advanced life support technologies. With the application of 5G technology and intelligent equipment, pre-hospital first aid is gradually realizing real-time data transmission and remote consultation of "treatment upon admission". This seamless connection mode between pre-hospital and in-hospital has significantly improved the success rate of first aid.

As an important part of the medical emergency system, the definition of pre-hospital first aid includes three key dimensions, as shown in **Table 1**.

Table 1. Analysis of core elements in the definition of pre-hospital first aid

Key links of pre-hospital first aid	Core characteristics	Operation points	Technical support
Rapid response	High timeliness	Optimized alarm dispatch	5G communication technology
On-site treatment	Professional medical intervention	Basic life support	Intelligent medical equipment
Transfer monitoring	Seamless connection	Continuous medical monitoring	Mobile ICU equipment

In terms of rapid response, the timeliness requirement meets the "golden hour" standard, relying on 5G communication technology to optimize alarm dispatch. The on-site treatment link emphasizes professional medical intervention, including standardized procedures such as basic life support and trauma treatment, equipped with intelligent medical equipment to improve treatment effect. The transfer monitoring link focuses on seamless connection between pre-hospital and in-hospital, realizing continuous medical monitoring through mobile ICU equipment, and finally forming a first-aid mode of "treatment upon admission". These elements together constitute the complete definition framework of modern pre-hospital emergency services.

In recent years, various regions have formed a variety of practical experiences with regional characteristics. For example, Shanghai has realized 3-kilometer coverage of emergency radius through the "emergency sub-station + ambulance team" mode, and the grid layout of emergency stations has shortened the average response time to less than 12 minutes. Shenzhen uses big data analysis to optimize the layout of emergency resources, and the "5G + intelligent first aid" system realizes real-time data sharing between ambulances and hospitals, reducing in-hospital preparation time by 40%. Nanning's "Emergency Volunteer Training Program" has trained 12,000 community first responders, significantly improving the bystander rescue rate. Shenyang Emergency Center has established an "emergency-first aid integration" mechanism, controlling the handover time of critically ill patients within 5 minutes. Practice shows that digital transformation, participation of social forces, optimal resource allocation and multi-department collaboration are the key elements to improve the efficiency of emergency services [6].

3. Impact of policy-driven on the upgrading of pre-hospital emergency services

Policy guidance plays a key role in improving the quality of pre-hospital emergency services. By formulating emergency response time standards, standardizing emergency operation procedures, and establishing a quality evaluation system, it provides a clear direction for improving service quality.

The *Healthy China 2030 Planning Outline* clearly requires that the average emergency response time should not exceed 15 minutes by 2030, which directly promotes local emergency centers to optimize dispatch processes and add emergency stations [7]. In terms of information construction, policies encourage the application of new technologies such as 5G and Internet of Things. For example, Shenzhen has built an intelligent first-aid system to realize real-time positioning of emergency vehicles and remote transmission of patients' vital signs, significantly improving emergency efficiency. In terms of quality supervision, many regions have established a performance appraisal mechanism for emergency services, incorporating indicators such as first-aid success rate and patient satisfaction into the appraisal system, forming a driving force for continuous improvement. In policy formulation, it is necessary to combine local reality, balance standardization and differentiation, ensure basic service quality, and encourage local innovation.

Human resource allocation is the core link of pre-hospital emergency service upgrading, showing a professional and standardized development trend driven by policies. According to the policy requirements of Healthy China 2030, local emergency centers have generally established a four-in-one professional team allocation mode of "emergency physician-nurse-driver-dispatcher", in which the ratio of emergency physicians to nurses reaches the standard configuration of 1:1.5.

Taking Shenzhen as an example, through the "Special Program for Pre-Hospital Emergency Personnel", 328 new emergency physicians were added in three years, an increase of 42% compared with before the

policy implementation. The application of digital dispatch system has significantly improved the efficiency of human resource utilization. For example, Shanghai Emergency Center has shortened the personnel response time to less than 90 seconds through the intelligent scheduling system. However, regional differences still exist, with the shortage of emergency personnel in the central and western regions reaching 23–35%, which prompts the policy formulation to particularly emphasize the establishment of talent assistance mechanisms and remote training systems between the east and west. It is worth noting that the application of 5G mobile emergency units is changing the traditional human resource allocation mode, realizing the mobile workstation configuration of "one physician with multiple nurses", expanding the service radius of a single emergency unit by 1.8 times.

4. Paths for upgrading pre-hospital emergency services

Guided by the Healthy China 2030 strategy, the upgrading of pre-hospital emergency services should build a four-dimensional collaborative development framework from policy guidance, resource integration to technological innovation and talent support. Fully implement the requirements of improving the emergency network in the *Healthy China 2030 Planning Outline*, and include emergency services in the key projects of regional health planning [8].

In terms of resource integration, establish a three-level network layout of "central station-sub-station-emergency point" to achieve full coverage of the 15-minute emergency circle. In terms of technological innovation, promote the application of 5G and Internet of Things technologies in emergency command systems. In terms of talent training, establish a trinity training system of theoretical training, simulation drills and actual combat assessment, focusing on improving the ability to deal with acute diseases such as myocardial infarction, stroke and trauma. Driven by both policy and technological innovation, the traditional first-aid mode will be transformed into an intelligent, standardized and coordinated modern emergency service system.

4.1. Continuously improve the resource integration and sharing mode

The core of resource integration and sharing is to break the information islands and resource barriers in traditional emergency services [9]. Through the establishment of a regional emergency resource collaboration platform, cross-institutional allocation and sharing of ambulances, medical equipment, professionals and other elements can be realized.

Taking Shenzhen's emergency information system as an example, the system integrates resources from 56 emergency network hospitals in the city, realizing real-time positioning of ambulances, sharing of patient information and visual query of hospital beds. In terms of human resource sharing, establish a rotation training mechanism for emergency doctors and emergency physicians to improve the comprehensive treatment ability of emergency personnel. In terms of equipment resource sharing, the distributed management mode of "center-station" can be adopted, setting up 3–5 emergency equipment sharing centers in the region, and realizing intelligent dispatch of key equipment such as AED and ventilators through Internet of Things technology. In terms of data sharing, it is necessary to build unified data standards and interface specifications to realize the interconnection of 120 dispatch systems, hospital information systems and public health platforms. This resource integration model can significantly improve the efficiency of emergency resource utilization.

4.2. Continuously improve the informatization level

Informatization construction is a key path to improve the efficiency and quality of pre-hospital emergency services. By building an intelligent first-aid system, further improve the real-time monitoring and dynamic allocation of emergency resources and improve the emergency response speed [10]. Establish a unified information management platform integrating GPS positioning, electronic medical records and remote consultation [11].

Through the establishment of pre-hospital emergency information system, the intelligent dispatch of ambulances, medical staff and medical equipment will be gradually realized, shortening the average response time [12]. The application of 5G technology has further promoted the development of mobile emergency hospitals, enabling emergency personnel to transmit patients' vital sign data in real time through high-definition video and obtain professional guidance from rear hospitals. At the same time, big data analysis technology can be used to optimize the layout of emergency stations, predict the peak of emergency demand according to historical call data, and realize accurate resource allocation. These information-based means not only improve the efficiency of first aid, but also provide a scientific decision-making basis for policy makers.

4.3. Continuously improve the professional quality of the emergency team

In the process of upgrading pre-hospital emergency services, personnel training and continuing education are the key links to improve the professional ability of the emergency team [13]. Emergency personnel need to receive standardized training courses including basic life support, advanced cardiovascular life support, trauma first aid, etc., with no less than 40 hours of training per year.

On the one hand, a combined mode of emergency training base and mobile training vehicle can be established, and a mixed training method of online theoretical assessment and offline practical drills can be adopted to achieve 100% coverage of skill training for emergency personnel [14]. On the other hand, in terms of continuing education, a systematic and standardized training system is an important way to effectively improve the professional quality and service ability of emergency personnel. Through the implementation of credit system management, emergency personnel are required to complete certain continuing education credits every quarter, covering new first-aid technologies, equipment operation and psychological intervention. A tutorial training system can also be established to select outstanding emergency personnel to participate in international certification training and cultivate a group of first-aid trainers with international standards.

4.4. Continuously improve the relevant policy system

Improving the policy system requires collaborative promotion from two levels: top-level design and local practice. In terms of top-level design, a policy framework with the *Healthy China 2030 Planning Outline* as the core should be established to further clarify the strategic positioning of pre-hospital emergency services in the public health system [15].

Specifically, it is necessary to formulate national unified pre-hospital emergency service standards, including key indicators such as emergency response time, equipment allocation standards and personnel qualification requirements. At the same time, a cross-departmental policy coordination mechanism should be established to integrate resources from health, finance, transportation and other departments to form policy synergy. At the local practice level, it is suggested to learn from the digital transformation experience of Shanghai, Shenzhen and other places, and include the application of new technologies such as 5G and

artificial intelligence into the scope of policy support. The policy system should also include a dynamic evaluation mechanism, regularly conduct third-party evaluation on the upgrading effect of pre-hospital emergency services in various regions, and take the evaluation results as an important basis for policy adjustment. In addition, it is necessary to improve the supporting financial security policies and set up special funds to support the renewal of emergency equipment and talent training. The design of the policy system should pay attention to differentiation, and formulate step-by-step promotion plans according to the development level of different regions to ensure the operability of the policy.

5. Conclusion

From the perspective of the Healthy China 2030 strategy, this paper comprehensively explores the improvement paths of pre-hospital emergency medical services driven by policies and draws the following core conclusions. First, policy guidance serves as the core driving force for the upgrading of pre-hospital emergency services. Policy goals set in the Healthy China 2030 Plan Outline concerning resource allocation standards, response time requirements and quality evaluation systems define the direction for its standardized development, which has been fully verified by practical experience in Shanghai, Shenzhen and other regions. Second, resource integration, information system construction and talent training are three key approaches to improve pre-hospital emergency services. Building a three-level emergency network to realize full coverage of the 15-minute emergency rescue circle, promoting in-depth application of 5G and IoT in emergency command systems, and establishing standardized regular training mechanisms for emergency staff can jointly elevate overall emergency service capacity. Third, a sound policy system is the fundamental guarantee for the sustainable development of pre-hospital emergency services. Joint efforts should be made in top-level design and local implementation to formulate unified national service standards, cross-departmental coordination mechanisms, dynamic evaluation systems and differentiated implementation strategies. In the future, with the steady advancement of the Healthy China 2030 strategy, China's pre-hospital emergency services will develop in an intelligent, standardized and coordinated manner. Widely applied digital technologies will shorten emergency response time, standardized systems will comprehensively improve service quality, and multi-party cooperation mechanisms will effectively solve resource shortages. The policies and optimization paths proposed in this study can provide references for local emergency system construction, and help build more efficient, equitable and accessible life-saving service channels.

Disclosure statement

The author declares no conflict of interest.

References

[1] Chen C, 2024, Research on 120 Dispatch Emergency Management of Y Provincial Emergency Center, thesis, Kunming University of Science and Technology.

[2] Xia H, 2024, Research on the Allocation and Countermeasures of Pre-Hospital Emergency Resources in Chengdu, thesis, University of Electronic Science and Technology of China.

[3] Tao J, Su M, Zhu Y, 2025, Management Countermeasures and Functions of Strengthening the Pre-Hospital

Emergency Medical Service System of 120 Emergency Center. China Health Industry, 22(03): 234–237.

[4] Chai Y, Han D, 2025, Hohhot: Emergency Services Upgraded Again. Health News, May 26: 005.

[5] Tang M, 2025, Research on Pre-Hospital Medical Emergency Service Problems in Guilin, thesis, Guangxi Normal University.

[6] Li C, Dong H, Li Y, 2024, Construction of Intelligent First-Aid System and Its Application in Pre-Hospital Emergency Quality Management. China Health Industry, 21(02): 139–141 + 146.

[7] Zou X, Sun P, 2024, Shenyang Emergency Center: Emergency in Seconds, Saving at the Edge of Life and Death. Health News, March 19: 003.

[8] Zheng X, Zhang Z, Zhang Y, et al., 2023, Digital Transformation of the Modern Development of Shanghai's Pre-Hospital Emergency System. Occupational Health and Emergency Rescue, 41(06): 751–756.

[9] Ouyang Y, 2023, Research on the Current Situation and Improvement Countermeasures of Shenzhen's Pre-Hospital Emergency Information System Construction, thesis, Harbin Institute of Technology.

[10] Shao X, Liu X, Chang W, et al., 2021, Reflections and Practices on the Construction of Tianjin's Pre-Hospital Emergency System. Chinese Urban-Rural Enterprise Health, 36(05): 91–94.

[11] Li J, Nong P, Chen X, et al., 2021, Building a Green Channel for Life to Promote the Construction of Healthy Nanning. Nanning Daily, October 28: 004.

[12] Lu C, Yang J, Yuan K, 2020, 5G Mobile Internet Emergency Hospital Reconstructs Pre-Hospital Emergency System. China Hospital President, 2020(08): 70–71.

[13] Li T, 2016, Design and Implementation of Daqing 120 Emergency Command and Dispatch Information System, thesis, Northeast Petroleum University.

[14] Wang C, Guo P, Zhou D, et al., 2016, Construction of a Peace-War Combined Trauma Emergency System Service Platform. Southeast National Defense Medicine, 18(03): 247–249 + 274.

[15] Wang H, Zhang H, 2024, Research on the Operation Mechanism of Industrial Policy-Driven "Agglomeration-Diversion" of Production Factors—From the Perspective of Social Trust. Lingnan Journal, 2024(04): 58–71.

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Clinical Efficacy of Immunoglobulin in Infants with Bronchopulmonary Dysplasia Complicated by Respiratory Syncytial Virus Infection

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Abstract: *Objective*: To investigate the clinical efficacy of immunoglobulin in infants with bronchopulmonary dysplasia (BPD) complicated by respiratory syncytial virus (RSV) infection. *Methods*: 104 infants with BPD complicated by RSV infection admitted to our hospital from May 2023 to November 2025 were enrolled. They were divided into observation group (n = 56, treated with immunoglobulin) and control group (n = 48, not treated with immunoglobulin), which accorded to whether they received immunoglobulin therapy. The therapeutic effects of the two groups were compared, and the levels of pulmonary function, arterial blood gas and inflammatory factors were recorded. *Results*: The overall therapeutic effect of the observation group was better than that of the control group ($p < 0.05$).The length of hospital stay and the time to disappearance of pulmonary rales were both significantly shorter in the observation group than in the control group ($p < 0.05$). After treatment, the PaO_2 and oxygenation index in the observation group were higher than those in the control group, while the $PaCO_2$ was lower than that in the control group ($p < 0.05$).After treatment, the serum levels of CRP and WBC in the observation group were lower than those in the control group ($p < 0.05$). *Conclusion*: The immunoglobulin has a significant therapeutic effect in infants with BPD complicated by RSV infection, it can help to alleviate inflammatory response, improves pulmonary function, and possesses high clinical application value.

Keywords: Immunoglobulin; Infants; Bronchopulmonary dysplasia; Respiratory syncytial virus infection; Curative effect observation

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1. Introduction

Bronchopulmonary dysplasia (BPD) is a common condition in infants and young children, often triggered by immature lung development and abnormal pulmonary vasculature. It can lead to persistent respiratory distress, hypoxia, coughing, wheezing, and other symptoms, and may even cause lung function impairment [1]. Infants and young children with BPD have weakened airway defense functions, compromised immune systems,

and a lack of specific antibodies, making them unable to effectively resist invasion by respiratory syncytial virus (RSV). This renders BPD patients a high-risk group for concurrent RSV infection [2]. Infants and young children with BPD complicated by RSV are more prone to lung function impairment, which affects their growth and development. In the past, symptomatic and supportive treatments such as oxygen therapy, mechanical ventilation, and anti-infection measures have been commonly employed, but specific therapeutic approaches are lacking, and the condition is prone to recurrence [3]. Therefore, optimizing treatment has garnered significant attention. Immunoglobulin is an artificially prepared antibody preparation that can neutralize antibodies, directly bind to viruses, prevent viral invasion of host cells, accelerate viral clearance, inhibit RSV replication, regulate the body's immune function, and alleviate inflammatory responses to achieve therapeutic goals [4]. However, reports on the application of immunoglobulin in infants and young children with BPD complicated by RSV infection are relatively rare. This study conducted a retrospective comparative study to explore the clinical value of immunoglobulin in infants and young children with BPD complicated by RSV, providing evidence for clinical practice. The report is as follows.

2. Materials and methods

2.1. Clinical data

PASS software was used to estimate the sample size. Clinical data from 104 infants and young children with BPD complicated by RSV infection who were treated in our hospital from July 2021 to November 2025 were collected for a retrospective comparative study.

2.1.1. Inclusion criteria

(1) All patients met the diagnostic criteria for BPD outlined in the "Expert Consensus on the Management of Bronchopulmonary Dysplasia in Childhood" [5]. RSV infection met the relevant criteria in the "Chinese Expert Consensus on the Clinical Diagnosis and Treatment of Respiratory Syncytial Virus Infection in Children" [6].
(2) All patients received standardized treatment.

2.1.2. Exclusion criteria

(1) Patients with concurrent congenital heart disease, immunodeficiency disorders, pneumothorax, or cardiac dysfunction;
(2) Patients with concurrent aplastic anemia, hemophilia, or neonatal hemolytic disease;
(3) Patients with concurrent malignancies;
(4) Patients who did not complete treatment as required or had missing clinical data.

2.1.3. Study group

Patients were divided into two groups based on whether they received immunoglobulin treatment: the observation group (56 cases) received immunoglobulin treatment, while the control group (48 cases) did not. There were no statistically significant differences in baseline data parameters such as gender, age, mode of delivery, and preterm birth status between the two groups ($p > 0.05$), as shown in **Table 1**, indicating comparability. This study was approved by the hospital's ethics committee.

Table 1. Baseline characteristics parameters of the two groups

Group	Number of cases	Gender		Age (years)	Delivery mode		Preterm birth
		Male	Female		Vaginal delivery	Cesarean section	
Observation group	56	32 (57.14)	24 (42.86)	1.91 ± 0.77	35 (62.50)	21 (37.50)	24 (42.86)
Control group	48	22 (45.83)	26 (54.17)	1.93 ± 0.76	27 (56.25)	21 (43.75)	18 (37.50)
t/χ^2 value		1.324		-0.178	0.419		0.308
p value		0.250		0.859	0.517		0.579

2.2. Treatment methods

Both groups of children received intervention with pulmonary surfactant (Poractant Alfa Injection, produced by Chiesi Farmaceutici S.p.A., Italy, Drug Registration Certificate No. 3 mL : 0.24 g H20140848, specification: 240 mg). The children were positioned with their upper bodies elevated by 30°, and the surfactant was administered via tracheal instillation at a dose of 100 mg/kg. Both groups were also treated with recombinant human interferon α-1b (produced by Shenzhen Kexing Biopharm Co., Ltd., National Medical Products Administration Approval No. S10960058, specification: 40 μg/vial) using a nebulizer (produced by Jiangsu Fulin Medical Equipment Co., Ltd., Jiangsu Medical Device Registration No. 20182080314, model: WP01-B) at a dose of 2–4 μg / (kg dose), twice daily. The intervention was continued for 3 consecutive days. In addition, children in the observation group received intervention with immunoglobulin (produced by Boya Bio-Pharmaceutical Group Co., Ltd., National Medical Products Administration Approval No. S19993012, specification: 2.5 g 50 mL) at a dose of 400 mg/(kg*day) via intravenous drip, once daily, for 3 consecutive days.

2.3. Observation indicators

(1) Efficacy evaluation

The efficacy was evaluated after 3 days of treatment [6]. Markedly effective: The symptoms of cough, wheezing, and shortness of breath disappeared in the children, along with the disappearance of pulmonary rales and wheezing sounds, normal respiratory rate, absence of three-concave sign, and disappearance of pulmonary shadows on chest X-ray. Effective: The symptoms of cough, wheezing, shortness of breath, and dyspnea were alleviated in the children, along with a reduction in pulmonary rales and wheezing sounds, and a decrease in pulmonary shadows. Ineffective: No improvement in clinical symptoms or signs, or even aggravation.

(2) The hospitalization duration and the time for pulmonary rales to disappear were recorded for both groups of children.

(3) Arterial blood gas parameters were measured using a blood gas analyzer (produced by Wuhan Mingde Biotechnology Co., Ltd., Hubei Medical Device Registration No. 20192222694, model: PT1000) before and after the intervention to record the arterial partial pressure of oxygen (PaO_2) and arterial partial pressure of carbon dioxide ($PaCO_2$) in the children, and the oxygenation index was calculated.

(4) Inflammatory factor detection

Blood samples (3.0 mL) were collected from the median cubital vein before and after treatment, centrifuged (2500 r/min for 15 minutes) using conventional methods, and the supernatant was retained for testing. The serum C-reactive protein (CRP) level was measured using an automatic biochemical

analyzer (produced by Shenzhen Shengxinkang Technology Co., Ltd., Guangdong Medical Device Registration No. 20182221055, model: SK6300). The white blood cell count (WBC) level in whole blood was measured using an automatic blood cell analyzer (produced by Qingdao Hantang Biotechnology Co., Ltd., Shandong Medical Device Registration No. 20202220789, model: HT-5010). The reagent kits were provided by Shanghai Bohu Biotechnology Co., Ltd., and the operations were strictly performed according to the reagent kit instructions.

2.4. Statistical methods

The SPSS 28.0 software package was selected for statistical analysis of the clinical medical data. Measurement data conforming to a normal distribution were described using ($\overline{x} \pm s$), and independent sample *t*-tests were performed for comparisons between two groups. Paired sample t-tests were performed for comparisons at different time points within the same group. Categorical data were described using [n (%)], and chi-square tests were performed for comparisons between groups. Rank sum tests were performed for ordinal data. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of efficacy between the two groups

Compared with the control group, the overall efficacy in the observation group was significantly improved ($p < 0.05$), as shown in Table 2.

Table 2. Comparison of overall efficacy between the two groups [n (%)]

Group	Number of cases	Markedly effective	Effective	Ineffective
Observation group	56	30 (53.57)	24 (42.86)	2 (3.57)
Control group	48	16 (33.33)	26 (54.17)	6 (12.50)
Z value			-2.315	
p value			0.021	

3.2. Comparison of hospitalization duration and disappearance time of pulmonary rales between the two groups

The hospitalization duration and the disappearance time of pulmonary rales in the observation group were significantly shorter than those in the control group ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of pulmonary function parameter level between the two groups of children (d, $\overline{x} \pm s$)

Group	Number of cases	Length of hospital stay	Disappearance time of pulmonary rales
Observation group	56	10.64 ± 2.46	4.96 ± 1.35
Control group	48	12.19 ± 3.11	7.60 ± 1.57
t value		-2.825	-9.235
p value		0.006	<0.001

Note: Compared with the same group before treatment, *$p < 0.05$.

3.3. Comparison of arterial blood gas parameters between the two groups

Before treatment, there were no statistically significant differences in PaO_2, $PaCO_2$, and oxygenation index levels between the two groups of children ($p > 0.05$). Compared with before treatment, both PaO_2 and oxygenation index significantly increased, while $PaCO_2$ significantly decreased in both groups after treatment. Moreover, the observation group exhibited higher levels of PaO_2 and oxygenation index and a lower level of $PaCO_2$ after treatment, with all differences being statistically significant ($p < 0.05$), as shown in **Table 4**.

Table 4. Comparison of arterial blood gas parameters between the two groups (mm Hg, $\overline{x} \pm s$)

Group	Number of cases	PaO_2		$PaCO_2$		Oxygenation index	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	56	55.14 ± 3.64	79.11 ± 3.92*	52.75 ± 10.97	37.86 ± 3.62*	180.73 ± 12.28	216.82 ± 23.54*
Control group	48	55.88 ± 3.94	71.94 ± 5.72*	58.74 ± 32.42	42.96 ± 2.86*	183.19 ± 17.31	205.54 ± 14.51*
t-value		0.984	7.542	-1.298	-7.880	-0.843	2.883
p-value		0.327	< 0.001	0.197	< 0.001	0.401	0.005

Note: Compared with the same group before treatment, *$p < 0.05$.

3.4. Comparison of serum factors between the two groups

Before treatment, there were no statistically significant differences in serum CRP and WBC levels between the two groups of children ($p > 0.05$). Compared with before treatment, serum CRP and WBC levels significantly decreased in both groups after treatment, and the levels of each parameter indicator were lower in the observation group after treatment ($p < 0.05$), as shown in **Table 5**.

Table 5. Comparison of serum factor levels between the two groups ($\overline{x} \pm s$)

Group	Number of cases	Serum CRP (mg/L)		WBC (× 10^9/L)	
		Before Treatment	After Treatment	Before Treatment	After Treatment
Observation group	56	18.11 ± 3.14	5.19 ± 1.83*	7.43 ± 1.48	4.83 ± 1.18*
Control group	48	17.17 ± 2.82	6.58 ± 1.30*	7.05 ± 1.18	5.97 ± 1.26*
t value		1.597	-4.377	1.437	-4.734
p value		0.113	< 0.001	0.154	< 0.001

Note: Compared with the same group before treatment, *$p < 0.05$.

4. Discussion

Infants with BPD often exhibit airway remodeling, immature lung development, and chronic inflammatory responses. These infants have reduced immune function and are prone to concurrent RSV infection. The condition of infants with BPD complicated by RSV infection is more likely to deteriorate, progressing to severe pneumonia and even leading to respiratory failure, thereby increasing the risk of adverse outcomes [7]. Immunoglobulin contains high titers of RSV-specific neutralizing antibodies that can directly block the replication, adsorption, and invasion of the RSV virus, and exert a synergistic effect when combine with antiviral drugs such as

interferon to achieve antiviral treatment goals [8]. Additionally, infants with BPD complicated by RSV infection have immune dysfunction. Immunoglobulin can regulate the levels of T lymphocyte subsets, promote the proliferation and differentiation of B lymphocytes, enhance the body's ability to produce its own antibodies, correct the state of immune dysfunction, and delay airway remodeling [9]. The results of this study also found that the overall therapeutic effect in the observation group significantly improved after treatment, suggesting that immunoglobulin as an adjunctive therapy for infants with BPD complicated by RSV infection helps improve therapeutic efficacy. Dong Huiru et al. also reported that immunoglobulin can reduce airway mucosal edema, decrease inflammatory secretions, improve ventilation function, thereby alleviating symptoms such as wheezing and shortness of breath, and consolidating therapeutic effects, supporting the findings of this study [10].

Infants with BPD complicated by RSV infection have prolonged illness, reduced lung compliance, an imbalance in the ventilation/perfusion ratio, alveolar dysplasia, and progressive lung function damage [11]. Immunoglobulin can promote the proliferation and differentiation of type II alveolar epithelial cells, accelerate the synthesis and secretion of pulmonary surfactant, improve alveolar expansion capacity, increase lung compliance, improve lung function, and promote early recovery in infants, thereby shortening the duration of pulmonary rales and hospital stay. Some studies also suggest that immunoglobulin can inhibit excessive fibroblast proliferation by regulating the synthesis and degradation of extracellular matrix (ECM) in lung tissue cells, reduce the formation of pulmonary fibrosis, delay the process of airway remodeling, and protect residual lung function [12–14]. Additionally, this study found that after treatment, the PaO_2 in the observation group was higher than that in the control group, while $PaCO_2$ was lower. This may be because immunoglobulin can inhibit alveolar epithelial cell apoptosis, maintain the integrity of alveolar structure, increase the area for gas exchange, and thereby improve pulmonary gas exchange function [15]. Furthermore, immunoglobulin can regulate pulmonary vascular tone, improve the distribution of pulmonary circulation blood flow, enhance alveolar gas exchange efficiency, correct hypoxemia, and improve the oxygenation index [16].

CRP is a commonly used pro-inflammatory factor in RSV infection that can increase vascular permeability, induce and exacerbate airway edema, while WBC can aggravate airway inflammation, trigger an inflammatory storm, and worsen lung injury [17,18]. The results of this study found that after treatment, serum CRP and WBC levels in the observation group were lower than those in the control group. Immunoglobulin can inhibit the release of inflammatory mediators, reduce the damage caused by inflammatory factors to the airways and lung parenchyma, alleviate airway mucosal edema, decrease secretions, and improve airway ventilation function [19]. After binding to Fc receptors on the surface of immune cells, immunoglobulin can activate downstream signaling molecules, inhibit the phosphorylation of NF-κB, thereby suppressing the transcription and expression of related genes, and reducing the synthesis and secretion of pro-inflammatory factors such as serum CRP and WBC [20]. This may also be an important mechanism by which immunoglobulin alleviates the condition of infants with BPD complicated by RSV infection.

5. Conclusion

In summary, the use of immunoglobulin in infants with BPD complicated by RSV infection has significant effects, helping to reduce inflammation and improve lung function.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Ke Q, Qiu Y, Gan X, et al., 2023, Analysis of the Efficacy of Budesonide Combined With Pulmonary Surfactant in the Treatment of Bronchopulmonary Dysplasia in Premature Infants with a Gestational Age of < 32 Weeks. Maternal and Child Health Care of China, 38(3): 451–454.

[2] Cortes J, Lopez-Lacort M, Mira-Iglesias A, et al., 2025, Optimal Immunization Strategy for Protection of Children < 1 Year Against Respiratory Syncytial Virus Infection and Hospitalization. Bulletin of Mathematical Biology, 88(1): 9.

[3] Li G, Huang Y, Fan Y, et al., 2025, Clinical Characteristics and Prognosis of Lower Respiratory Tract Infections in Infants with Bronchopulmonary Dysplasia. Chongqing Medical Journal, 54(2): 366–371.

[4] Li J, Zhong P, Liao Y, et al., 2025, Survey on Knowledge, Attitudes, and Behaviors Related to the Prevention and Treatment of Respiratory Syncytial Virus Infection Among Caregivers of Children Aged 0–12 Months in Shanghai in 2024. Chinese Journal of Vaccines and Immunization, 31(3): 336–341.

[5] Pediatric Professional Committee of China Medical Education Association, Respiratory Group of Pediatric Branch of Chinese Medical Association, Neonatology Group of Pediatric Branch of Chinese Medical Association, et al., 2022, Expert Consensus on the Management of Bronchopulmonary Dysplasia in Children. Chinese Journal of Practical Pediatrics, 37(20): 1527–1538.

[6] National Clinical Research Center for Child Health and Diseases, Infectious Disease Group of Pediatric Branch of Chinese Medical Association, Infectious Disease Branch of Shanghai Medical Association, et al., 2024, Chinese Expert Consensus on the Clinical Diagnosis and Treatment of Respiratory Syncytial Virus Infection in Children (2023 Edition). Journal of Clinical Pediatrics, 42(1): 1–14.

[7] Mariani A, Ghezzi E, Pesenti N, et al., 2025, Nasal High-Flow Therapy Versus Low-Flow Oxygen Therapy Post-Discharge in Infants with Bronchopulmonary Dysplasia: A Retrospective Observational Study. Pediatric Pulmonology, 60(1): e27450.

[8] Yu B, Gong C, He P, 2023, Correlation of Serum 25-Hydroxyvitamin D and Immunoglobulin Levels With the Occurrence and Severity of Pneumonia in Infants and Young Children. Journal of Molecular Diagnostics and Therapy, 15(2): 310–313.

[9] Deng J, Yu L, 2025, Preparation and Application of a Human-Mouse Chimeric Respiratory Syncytial Virus-Immunoglobulin M Recombinant Antibody. Journal of Xinxiang Medical University, 42(7): 538–543.

[10] Dong H, Feng L, Shi S, et al., 2025, Efficacy of Recombinant Human Interferon Combined with Human Immunoglobulin in the Treatment of Children with Severe RSV Pneumonia. Chinese Journal of Drug Application and Monitoring, 22(7): 1273–1277.

[11] Zeng L, Xie X, Chen X, et al., 2020, Clinical Characteristics and Pathogen Analysis of Readmission for Lower Respiratory Tract Infections Within 2 Years in Children with Bronchopulmonary Dysplasia (With a Report of 52 Cases). Chinese Journal of Practical Pediatrics, 35(11): 885–890.

[12] Yu Y, Zhou P, Wu Y, et al., 2026, Expert Consensus on the Prevention of Respiratory Syncytial Virus Infection in Infants and Young Children with Special Health Conditions. Chinese Journal of Perinatal Medicine, 29(2): 105–116.

[13] Yang S, Qi X, Chen J, et al., 2022, Clinical Efficacy of Human Immunoglobulin in the Treatment of Children with Infectious Pneumonia and Its Impact on Serum-Related Factor Levels. Maternal and Child Health Care of China, 37(9): 1635–1638.

[14] Mohamed B, Kulkarni A, Duffy D, et al., 2025, Respiratory Physiological Changes Post Initiation of Neurally Adjusted Ventilatory Assist in Preterm Infants with Evolving or Established Bronchopulmonary Dysplasia. European Journal of Pediatrics, 184(2): 159.

[15] Lv M, Chen Q, Pang Y, et al., 2022, Clinical Value of Detecting Serum Cysteinyl Leukotrienes, Eosinophil Cationic Protein, Immunoglobulin E, and Serum Inflammatory Factors in Children with Bronchiolitis Caused by Respiratory Syncytial Virus Infection. Anhui Medical and Pharmaceutical Journal, 26(2): 365–368.

[16] Cai S, Zhu C, Chen F, et al., 2023, Construction of a Risk Model for Severe Adenovirus Pneumonia in Children and a Prospective Study on the Timing of Intravenous Immunoglobulin Treatment. Chinese Journal of Contemporary Pediatrics, 25(6): 619–625.

[17] Liu S, Zhang Y, Zhao X, 2024, Mechanism of microRNA-93-5p in Regulating the Toll-Like Receptor 4 Gene to Inhibit the Inflammatory Response of Bronchial Epithelial Cells Infected with Respiratory Syncytial Virus. Chinese Journal of Virology, 40(3): 469–475.

[18] Santos L, Antunes K, Muraro S, et al., 2021, TNF-Mediated Alveolar Macrophage Necroptosis Drives Disease Pathogenesis During Respiratory Syncytial Virus Infection. European Respiratory Journal, 57(6): 2003764.

[19] Zhang L, Zhong X, 2023, Effects and Significance of Overweight/Obesity Factors on Serum Immunoglobulin and IGF-1 Levels in Children with Recurrent Respiratory Tract Infections. Journal of Public Health and Preventive Medicine, 34(2): 139–142.

[20] Ding Y, Zhang H, Xianyu X, 2025, Efficacy of Budesonide Aerosol Inhalation Combined with Intravenous Immunoglobulin in the Treatment of Children with Infectious Pneumonia and Its Impact on Inflammatory Marker Levels. Northwestern Pharmaceutical Journal, 40(6): 179–185

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Research Progress on Exercise Intervention in the Management of Polycystic Ovary Syndrome

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Abstract: Polycystic ovary syndrome (PCOS) is a common reproductive endocrine disease in women. Its pathogenesis is complex and varies among individuals. It is characterized by hyperandrogenemia, insulin resistance and ovarian dysfunction, accompanied by psychological problems such as anxiety and depression, which have a profound impact on women's health and are one of the causes of infertility. Exercise intervention can relieve the symptoms related to PCOS by improving insulin sensitivity, body composition and sex hormone levels. This paper aims to review the relevant exercise mechanisms to relieve PCOS and improve the effects of exercise on core symptoms in recent years, so as to provide new ideas for further Exploration.

Keywords: Polycystic ovary syndrome; Insulin resistance; Hyperandrogenemia; Ovarian dysfunction; High-intensity interval training

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1. Research background

Polycystic Ovary Syndrome (PCOS) is a common reproductive endocrine and metabolic disorder affecting women of reproductive age, characterized primarily by hyperandrogenism, menstrual irregularities, and difficulty conceiving, often accompanied by psychological issues such as anxiety and depression, which may be associated with imbalances in neurotransmitter levels [1]. In recent years, influenced by factors including unreasonable dietary patterns, reduced physical activity, environmental pollution, and sleep disturbances, the incidence of PCOS has been increasing annually, with a trend toward younger age of onset. Epidemiological data indicate that approximately 6–20% of women of reproductive age worldwide are affected by PCOS, and its impact extends beyond reproductive health to include metabolic complications such as obesity, type 2 diabetes mellitus, cardiovascular disease, and chronic kidney disease, imposing a substantial burden on healthcare systems [2]. The etiology of PCOS remains incompletely understood, but it is currently believed to be closely associated with insulin resistance, hyperandrogenemia, and chronic inflammation, with

evidence of familial clustering and genetic predisposition [3]. Relevant studies have shown that compared with healthy women, PCOS patients, regardless of obesity status, exhibit more pronounced insulin resistance and sex hormone disturbances, along with metabolic abnormalities and reduced mitochondrial respiratory function in abdominal subcutaneous adipose tissue. Moreover, some PCOS patients with body mass index (BMI) and waist-to-hip ratio within normal reference ranges still have significantly higher body fat percentages than healthy control women [4,5]. For clinical diagnosis, the Rotterdam Criteria are the most widely adopted diagnostic framework internationally, requiring at least two of the following three criteria: (1) hyperandrogenemia or clinical signs of hyperandrogenism (e.g., hirsutism); (2) ovulatory dysfunction (oligomenorrhea/amenorrhea); (3) polycystic ovarian morphology (ultrasound showing ovarian volume ≥ 10 cm^3 or antral follicle count > 20) [6].

In terms of management strategies, the international evidence-based guideline for PCOS (2023) has clearly recommended that patients adopt a healthy lifestyle, including a balanced diet and regular physical activity, to achieve or maintain a healthy body weight and improve metabolic and psychological status [7]. Since pharmacological treatments typically target specific symptoms and may be associated with adverse effects, and no curative intervention is currently available, exercise intervention, as a safe, cost-effective, and highly adherent non-pharmacological approach, has gradually become an important component of long-term PCOS management [8]. Existing studies have shown that exercise exerts comprehensive therapeutic effects through multiple mechanisms, including improving insulin signaling pathways, regulating androgen levels, optimizing the ovarian microenvironment, and alleviating chronic low-grade inflammation [9,10]. Therefore, a systematic review of the mechanisms of action of exercise intervention in PCOS and the effects of different exercise modalities holds significant clinical and research value.

2. Exercise-induced amelioration of core symptoms in PCOS

2.1. Exercise and insulin resistance

Insulin resistance (IR) refers to a reduced sensitivity of peripheral tissues to the biological effects of insulin, leading to compensatory hypersecretion by pancreatic β-cells that nevertheless remains relatively insufficient [11]. The prevalence of IR is high among patients with PCOS. Generally, there are abnormalities observed in the insulin signaling pathway and metabolic dysfunction of insulin target tissues. Then, it leads PCOS patients to develop insulin resistance, which can participate in the pathogenesis of PCOS through various mechanisms, including interference with glucose metabolism and modulation of sex hormone synthesis. In the mechanistic study of insulin resistance in PCOS, a classic hypothesis proposes that abnormally increased serine phosphorylation of insulin receptor substrates (IRS) inhibits their tyrosine phosphorylation, thereby blocking downstream insulin signal transduction and leading to insulin dysfunction [12,13]. However, with advancing research, it is now believed that PCOS-related insulin signaling defects may also lie downstream of IRS (e.g., diminished Akt/mTOR signaling) and are closely associated with multiple factors, such as lipotoxicity, mitochondrial dysfunction, endoplasmic reticulum stress, and TGF-β-mediated tissue fibrosis [14,15]. Moreover, IR and hyperinsulinemia are key core features in PCOS patients and are closely related to the long-term metabolic complications of PCOS. Studies have found that the prevalence of metabolic syndrome and IR is higher in obese adolescents, and IR is positively correlated with body composition indices (body mass index, body fat percentage, waist circumference, and subcutaneous fat) and significantly associated with high-density

lipoprotein cholesterol and metabolic syndrome [16].

In terms of exercise intervention, multiple randomized controlled trials have shown that regular moderate-to-vigorous intensity physical activity can significantly improve insulin sensitivity in patients with PCOS, particularly in those who are overweight or obese. A systematic review indicated that a combined regimen of high-intensity interval training (HIIT) and resistance training yielded the greatest improvement in the HOMA-IR index [14,17]. Furthermore, exercise can enhance the body's insulin response by increasing skeletal muscle glucose uptake capacity and improving capillary blood flow. Of note, some lean PCOS patients do not show significant improvement, which may be related to an insufficient upregulation capacity of key proteins in the skeletal muscle insulin signaling pathway [18]. This suggests that future research should develop individualized exercise prescriptions based on different phenotypes.

2.2. Exercise and hyperandrogenemia

Abnormally elevated androgen levels constitute a major driving factor in the pathogenesis of polycystic ovary syndrome and the development of metabolic syndrome, termed "hyperandrogenemia (HA)". Its clinical manifestations primarily include hirsutism, acne, and male pattern hair loss (androgenetic alopecia) [19,20]. HA in PCOS patients mainly originates from excessive androgen secretion by the ovaries and adrenal cortex, with dysregulation of steroid hormone homeostasis being one of the core etiological factors. Studies have shown that IR and HA may form a vicious cycle: hyperinsulinemia promotes ovarian androgen synthesis, while excess androgens in turn exacerbate insulin resistance [21,22]. Furthermore, PCOS patients often exhibit ovarian theca-interstitial hyperplasia and arrested follicular development, indicating that the reproductive microenvironment is chronically exposed to a state of androgen excess [23,24].

Multiple studies have confirmed that exercise interventions can positively affect androgen parameters in patients with PCOS. Research has shown that high-intensity interval training or resistance training can increase sex hormone-binding globulin (SHBG) levels and reduce free testosterone concentrations; both aerobic exercise and HIIT can lower serum testosterone levels and body fat percentage within 16 weeks, while also improving menstrual cycle regularity [25–27]. Among these, HIIT is superior to resistance training alone in reducing serum testosterone and improving body composition. In summary, exercise not only improves metabolic status but also serves as an important means of modulating the androgen environment, thereby exerting positive effects on reproductive health in women with PCOS.

2.3. Exercise and ovarian dysfunction

Chronic low-grade inflammation is considered a key pathogenic factor in PCOS. In PCOS patients, macrophages and neutrophils constitute the predominant immune cell populations, which can secrete various pro-inflammatory cytokines, including IL-1, IL-6, IL-18, and TNF-α. The concentrations of these inflammatory cytokines are elevated in both serum and follicular fluid of patients, regardless of obesity status [28]. Recent studies suggest that IL-1 plays a particularly prominent role in PCOS-related chronic inflammation, and the local inflammatory environment driven by IL-1 may affect follicular development and ovarian fibrosis [29].

Furthermore, elevated oxidative stress levels also exacerbate ovarian damage. Animal studies have shown that regular exercise can improve ovarian function in PCOS rats, and the exercise-induced myokine Irisin reduces inflammatory responses and oxidative stress by inhibiting the IRE1α-TXNIP/ROS-

NLRP3 pathway, thereby improving follicular function and ovarian fibrosis [30]. Clinical studies have also demonstrated that aerobic exercise can reduce serum levels of IL-6, TNF-α, and C-reactive protein in patients, suggesting that exercise may ameliorate the ovarian microenvironment through anti-inflammatory and antioxidant mechanisms, thereby enhancing ovulatory function and fertility [28].

3. Different exercise types and PCOS

In recent years, an increasing number of studies have focused on the differential effects of various exercise types on the improvement of clinical symptoms in PCOS patients. Exploring different forms of exercise interventions, such as aerobic exercise, resistance training, and high-intensity interval training, has become a hot topic in current research. According to the international PCOS guideline recommendations, to prevent weight gain, at least 150 minutes of moderate-intensity exercise or at least 75 minutes of vigorous-intensity exercise per week is advised; for weight loss and prevention of weight regain, at least 250 minutes of moderate-intensity exercise or at least 150 minutes of vigorous-intensity exercise per week is recommended [7].

Existing studies have shown that different exercise modalities each have advantages for improving insulin resistance, androgen levels, ovarian function, and psychological health, but overall, they can offer multiple benefits to PCOS patients. These will be described by type in the following sections.

3.1. High-intensity interval training

HIIT is a form of high-intensity interval training characterized by alternating cycles of high-intensity and low-intensity exercise. It has been found to effectively increase maximal oxygen consumption (VO_2max) and sex hormone-binding globulin levels in the PCOS patients, improve metabolic and cardiorespiratory fitness, and ameliorate insulin resistance and menstrual cycle regularity [31].

An 8-week RCT showed that HIIT significantly improved aerobic capacity, insulin resistance and sensitivity, blood lipid levels, and inflammatory and cardiovascular parameters in women with PCOS [10]. Another study comparing HIIT with combined training (resistance plus aerobic) found that both reduced BMI and free androgen index, but HIIT was superior in improving VO_2max [32]. Furthermore, a 12-week HIIT intervention demonstrated better effects to reduce serum testosterone levels and body fat compared with resistance training alone [25]. In summary, HIIT offers multiple benefits for PCOS patients, particularly in enhancing cardiorespiratory fitness and improving ovarian function, and has become a research hotspot for improving outcomes in PCOS.

3.2. Aerobic exercise

Aerobic exercise is also a commonly used exercise type for improving outcomes in PCOS patients. Studies have shown that regular aerobic exercise not only improves cardiorespiratory fitness but also exerts positive effects on ovarian hormone levels and oxidative stress-related parameters. In a 12-week aerobic exercise study, PCOS patients demonstrated significant improvements in cardiovascular fitness, anti-Müllerian hormone (AMH) levels, and oxidative stress markers (malondialdehyde, superoxide dismutase, and total antioxidant capacity) [33]. Another randomized controlled trial indicated that both continuous aerobic training and intermittent aerobic training effectively reduced testosterone levels, improved body composition, and enhanced quality of life in PCOS patients [34]. In summary, aerobic exercise plays a stable role in improving

metabolic health, regulating endocrine function, and enhancing quality of life, and is suitable for PCOS patients with poor baseline fitness or difficulty adhering to high-intensity exercise.

3.3. Physical resistance training

PRT is a form of anaerobic exercise that enhances muscle strength and endurance through resistance against an external force. Studies have shown that after four months of resistance training, PCOS patients exhibited significant improvements in muscle strength, along with reduced body fat, increased lean body mass, and amelioration of hyperandrogenism [35]. In another 16-week study comparing aerobic exercise and PRT, both modalities improved anthropometric measures, metabolic dysfunction, and hyperandrogenemia in PCOS patients, with no significant difference in effects between the two [36]. Therefore, PRT can improve body composition, metabolic function, and hyperandrogenemia in PCOS patients, with notable efficacy in enhancing muscle strength, making it particularly suitable for PCOS patients with low muscle mass or concomitant obesity.

3.4. Summary comparison of exercise modalities

Table 1. Comparison of exercise modalities

Exercise Type	Intervention Duration and Frequency	Main Improved Parameters	Advantages	Limitations	Suitable Population
HIIT	8–12 weeks, 3–4 times/week	Insulin sensitivity ↑, VO_2max ↑, Testosterone ↓, Body fat ↓	Time-efficient, improves multiple parameters	High intensity, potential for poor adherence	Young adults, overweight/obese PCOS patients with good cardiorespiratory fitness
Aerobic exercise	12–16 weeks, 3–5 times/week	Cardiorespiratory fitness ↑, Anti-Müllerian hormone (AMH) ↑, Oxidative stress ↓, Testosterone ↓	Easy to promote, high safety profile	High safety profile, slower onset of effects, requires long-term adherence	All PCOS patients, especially those with cardiovascular risk or poor baseline fitness
Resistance training	12–16 weeks, 2–3 times/week	Muscle strength ↑, Body fat ↓, Lean body mass ↑, Androgens ↓	Significant improvement in body composition, strength gain	Limited effect on cardiorespiratory fitness when used alone	PCOS patients with obesity or low muscle mass, those seeking improved body shape and metabolic function

Table 1 is primarily based on findings from recent randomized controlled trials and systematic reviews of HIIT, aerobic exercise, and resistance training [9,23,25,26,30–35]. These findings suggest that exercise intervention has definite efficacy in improving PCOS, although further large-scale studies are still needed for validation.

4. Conclusion

In recent years, research on the application of exercise intervention in the management of polycystic ovary syndrome (PCOS) has continued to deepen, and its efficacy and value have gradually gained widespread recognition. A large body of studies has shown that regular exercise not only effectively improves insulin resistance, reduces androgen levels, optimizes body composition, and restores ovulatory function, but also alleviates chronic inflammation and improves psychological status and quality of life. As a safe, cost-

effective, and highly adherent non-pharmacological treatment, exercise intervention offers significant advantages in promoting metabolic homeostasis, improving reproductive health, and enhancing overall quality of life, thereby providing important support for long-term comprehensive management of PCOS. Notably, HIIT has demonstrated particularly prominent comprehensive efficacy in recent studies.

However, current research on exercise intervention still has certain limitations. Most trials have limited sample sizes and short follow-up periods, lacking systematic evidence on long-term efficacy and safety. Considerable heterogeneity in exercise prescription design across studies results in insufficient comparability and reproducibility of findings. Moreover, studies on individualized interventions tailored to different PCOS phenotypes remain relatively scarce. Future efforts should focus on conducting multicenter, large-sample, long-term follow-up clinical trials, combined with basic mechanistic research, to further elucidate the role of exercise in inflammation regulation, oxidative stress, and gut microbiota homeostasis. Additionally, digital health technologies should be utilized to enhance patient exercise adherence, and integrated management models combining exercise with nutritional management, psychological intervention, and pharmacotherapy should be explored.

In summary, exercise intervention has unique and irreplaceable advantages in PCOS management. With the continuous accumulation of high-quality evidence-based data, its clinical application value in improving metabolic, endocrine, and psychological health will be further enhanced, laying a solid foundation for achieving precise and long-term management of PCOS.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Chaudhari N, Dawalbhakta M, Nampoothiri L, 2018, GnRH Dysregulation in Polycystic Ovarian Syndrome (PCOS) Is a Manifestation of an Altered Neurotransmitter Profile. Reprod Biol Endocrinol, 16(1): 37.

[2] Zheng L, Xu X, Zhou JZ, et al., 2025, The Burden of Polycystic Ovary Syndrome-Related Infertility in 204 Countries and Territories, 1990–2021: An Analysis of the Global Burden of Disease Study 2021. Front Endocrinol (Lausanne), 16: 1559246.

[3] Stener-Victorin E, Padmanabhan V, Walters KA, et al., 2020, Animal Models to Understand the Etiology and Pathophysiology of Polycystic Ovary Syndrome. Endocr Rev, 41(4): bnaa010.

[4] Zhang H, Wang W, Zhao J, et al., 2023, Relationship Between Body Composition, Insulin Resistance, and Hormonal Profiles in Women With Polycystic Ovary Syndrome. Frontiers in Endocrinology, 13.

[5] Lionett S, Kiel IA, Rosbjorgen R, et al., 2021, Absent Exercise-Induced Improvements in Fat Oxidation in Women With Polycystic Ovary Syndrome After High-Intensity Interval Training. Front Physiol, 12: 649794.

[6] Rotterdam EASPCWG, 2004, Revised 2003 Consensus on Diagnostic Criteria and Long-Term Health Risks Related to Polycystic Ovary Syndrome (PCOS). Hum Reprod, 19(1): 41–47.

[7] Teede HJ, Tay CT, Laven JJE, et al., 2023, Recommendations From the 2023 International Evidence-Based Guideline for the Assessment and Management of Polycystic Ovary Syndrome. J Clin Endocrinol Metab, 108(10): 2447–2469.

[8] King AK, McGill-Meeks K, Beller JP, et al., 2019, Go Girls!–Dance-Based Fitness to Increase Enjoyment of

Exercise in Girls at Risk for PCOS. Children (Basel), 6(9): 99.

[9] Nybacka A, Carlstrom K, Stahle A, et al., 2011, Randomized Comparison of the Influence of Dietary Management and/or Physical Exercise on Ovarian Function and Metabolic Parameters in Overweight Women With Polycystic Ovary Syndrome. Fertil Steril, 96(6): 1508–1513.

[10] Mohammadi S, Monazzami A, Alavimilani S, 2023, Effects of Eight-Week High-Intensity Interval Training on Some Metabolic, Hormonal and Cardiovascular Indices in Women with PCOS: A Randomized Controlled Trial. BMC Sports Sci Med Rehabil, 15(1): 47.

[11] DeFronzo RA, Tobin JD, Andres R, 1979, Glucose Clamp Technique: A Method for Quantifying Insulin Secretion and Resistance. Am J Physiol, 237(3): E214–223.

[12] Dunaif A, Xia J, Book CB, et al., 1995, Excessive Insulin Receptor Serine Phosphorylation in Cultured Fibroblasts and in Skeletal Muscle: A Potential Mechanism for Insulin Resistance in the Polycystic Ovary Syndrome. J Clin Invest, 96(2): 801–810.

[13] Corbould A, Kim YB, Youngren JF, et al., 2005, Insulin Resistance in the Skeletal Muscle of Women With PCOS Involves Intrinsic and Acquired Defects in Insulin Signaling. Am J Physiol Endocrinol Metab, 288(5): E1047–1054.

[14] Stepto NK, Hiam D, Gibson-Helm M, et al., 2020, Exercise and Insulin Resistance in PCOS: Muscle Insulin Signalling and Fibrosis. Endocr Connect, 9(4): 346–359.

[15] Hansen SL, Svendsen PF, Jeppesen JF, et al., 2019, Molecular Mechanisms in Skeletal Muscle Underlying Insulin Resistance in Women Who Are Lean With Polycystic Ovary Syndrome. J Clin Endocrinol Metab, 104(5): 1841–1854.

[16] Gobato AO, Vasques AC, Zambon MP, et al., 2014, Metabolic Syndrome and Insulin Resistance in Obese Adolescents. Rev Paul Pediatr, 32(1): 55–62.

[17] García-Hermoso A, López-Gil JF, Izquierdo M, et al., 2023, Exercise and Insulin Resistance Markers in Children and Adolescents With Excess Weight: A Systematic Review and Network Meta-Analysis. JAMA Pediatrics, 177(12): 1276–1284.

[18] Hansen SL, Bojsen-Moller KN, Lundsgaard AM, et al., 2020, Mechanisms Underlying Absent Training-Induced Improvement in Insulin Action in Lean, Hyperandrogenic Women With Polycystic Ovary Syndrome. Diabetes, 69(11): 2267–2280.

[19] Azziz R, Carmina E, Dewailly D, et al., 2006, Position Statement: Criteria for Defining Polycystic Ovary Syndrome as a Predominantly Hyperandrogenic Syndrome: An Androgen Excess Society Guideline. J Clin Endocrinol Metab, 91(11): 4237–4245.

[20] Teede HJ, Misso ML, Costello MF, et al., 2018, Recommendations From the International Evidence-Based Guideline for the Assessment and Management of Polycystic Ovary Syndrome. Hum Reprod, 33(9): 1602–1618.

[21] Qu F, Wang FF, Lu XE, et al., 2010, Altered Aquaporin Expression in Women With Polycystic Ovary Syndrome: Hyperandrogenism in Follicular Fluid Inhibits Aquaporin-9 in Granulosa Cells Through the Phosphatidylinositol 3-Kinase Pathway. Hum Reprod, 25(6): 1441–1450.

[22] Huang-Doran I, Kinzer AB, Jimenez-Linan M, et al., 2021, Ovarian Hyperandrogenism and Response to Gonadotropin-Releasing Hormone Analogues in Primary Severe Insulin Resistance. J Clin Endocrinol Metab, 106(8): 2367–2383.

[23] Lindheim L, Bashir M, Munkzker J, et al., 2017, Alterations in Gut Microbiome Composition and Barrier Function Are Associated with Reproductive and Metabolic Defects in Women with Polycystic Ovary Syndrome (PCOS): A

Pilot Study. PLoS One, 12(1): e0168390.

[24] Tosi F, Villani M, Migazzi M, et al., 2021, Insulin-Mediated Substrate Use in Women With Different Phenotypes of PCOS: The Role of Androgens. J Clin Endocrinol Metab, 106(9): e3414–e3425.

[25] Rao M, Khan AA, Adnan QUA, 2022, Effects of High-Intensity Interval Training and Strength Training on Levels of Testosterone and Physical Activity Among Women With Polycystic Ovary Syndrome. Obstet Gynecol Sci, 65(4): 368–375.

[26] Almenning I, Rieber-Mohn A, Lundgren KM, et al., 2015, Effects of High Intensity Interval Training and Strength Training on Metabolic, Cardiovascular and Hormonal Outcomes in Women with Polycystic Ovary Syndrome: A Pilot Study. PLoS One, 10(9): e0138793.

[27] Philbois SV, Ribeiro VB, Tank J, et al., 2022, Cardiovascular Autonomic Modulation Differences Between Moderate-Intensity Continuous and High-Intensity Interval Aerobic Training in Women with PCOS: A Randomized Trial. Front Endocrinol (Lausanne), 13: 1024844.

[28] Vasyukova E, Zaikova E, Kalinina O, et al., 2023, Inflammatory and Anti-Inflammatory Parameters in PCOS Patients Depending on Body Mass Index: A Case-Control Study. Biomedicines, 11(10): 2791.

[29] Walchli-Popovic M, Monnerat S, Taylor AE, et al., 2024, Effects of Interleukin-1 Receptor Antagonism in Women With Polycystic Ovary Syndrome—The FertIL Trial. Front Endocrinol (Lausanne), 15: 1435698.

[30] Weng Y, Zhang Y, Wang D, et al., 2023, Exercise-Induced Irisin Improves Follicular Dysfunction by Inhibiting IRE1alpha-TXNIP/ROS-NLRP3 Pathway in PCOS. J Ovarian Res, 16(1): 151.

[31] Patten RK, McIlvenna LC, Levering I, et al., 2022, High-Intensity Training Elicits Greater Improvements in Cardio-Metabolic and Reproductive Outcomes Than Moderate-Intensity Training in Women with Polycystic Ovary Syndrome: A Randomized Clinical Trial. Hum Reprod, 37(5): 1018–1029.

[32] Nasiri M, Monazzami A, Alavimilani S, et al., 2022, The Effect of High Intensity Intermittent and Combined (Resistant and Endurance) Trainings on Some Anthropometric Indices and Aerobic Performance in Women with Polycystic Ovary Syndrome: A Randomized Controlled Clinical Trial Study. Int J Fertil Steril, 16(4): 268–274.

[33] Wu X, Wu H, Sun W, et al., 2021, Improvement of Anti-Mullerian Hormone and Oxidative Stress Through Regular Exercise in Chinese Women with Polycystic Ovary Syndrome. Hormones (Athens), 20(2): 339–345.

[34] Ribeiro VB, Lopes IP, Dos Reis RM, et al., 2021, Continuous Versus Intermittent Aerobic Exercise in the Improvement of Quality of Life for Women with Polycystic Ovary Syndrome: A Randomized Controlled Trial. J Health Psychol, 26(9): 1307–1317.

[35] Kogure GS, Silva RC, Miranda-Furtado CL, et al., 2018, Hyperandrogenism Enhances Muscle Strength After Progressive Resistance Training, Independent of Body Composition, in Women With Polycystic Ovary Syndrome. J Strength Cond Res, 32(9): 2642–2651.

[36] Miranda Furtado CL, Hansen M, Kogure GS, et al., 2024, Resistance and Aerobic Training Increases Genome-Wide DNA Methylation in Women with Polycystic Ovary Syndrome. Epigenetics, 19(1): 2305082.

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Research Progress on Assessment Tools for Risk Factors of Pressure Injury in Elderly Inpatients

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Abstract: Elderly hospitalized patients frequently experience nursing complications such as pressure injuries. It is crucial for nursing staff to accurately identify risk factors and appropriately utilize assessment tools, which constitutes a key focus of clinical prevention efforts. This article categorizes the risk factors for pressure injuries in elderly patients into three types: non-modifiable factors, modifiable factors, and environmental/nursing-related factors. It provides a comprehensive analysis of the application and limitations of traditional assessment tools such as the Braden, Waterlow, and Norton scales, while summarizing research advancements in modified localized scales, risk prediction models, intelligent assessment tools, and specialized evaluation instruments to assist clinical nursing professionals in selecting and employing appropriate assessment tools as references.

Keywords: Elderly hospitalization; Risk factors for pressure injuries; Assessment tools; Research progress

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1. Introduction

Pressure injury refers to localized damage to the skin and deep soft tissues caused by pressure or a combination of pressure and shear forces, manifesting as skin breakdown or open ulcers at bony prominences. It is one of the most common nursing complications among elderly hospitalized patients [1]. The aging population in China is accelerating at a rapid pace, and the number of elderly hospitalized patients continues to increase annually. Elderly individuals often suffer from chronic underlying diseases and functional decline, resulting in persistently high rates of pressure injuries. Identifying the risk factors for pressure injuries in elderly hospitalized patients and appropriately selecting and utilizing assessment tools constitute critical components of clinical pressure injury prevention [2]. This article primarily reviews the classification of risk factors for pressure injuries in elderly hospitalized patients, traditional assessment tools and their clinical applications, as well as research advancements in novel assessment tools, aiming to provide references for clinical nursing practice.

2. Classification of risk factors for pressure injury in elderly hospitalized patients

2.1. Unalterable risk factors

Unalterable risk factors refer to characteristics inherent in patients that cannot be directly modified through nursing interventions, yet they remain of significant value for risk assessment and graded prevention.

2.1.1. Age

With advancing age, the elasticity of the skin declines, the subcutaneous fat layer thins, and collagen in the dermis decreases, resulting in reduced skin resilience against pressure and shear forces. The microcirculatory function of the skin deteriorates, and capillary regeneration capacity diminishes, leading to a slower repair process under compression. Numerous studies have demonstrated that hospitalized patients aged 70 years or older exhibit a higher probability of developing pressure injuries compared to younger patients, with the risk increasing significantly for every additional decade of age [3].

2.1.2. Gender factor

The incidence of stress injuries in elderly female patients is generally higher than that in males, which may be attributed to the sudden decline in estrogen levels post-menopause, leading to reduced collagen content in the skin and diminished skin barrier function. Additionally, the anatomical characteristics of the hip and pelvis in elderly women subject the sacrococcygeal region and bony prominences such as the ischial tuberosities to greater local pressure, thereby increasing the likelihood of injury [4].

2.1.3. Presence of multiple underlying diseases

Diabetes mellitus is one of the most prominent conditions, where chronic hyperglycemia leads to peripheral neuropathy, reducing patients' sensitivity to compressive discomfort, while microvascular complications result in inadequate local tissue perfusion and impair tissue ischemia tolerance and repair capacity. Patients with sequelae of cerebrovascular diseases, such as hemiplegia or paraplegia, face an extremely high risk due to prolonged bed rest accompanied by sensory and motor dysfunction, resulting in sustained local tissue compression [5]. Patients with chronic cardiopulmonary insufficiency face elevated risks due to prolonged tissue hypoxia and inadequate nutritional supply to the skin and subcutaneous tissues. Patients with advanced-stage malignant tumors are often at high risk owing to cachexia and systemic organ failure. A prior history of pressure injuries should also not be overlooked, as patients with such a history exhibit significantly increased recurrence risk.

2.2. Modifiable risk factors

Modifiable risk factors refer to those that can be improved through active interventions; addressing these factors constitutes the primary strategy for preventing stress injuries.

2.2.1. Nutritional status

Elderly hospitalized patients often experience insufficient protein and caloric intake due to decreased appetite, masticatory dysfunction, and impaired digestive and absorptive capacity, leading to hypoproteinemia. Reduced serum albumin levels constitute an independent risk factor for stress injury in elderly patients. Adequate protein intake is essential for maintaining the normal structure of skin and subcutaneous tissues and promoting wound healing. Trace elements such as vitamin C and zinc play critical roles in collagen synthesis

and wound healing; their deficiency increases the likelihood of injury occurrence [6].

2.2.2. Limited mobility and movement capacity

Elderly hospitalized patients experience prolonged bed rest due to illness, postoperative immobilization, or pain, resulting in sustained vertical pressure on bony prominences. When tissue pressure exceeds the capillary occlusion pressure and persists for an extended duration, local blood flow is interrupted, leading to tissue ischemia and hypoxia, ultimately causing cell necrosis. Assisting patients with active movement or passive position changes constitutes a fundamental approach to preventing pressure injuries. A moist environment compromises skin integrity, representing another modifiable factor. Elderly patients often experience prolonged skin moisture due to urinary/fecal incontinence, excessive sweating, or wound exudate. Moisture softens the stratum corneum and weakens barrier function, increasing susceptibility to friction and shear forces while creating a favorable environment for bacterial and fungal growth. Impaired sensory perception is closely associated with pressure injuries. Due to cognitive dysfunction, delirium, or neurological disorders, elderly patients exhibit diminished awareness of compressive discomfort and are unable to voluntarily adjust their posture to alleviate localized pressure [7].

2.3. Environmental and nursing factors

Devices such as dynamic alternating-pressure air mattresses and static pressure-relieving cushions can automatically adjust pressure distribution according to changes in patient positioning, significantly reducing peak pressure at bony prominences, and have been proven effective in reducing the incidence of pressure injuries [8]. Position management and repositioning frequency directly affect the duration of sustained pressure on local tissues; regular repositioning is the most fundamental and effective measure for preventing pressure injuries, with a general recommendation that bedridden patients be repositioned every two hours, with the specific frequency individually adjusted based on the patient's risk level. Insufficient nursing staffing is likewise an important factor affecting the quality of prevention; when nursing workloads are excessive, it becomes difficult to complete preventive measures such as repositioning and skin assessments as scheduled. Strengthening nursing staff training and optimizing workflows have positive significance for reducing the incidence of pressure injuries.

3. Traditional pressure injury risk assessment tools and their clinical applications

3.1. Commonly used classic assessment scales

3.1.1. Braden scale

The Braden Scale, developed by Braden and Bergstrom in 1987, is currently the most widely used tool for assessing pressure injury risk in clinical nursing practice both domestically and internationally. The scale provides a comprehensive evaluation across six dimensions: perception ability, moisture level, mobility, activity capacity, nutritional intake, and friction/shear forces, with a total score ranging from 6 to 23 points, where lower scores indicate higher risk. Clinically, a score of 18 is considered the critical threshold: 15–18 indicates mild risk, 13–14 indicates moderate risk, and 12 or below indicates high risk. The Braden Scale features a concise structure, allowing nursing staff to master it after brief training [9].

Validation studies conducted on elderly hospitalized patients demonstrated that the Braden Scale exhibits high sensitivity and moderate specificity. However, certain assessment dimensions, such as perceived

ability and subjective evaluation of nutritional intake, show significant inter-assessor variability in scoring consistency [10]. Additionally, the scale does not incorporate age and comorbidities, factors specific to elderly patients which somewhat limits its predictive accuracy.

3.1.2. Waterlow scale

The Waterlow Scale was developed by Waterlow in 1985 and covers multiple dimensions including body mass index (BMI), skin type, gender, age, nutritional status, incontinence status, mobility, neurological dysfunction, and medication use. It also includes items related to surgical risks. The total score is calculated by assigning different weights to each item, with higher total scores indicating greater risk [11].

This scale features a comprehensive range of assessment dimensions, with particular emphasis on nutritional status and skin condition, making it highly suitable for elderly patients with multiple chronic comorbidities. However, its extensive item list includes some entries with insufficiently clear definitions, resulting in prolonged assessment time. Additionally, studies suggest that its specificity is relatively low, increasing the risk of over-assessment and consequently unnecessary waste of nursing resources.

3.1.3. Norton scale

The Norton Scale, developed by Norton et al. in 1962, is one of the earliest tools for assessing the risk of pressure injuries. The scale comprises five dimensions: physical condition, mental status, activity capacity, mobility ability, and incontinence. Each dimension is scored on a four-point scale ranging from 1 to 4, with a total score ranging from 5 to 20 points. Clinically, a score of 14 is often used as the cutoff value; scores below 14 indicate an elevated risk [12,13]. The Norton Scale features a simple structure and is widely used in geriatric care. However, it has limited assessment dimensions and does not cover critical risk factors such as nutritional status and friction-shear forces, resulting in limited capacity to evaluate patient-specific risks in elderly individuals. Some studies indicate that its ability to identify high-risk patients is inferior to that of the Braden Scale, leading to a declining global usage rate.

3.2. Common issues with traditional scales

The aforementioned scales still exhibit certain common issues when applied to elderly hospitalized patients. First, these scales were developed based on Western populations, resulting in applicability biases in the China elderly patient population. Second, most are general-purpose assessment tools that fail to adequately account for age-specific factors such as geriatric syndromes, polypharmacy, and cognitive dysfunction. Third, the guidance regarding assessment timing and frequency is rather vague, lacking dynamic evaluation strategies tailored to elderly patients with varying risk levels. Fourth, assessment outcomes rely on the subjective judgment of caregivers, leading to significant scoring discrepancies among different assessors.

4. Research progress on novel risk assessment tools for pressure ulcers

4.1. Modified localized assessment scale

Due to the poor applicability of traditional assessment tools in the elderly patient population in China, domestic scholars have conducted extensive efforts in introducing and modifying these tools. The PURPOSE-T scale was developed by British researchers and comprises two primary assessment modules: skin condition and patient risk factors, covering aspects such as skin integrity, history of pressure injuries,

age, nutritional status, incontinence, mobility, and medication use [14]. Domestic researchers localized the imported data and conducted reliability and validity tests, with results demonstrating that the Chinese version of PURPOSE-T exhibits strong internal consistency and discriminant validity. Some researchers modified the scale based on the Braden Scale, adding items related to elderly patients such as cognitive function, diabetes history, and hemoglobin levels, and recalibrated the cutoff values using large-scale domestic sample data [15]. The improved scale demonstrates enhanced sensitivity and specificity compared to the original version; however, results from different studies still vary, necessitating larger-scale multicenter studies for validation.

4.2. Risk prediction model

Risk prediction models employ statistical methods or machine learning algorithms to construct mathematical models based on patients' demographic characteristics, disease information, and laboratory test indicators, enabling the quantification of an individual's probability of developing pressure injuries. Compared to traditional scales, risk prediction models can incorporate more objective variables and account for complex interactions among these variables [16]. The column chart has become a widely used visualization tool for prediction in recent years. Researchers collect large-scale clinical data and employ logistic regression to identify independent risk factors such as age, serum albumin levels, diabetes, consciousness status, and bed rest duration, presenting them in the form of column charts. Nursing staff can quickly estimate the probability of occurrence by summing the corresponding scores for each factor, offering an intuitive and user-friendly approach.

Machine learning-based prediction models have increasingly become a research hotspot. Algorithms such as random forests, support vector machines, and artificial neural networks can automatically identify nonlinear relationships and higher-order interaction effects in data, demonstrating advantages in processing high-dimensional clinical data. Multiple studies indicate that their predictive accuracy surpasses that of traditional Braden scale scores; however, model construction relies on large volumes of high-quality data with limited interpretability, resulting in relatively high barriers to clinical application.

4.3. Intelligent assessment tool

Intelligent assessment tools hold significant potential for development in the field of pressure ulcer risk evaluation. An intelligent posture monitoring system utilizing thin-film pressure sensors can obtain real-time pressure distribution data from the patient's body-to-mattress contact surface and transmit this data wirelessly to the nursing terminal. If the pressure duration on any area exceeds a preset threshold, the system automatically sends a repositioning reminder. Studies indicate that the implementation of this system has led to a notable improvement in patients actual repositioning compliance rates and a significant reduction in the incidence of pressure ulcers [17]. Evaluation applications for smartphones and tablets have been implemented in several hospitals, digitizing assessment scales and incorporating automated scoring and risk grading features. This reduces errors associated with manual calculations while automatically recording evaluation times and results, facilitating the tracking of dynamic changes in patient risks. Some applications integrate stress ulcer staging identification capabilities, utilizing image processing technology to assist in determining injury staging and severity, thereby enhancing the standardization of assessments.

4.4. Special assessment tool

Elderly inpatients exhibit significant variations in disease types and nursing needs, making it challenging

for general assessment tools to meet the precision requirements of different specialties. In the field of intensive care, specialized assessment tools for ICU patients incorporate specific items such as hemodynamic parameters, mechanical ventilation duration, and sedation-anesthesia scores into routine evaluations, thereby enhancing the accuracy of risk prediction for critically ill elderly patients [18]. In the field of operating rooms, tools for assessing intraoperative acquired pressure injuries incorporate surgical factors such as procedure type, estimated operative duration, intraoperative positioning, and anesthesia method, providing a targeted basis for intraoperative risk stratification. In the context of long-term care for elderly patients, simplified assessment tools retain key items while streamlining the scale structure for bedridden seniors, thereby reducing evaluation time and making them more suitable for use in institutions with limited nursing resources [19].

5. Conclusion

The development of pressure injury risk assessment tools has evolved from universal scales to locally adapted modified scales, and ultimately to intelligent predictive systems. For the specific population of elderly hospitalized patients, a single assessment tool is no longer sufficient to meet the demands of precise prevention. Future efforts should focus on establishing a comprehensive risk assessment system that integrates static evaluations with dynamic monitoring, tailored to the clinical characteristics of elderly patients. While advancing the development and validation of new tools, it is essential to enhance nursing staff training to improve their proficiency in correctly utilizing various assessment tools, thereby ensuring accurate alignment between assessment findings and preventive measures and effectively reducing the incidence of pressure injuries among elderly hospitalized patients.

Disclosure statement

The author declares no conflict of interest.

References

[1] Hu T, Zhang C, 2026, Clinical Efficacy of Medical High-Flow Nasal Cannula Decompression Pads in Emergency Care for Elderly Critically Ill Patients. Medical Equipment, 39(06): 29–32.

[2] Xiang Y, Wang N, Wang T, et al., 2026, Research Progress on Risk Factors and Assessment Tools for Stress Injuries in the Elderly Population. Modern Medicine and Health, 1–11.

[3] Qian C, Bao Y, Li X, 2026, Construction and Predictive Value of a Risk Prediction Model for Oral Mucosal Pressure Injury in Elderly Patients with Severe Traumatic Brain Injury in the ICU. Clinical Misdiagnosis and Mismanagement, 39(02): 76–84.

[4] Wang C, Liang P, Li Y, et al., 2026, Construction of a Risk Prediction Model for Intraoperative Acquired Pressure Injuries in Elderly Patients Based on gcForest. Computer Knowledge and Technology, 22(03): 22–27.

[5] Guan L, Yang Y, Li X, 2025, The Effect of Pressure Ulcer Early Warning Nursing Combined with Hierarchical Nursing on Pressure Injuries in Elderly Bedridden Patients in the Cardiology Department. Liaoning Medical Journal, 39(05): 90–94.

[6] Yang S, Qin W, Wang S, 2025, Analysis of the Application Effect of Pressure Injury Risk Early Warning Management in Preventing Pressure Injuries in Intensive Care Unit Patients Undergoing Total Hip Arthroplasty.

Henan Journal of Surgery, 31(05): 126–128.

[7] Wang J, Wu L, Niu X, 2026, Analysis of Risk Factors and Construction of a Risk Prediction Model for Pressure Injuries in Elderly Patients with Acute Myocardial Infarction. Journal of Chengdu Medical University, 21(02): 228–232.

[8] Yang L, Xie R, Yao Y, et al., 2025, Application of Doppler Ultrasound in the Prevention and Nursing Care of Pressure Injuries in Elderly Patients Undergoing Long-Term Mechanical Ventilation. Imaging Research and Medical Applications, 9(16): 183–185.

[9] Gu X, Xie L, Qiu L, et al., 2025, Analysis of the Needs for Prevention and Nursing Care of Pressure Injuries in Home-Bound Elderly Individuals with Functional Impairment. China Typical Case Collection, 19(02): 812–817.

[10] Yang Y, Chen W, Zhang L, 2025, A Multicenter Investigation of Risk Factors for Hospital-Acquired Pressure Injuries in Elderly Patients. Nursing Research, 39(11): 1836–1841.

[11] Zhao Q, 2025, Analysis of the Preventive Effect of Prospective Nursing Based on Dynamic Risk Assessment on Pressure Injury Occurrence After Pelvic Fracture Surgery in Elderly Patients. Chinese Journal of Health Preservation, 43(08): 164–167.

[12] Xue Y, Du J, Lin L, et al., 2025, Analysis of Relevant Risk Factors Influencing Pressure Injury in Elderly Patients with Chronic Obstructive Pulmonary Disease Undergoing Mechanical Ventilation. Geriatrics and Healthcare, 31(01): 161–165.

[13] Li H, Li W, 2025, Construction of a Predictive Model for Intraoperative Acquired Pressure Injury Risk in Elderly Patients Undergoing Hip Arthroplasty. Journal of Wannan Medical University, 44(01): 89–93.

[14] Zhang J, Huang B, Li Y, et al., 2025, Development and Validity/Reliability Testing of a Caregiver-Based Pressure Injury Risk Assessment Scale Based on the Delphi Method. Journal of Chengdu Medical University, 20(03): 498–501.

[15] Zhang Y, Ma F, Ma S, et al., 2024, A Web-Based Calculator for the Risk of Hospital-Acquired Pressure Injuries in Elderly Patients Receiving Postoperative Intensive Care Following Hip Fracture. China Journal of Bone and Joint, 13(12): 1007–1013.

[16] Jiang S, Ma L, Kang B, et al., 2024, Application of the FRAIL Scale in Predicting the Risk of Pressure Injuries After Joint Replacement Surgery in Elderly Patients. Journal of Shandong University (Medical Edition), 62(11): 54–66.

[17] Zhang S, Jiang H, Hou J, et al., 2024, Construction of a Predictive Model for Oral Mucosal Pressure Injury Risk in Elderly Patients Undergoing Endotracheal Intubation in the ICU. Nursing Research, 38(20): 3592–3597.

[18] Zhang L, Tang F, Zhang Y, 2024, Research Progress on the Epidemiological Characteristics and Risk Prediction of Pressure Injuries in the Elderly Domestically and Internationally Over the Past Decade. General Practice Nursing, 22(14): 2641–2644.

[19] Dong Y, Yan L, 2024, Construction and Validation of a Nomogram Model for Individualized Prediction of Intraoperative Acute Pressure Injury Risk in Elderly Patients with Gynecological Malignancies. Advances in Modern Obstetrics and Gynecology, 33(07): 525–529

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Exploring the Mechanistic Foundations of the Long-Term Safety of IL-1β Targeted Anti-Inflammatory Therapy

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Abstract: The expanding clinical use of interleukin-1β (IL-1β) monoclonal antibodies (mAbs) for chronic diseases raises important questions about their long-term safety, particularly infection risk. Despite IL-1β serves as a central driver of inflammatory responses, multiple large-scale clinical trials have demonstrated that specific blockade of IL-1β does not substantially increase overall infection risk in patients. This review explores the mechanistic basis for this favorable benefit-risk profile. It highlights the constitutive immune mechanisms that provide a stable first line of defense independent of IL-1β induction, the high complementarity within the IL-1 family enabling selective blockade benefits, and the pharmacokinetic profiles of biologics ensuring selective lesion distribution. Furthermore, it discusses the precise neutralization of systemic spillover inflammation while preserving local autocrine/paracrine homeostasis, the evolving disease spectrum in which sterile inflammation has surpassed infection as a primary health challenge, and the need for clinical vigilance against specific pathogen infections. Overall, specific blockade of IL-1β achieves effective anti-inflammatory therapy without compromising fundamental host defense.

Keywords: IL-1β monoclonal antibodies; Long-term safety; Constitutive immunity; Sterile inflammation; Infection risk

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1. Introduction

As the clinical application of interleukin-1β (IL-1β) monoclonal antibodies (mAbs) expands from rare diseases to broader indications, such as gout and the prevention of cardiovascular events, their remarkable clinical efficacy has been robustly validated. However, the safety profile associated with long-term use, particularly the risk of infection, remains a core clinical concern. Encouragingly, multiple large-scale clinical trials have shown that specific blockade of IL-1β is associated with a generally favorable safety profile,

with only a modest increase in selected infections and no substantial increase in opportunistic infections. Elucidating the molecular mechanisms by which IL-1β mAbs achieve an optimal balance between benefit and risk is crucial for accurately identifying target populations and formulating scientifically sound treatment strategies. Here, from an immunological perspective, we systematically review why IL-1β mAbs can exert potent anti-inflammatory effects without disrupting the host's fundamental defence homeostasis, and we discuss clinical considerations essential for modern chronic disease management.

2. Constitutive immune mechanisms: The fundamental cornerstone of host defence and cytokine signaling redundancy

Clinical evidence indicates that the specific blockade of IL-1β does not significantly elevate the overall incidence of severe infections. The core mechanism underlying this safety profile lies in the existence of a constitutively active immune defence system that operates independently of pro-inflammatory cytokine induction. As reviewed by Paludan et al., the host maintains a repertoire of "always-on" basal defence mechanisms, encompassing physical barriers (skin and mucosa), the complement system, antimicrobial peptides, and constitutively expressed restriction factors. These mechanisms form the "chassis" of the immune response, functioning without the requirement for induction by IL-1β or other cytokines, thereby providing the host with its first and most stable line of defence (Constitutive immune mechanisms: mediators of host defence and immune regulation) [1].

When pathogens breach these constitutive barriers, the host initiates an inducible response characterized by cytokines such as IL-1β, TNF-α, and type I interferons (IFNs). However, there is substantial systemic redundancy in the biological functions of these cytokines [2]. In the vast majority of animal infection models, even when the IL-1β pathway is completely abrogated, whether through targeted pharmacological inhibition with monoclonal antibodies or germline deletion, other pro-inflammatory pathways (e.g., IL-6, IL-18, or type I IFN signaling) may partially compensate for the loss of IL-1β signalling in many infectious settings, although this compensation is pathogen-dependent. This functional division of labor between constitutive defences and inducible responses ensures the continuity of basal immunological competence. See **Figure 1**.

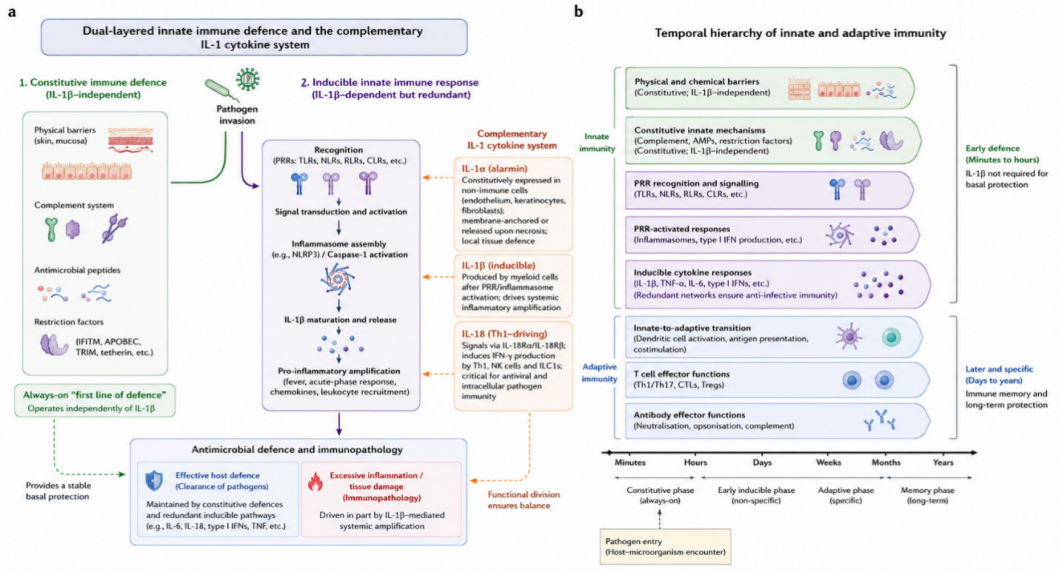


Figure 1. Constitutive innate immunity negatively regulates the inducible immune response.

3. High complementarity of the IL-1 family and the advantages of selective blockade

Although members of the IL-1 family share certain receptors, they exhibit a distinct division of labor regarding cellular sources, expression regulation, and biological functions. IL-1α is constitutively expressed primarily by non-immune cells (such as endothelial cells, keratinocytes, and fibroblasts) and acts as an "alarmin", exerting local tissue defence via membrane anchorage or release upon necrosis. In contrast, IL-1β is primarily induced and synthesized by myeloid cells (monocyte-macrophages and neutrophils) following Toll-like receptor (TLR) or inflammasome activation; after maturation via caspase-1 cleavage, it mediates systemic inflammatory amplification (driving fever, acute-phase responses, and chemokine induction). Furthermore, IL-18 strongly drives IFN-γ production via the IL-18Rα/IL-18Rβ complex, serving as a core factor for type I immune responses mediated by Th1 cells, NK cells, and type 1 innate lymphoid cells (ILC1s), making it indispensable for antiviral and intracellular pathogen defences [3].

This functional complementarity endows the IL-1 system with potent compensatory capabilities. Monoclonal antibodies specifically targeting IL-1β can selectively abrogate pathological systemic inflammatory amplification while fully preserving the local alarmin function of IL-1α and the IFN-γ-inducing activity of IL-18. This avoids the broad immunosuppression that could result from the complete blockade of the IL-1 receptor 1 (IL-1R1). Animal models further corroborate this: while IL-1R1 knockout mice exhibit high susceptibility to a variety of pathogens (including *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Mycobacterium tuberculosis*, and fungi), specific IL-1β deficiency is not lethal [4–6]. In certain infections, the absence of IL-1β can even mitigate infection-associated hyperinflammatory damage [7,8].

4. Pharmacokinetic profiles of biologics and selective distribution to lesions

Under physiological conditions, large-molecule biologics are predominantly confined to the blood circulation and struggle to penetrate the deep interstitial spaces of healthy tissues, thereby minimizing interference with the immune microenvironment of normal tissues. Under inflammatory pathological conditions, however, local vascular permeability increases significantly, allowing monoclonal antibodies to selectively accumulate at the lesion site alongside the exudate. This distribution characteristic of "systemic circulation combined with on-demand local penetration" enables the effective control of systemic inflammation while maximizing the preservation of immune homeostasis in healthy tissues [9,10].

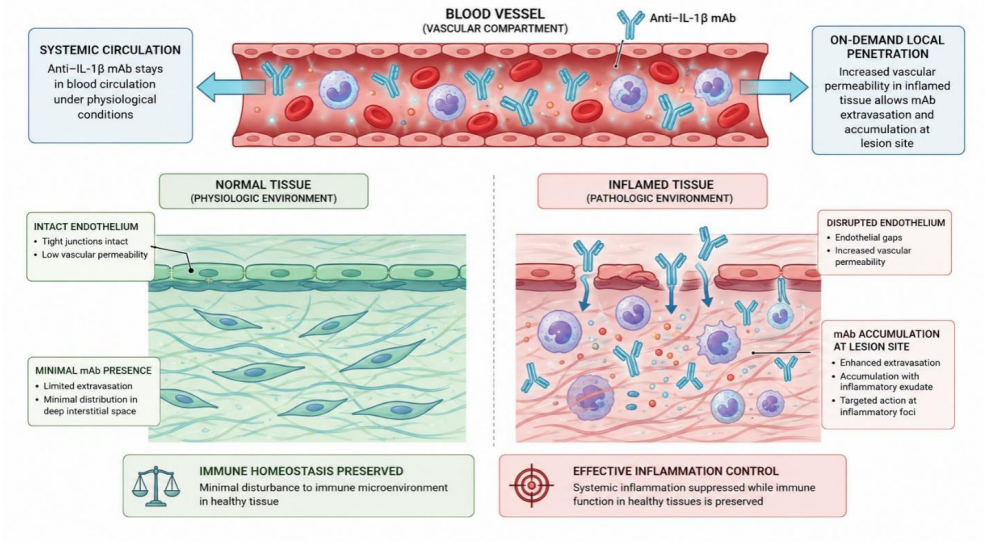


Figure 2. Mechanism of targeted distribution of il-1β monoclonal antibody in normal tissues and inflamed tissues.

5. Precise neutralization of systemic spillover inflammation with preservation of local autocrine/paracrine homeostasis

The secretion of IL-1β relies on unconventional protein secretion (UPS) and bypasses the traditional endoplasmic reticulum-Golgi pathway. This distinct feature dictates its differential behavior under physiological versus pathological conditions. According to studies by Lopez-Castejon et al., IL-1β release exhibits a "continuous spectrum" characteristic that is dependent on stimulus intensity. Under physiological conditions or mild stress, cells utilize a "rescue and redirect" mechanism to release small amounts of IL-1β via macrovesicles or exosomes, thereby mediating local autocrine/paracrine signaling essential for tissue homeostasis and repair [11]. Because monoclonal antibodies are large molecules with limited penetration into healthy tissue interstitial, such low-level, localized physiological communication is generally preserved.

Conversely, in pathological states such as acute gout flares, cardiovascular diseases, or chronic kidney disease, intense inflammatory stimuli trigger pyroptosis. This results in the disruption of cell membrane integrity and the massive "terminal release" of mature IL-1β into the systemic circulation, driving systemic inflammation. In this scenario, mAbs can specifically neutralize this pathological spillover component, achieving precise immunological modulation [12,13].

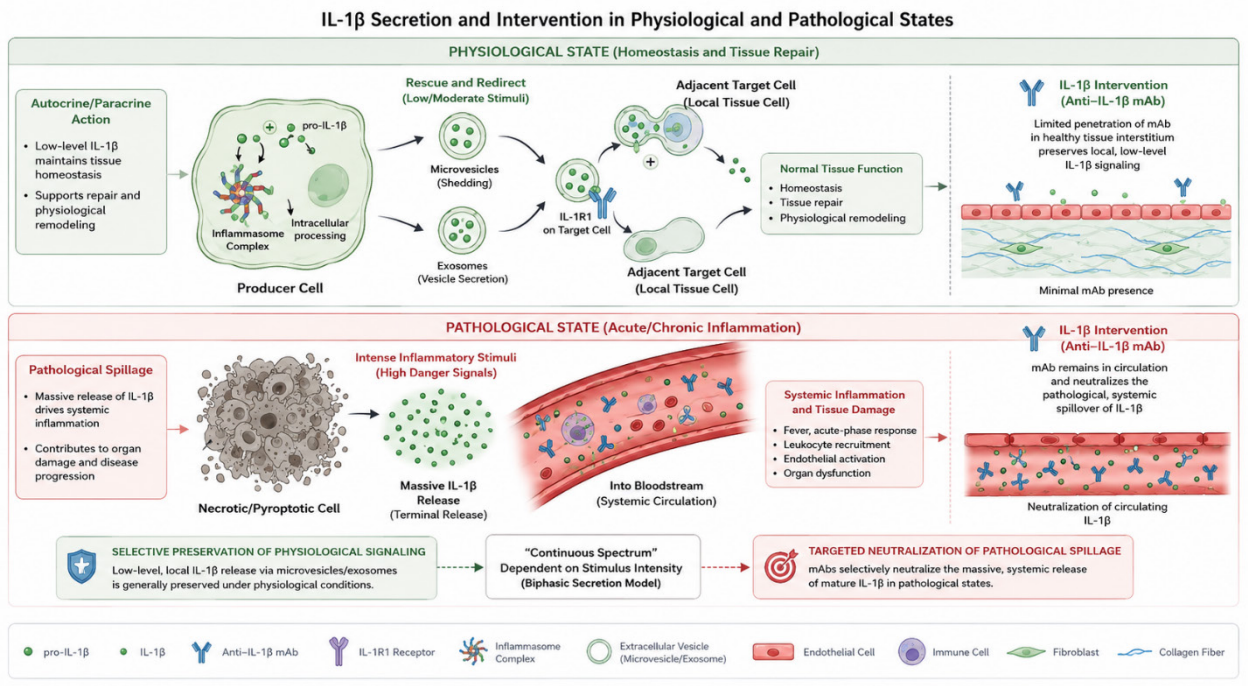


Figure 3. IL-1β secretion and intervention in physiological and pathological states.

6. Evolution of the disease spectrum: IL-1β-mediated sterile inflammation has surpassed infection as the primary challenge to modern health

Over the past two centuries, the burden of human disease has undergone a profound paradigm shift. With advancements in public health, vaccination, and the widespread application of antibiotics, the mortality burden of infectious diseases has declined to approximately 15%. Concurrently, over 80% of deaths in Western societies are now attributed to non-communicable chronic diseases (e.g., cardiovascular disease,

type 2 diabetes, and obesity), which are closely linked to high-calorie "Western diets." Basic research has revealed that Western diets can directly activate the NLRP3 inflammasome, triggering "sterile inflammation" and supplanting traditional pathogens as the primary danger signals recognized by the immune system [14].

Furthermore, Western diets can induce epigenetic reprogramming of bone marrow myeloid progenitors, a process known as trained immunity. IL-1β, released following NLRP3 activation, is the critical mediator driving the formation of this long-term innate immune memory, keeping immune cells in a state of chronic hyperactivation and accelerating immunosenescence. Animal models have confirmed that intervention with IL-1 inhibitors significantly attenuates diet-induced elevations of systemic inflammatory cytokines and acute-phase proteins, highlighting the potential therapeutic value of IL-1β blockade in chronic non-infectious inflammatory diseases [15–17].

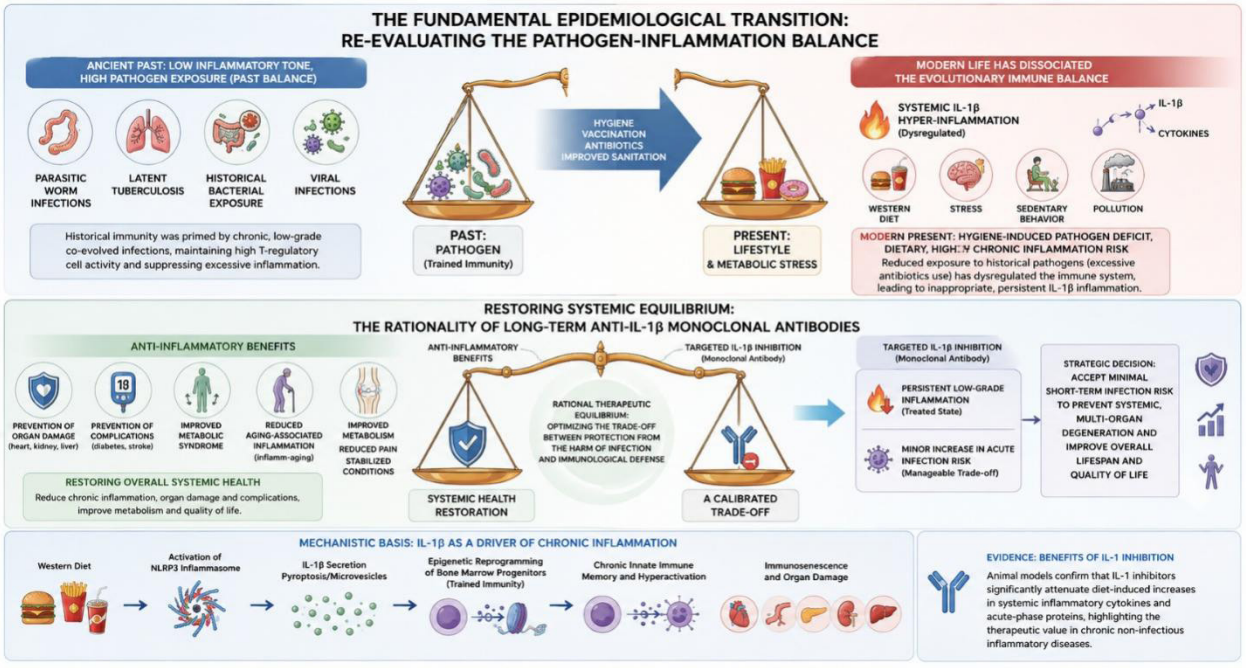


Figure 4. The fundamental epidemiological transition: re-evaluating the pathogen-inflammation balance.

7. Risk assessment for specific pathogen infections and diagnostic interference by IL-1β monoclonal antibodies

Although the overall safety profile of IL-1β mAbs is highly favorable, attention must be directed toward their unique role in defending against specific pathogens. IL-1β can function directly as a "sensor" for microbial proteases: for instance, the SpeB protease secreted by Group A Streptococcus (GAS) can bypass host caspase-1 to directly cleave and activate IL-1β, generating an early, rapid-onset defensive signal. Clinical surveillance indicates a relatively higher proportion of reported invasive GAS infections among patients receiving IL-1β inhibitors, suggesting that blocking this pathway may compromise early, restrictive inflammatory responses to certain bacteria [18]. Group A *Streptococcus* (GAS) remains highly susceptible to standard antibiotics [19]. Clinical evidence from Ridker PM indicates that these infection risks are exceedingly low and do not involve opportunistic pathogens. Furthermore, the risk profile becomes neutral provided that

routine antibiotics are administered promptly for early intervention [20].

Additionally, IL-1β mAbs can suppress infection-associated fever and C-reactive protein (CRP) elevations, leading to the "silencing" of infection symptoms. This necessitates enhanced aetiological monitoring by clinicians, particularly in cases of skin and soft tissue infections, rather than relying solely on fever or CRP metrics for diagnosis [19]. Existing genetic polymorphism studies have not established a strong association between IL-1β loci and the risk of common bacterial or fungal infections. However, given its physiological function as a sensor, appropriate vigilance should be maintained during therapy to optimally balance anti-inflammatory benefits against the potential risk of specific infections [21].

Disclosure statement

The authors declare no conflict of interest.

References

[1] Paludan S, Pradeu T, Masters S, et al., 2021, Constitutive Immune Mechanisms: Mediators of Host Defence and Immune Regulation. Nature Reviews Immunology, 21(3): 137–150.

[2] Nish S, Medzhitov R, 2011, Host Defense Pathways: Role of Redundancy and Compensation in Infectious Disease Phenotypes. Immunity, 34(5): 629–636.

[3] Garlanda C, Di Ceglie I, Jaillon S, 2025, IL-1 Family Cytokines in Inflammation and Immunity. Cellular & Molecular Immunology, 22(11): 1345–1362.

[4] Bourigault M, Segueni N, Rose S, et al., 2013, Relative Contribution of IL-1α, IL-1β and TNF to the Host Response to Mycobacterium tuberculosis and Attenuated M. bovis BCG. Immunity, Inflammation and Disease, 1(1): 47–62.

[5] Putnam N, Fulbright L, Curry J, et al., 2019, MyD88 and IL-1R Signaling Drive Antibacterial Immunity and Osteoclast-Driven Bone Loss During *Staphylococcus aureus* Osteomyelitis. PLoS Pathogens, 15(4): e1007744.

[6] Eislmayr K, Bestehorn A, Morelli L, et al., 2022, Nonredundancy of IL-1α and IL-1β Is Defined by Distinct Regulation of Tissues Orchestrating Resistance Versus Tolerance to Infection. Science Advances, 8(9): eabj7293.

[7] Bader S, Scherer L, Schaefer J, et al., 2025, IL-1β Drives SARS-CoV-2-Induced Disease Independently of the Inflammasome and Pyroptosis Signalling. Cell Death & Differentiation, 32(7): 1353–1366.

[8] Bawazeer A, Rosli S, Harpur C, et al., 2021, Interleukin-1β Exacerbates Disease and Is a Potential Therapeutic Target to Reduce Pulmonary Inflammation During Severe Influenza A Virus Infection. Immunology & Cell Biology, 99(7): 737–748.

[9] Chen X, DuBois D, Almon R, et al., 2015, Biodistribution of Etanercept to Tissues and Sites of Inflammation in Arthritic Rats. Drug Metabolism and Disposition, 43(6): 898–907.

[10] Tabrizi M, Bornstein G, Suria H, 2010, Biodistribution Mechanisms of Therapeutic Monoclonal Antibodies in Health and Disease. AAPS Journal, 12(1): 33–43.

[11] Lopez-Castejon G, Brough D, 2011, Understanding the Mechanism of IL-1β Secretion. Cytokine & Growth Factor Reviews, 22(4): 189–195.

[12] Scanu A, Oliviero F, Ramonda R, et al., 2012, Cytokine Levels in Human Synovial Fluid During the Different Stages of Acute Gout: Role of Transforming Growth Factor β1 in the Resolution Phase. Annals of the Rheumatic Diseases, 71(4): 621–624.

[13] Silvain J, Kerneis M, Zeitouni M, et al., 2020, Interleukin-1β and Risk of Premature Death in Patients with Myocardial Infarction. Journal of the American College of Cardiology, 76(15): 1763–1773.

[14] GBD 2019 Diseases and Injuries Collaborators, 2020, Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990–2019: A Systematic Analysis for the Global Burden of Disease Study 2019. Lancet, 396(10258): 1204–1222.

[15] Ridker PM, Everett BM, Thuren T, MacFadyen JG, Chang WH, Ballantyne C, Fonseca F, Nicolau J, Koenig W, Anker SD, Kastelein JJP, Cornel JH, Pais P, Pella D, Genest J, Cifkova R, Lorenzatti A, Forster T, Kobalava Z, Vida-Simiti L, Flather M, Shimokawa H, Ogawa H, Dellborg M, Rossi PRF, Troquay RPT, Libby P, Glynn RJ; CANTOS Trial Group. Antiinflammatory Therapy with Canakinumab for Atherosclerotic Disease. N Engl J Med. 2017; 377(12):1119-1131.

[16] Christ A, Günther P, Lauterbach M, et al., 2018, Western Diet Triggers NLRP3-Dependent Innate Immune Reprogramming. Cell, 172(1–2): 162–175.

[17] Liesz A, 2026, Trained Immunity in Interorgan Communication and Vascular Inflammation. Arteriosclerosis, Thrombosis, and Vascular Biology, 46(3): e323130.

[18] LaRock C, Todd J, LaRock D, et al., 2016, IL-1β Is an Innate Immune Sensor of Microbial Proteolysis. Science Immunology, 1(2): eaah3539.

[19] Brouwer S, Rivera-Hernandez T, Curren B, et al., 2023, Pathogenesis, Epidemiology and Control of Group A Streptococcus Infection. Nature Reviews Microbiology, 21(7): 431–447.

[20] Ridker P, Bhatt D, Nissen S, 2024, Inflammation, Infection, and Cardiovascular Risk—Authors' Reply. Lancet, 403(10431): 1025–1026.

[21] Li Y, Oosting M, Deelen P, et al., 2016, Inter-Individual Variability and Genetic Influences on Cytokine Responses to Bacteria and Fungi. Nature Medicine, 22(8): 952–960.

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Research on Process Optimization and Quality Control of Oral Tablets

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Abstract: Oral tablets are the most widely used solid dosage form in clinical practice with the highest patient compliance. Their preparation process and quality control directly affect the safety and efficacy of medicines. This paper conducts an in-depth study on the process optimization and quality control of oral tablets, analyzes the key problems in quality control, and proposes practical optimization and control strategies. It aims to provide a reference for improving the production quality of oral tablets.

Keywords: Oral tablets; Process optimization; Quality control

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1. Introduction

With the advantages of low production cost, accurate dosage and convenient administration, oral tablets have become the most widely used dosage form in the global pharmaceutical industry. With the continuous improvement of China's drug regulatory system and the upgrading of GMP standardization, higher requirements have been put forward for the production process, mass uniformity and in vitro release consistency of oral tablets [1]. In actual production, oral tablets are easily affected by many factors such as coating process, ambient temperature and powder properties, which further influence the hardness, appearance, stability and dissolution of tablets [2]. Without effective control, problems such as delayed disintegration, unstable dissolution and uneven content are likely to occur, which not only affect the production efficiency and economic benefits of oral tablets, but also directly affect clinical efficacy and medication safety. Therefore, based on the production requirements of oral tablets, this paper systematically sorts out the existing problems in production and explores scientific and complete process optimization and quality control strategies, which is of great practical significance for promoting the healthy development of pharmaceutical enterprises and ensuring drug quality and safety.

2. Main problems in the preparation and quality control of oral tablets

A series of problems exist in the preparation and quality control of oral tablets, as follows:

2.1. Unreasonable formulation design and unscientific excipient selection and proportion

Formulation is an important prerequisite for tablet forming and efficacy [3]. At present, unreasonable formulation design is common. First, improper selection of excipients: poor compressibility of fillers, too strong or too weak adhesion of binders, unscientific type and dosage of disintegrants, excessive lubricants, etc. Second, insufficient research on the compatibility of some drugs and excipients leads to compatibility reactions, resulting in discoloration, increased impurities and decreased content of tablets. Third, lack of evaluation of micromeritic properties. Inadequate investigation of raw material properties causes difficulties in granulation and tableting. Fourth, insufficient uniformity design leads to uneven content of tablets. All these affect the forming and efficacy of tablets.

2.2. Extensive granulation process and large fluctuation of granule quality

Granulation is one of the key links in tablet production, with prominent problems [4]. First, in wet granulation, the concentration, dosage and stirring speed of binders are not strictly controlled, resulting in uneven tightness of granules. Second, environmental factors such as drying and high temperature affect the granulation process, leading to decomposition of active ingredients or excessive moisture content. Third, in dry granulation, unstable pressure results in uneven particle size distribution and variable compressibility. Lack of effective control of granule bulk density, moisture content and fluidity will cause fluctuations in the tableting process.

2.3. Improper tableting process control and common forming defects

Tableting is the process most prone to appearance and internal quality problems in tablet production [5]. Low tableting pressure may cause loose tablets and insufficient hardness. Excessive tableting pressure may cause capping, delayed disintegration and splitting. Excessively high tableting speed may prevent the air in the granules from being discharged in time, aggravating splitting. In addition, mismatched structure and speed of feeder will cause uneven filling of granules and weight difference beyond production standards.

2.4. Non-standard coating process control and substandard appearance and function

Coating is also one of the key processes in tablet production, with main problems focusing on process and formulation [6]. In terms of formulation, unreasonable coating solution design and unscientific proportion of pigments and plasticizers may cause spots and film brittleness. Inaccurate control of coating weight gain leads to too thick or too thin coating, affecting the production quality of tablets.

2.5. Imperfect quality control system and insufficient monitoring of key indicators

There are some problems in tablet quality control [7]. First, imperfect quality standards: only meeting the minimum requirements of pharmacopoeia, lack of in-depth research on dissolution curve and content uniformity. Second, inaccurate detection methods with low sensitivity affect the authenticity and accuracy of results, making it difficult to accurately reflect product quality. Third, insufficient process management and lack of online detection mechanism prevent early warning.

Poor batch-to-batch consistency and no evaluation and verification of process changes.

2.6. Insufficient research on dissolution and *in vitro-in vivo* correlation

Some tablets lack systematic dissolution research and only meet disintegration time limit inspection. Single dissolution medium and unscientific rotating speed cannot fully reflect the *in vivo* release behavior. Without dissolution curve comparison, bioequivalence is difficult to guarantee. Obvious fluctuation of dissolution data and insufficient process stability are inconsistent with clinical efficacy.

2.7. Unsystematic stability study and unscientific shelf life and storage conditions

Stability research is unsystematic, with unreasonable condition setting, incomplete inspection items and in-depth evaluation [8]. Long-term test, accelerated test and stress test are not standardized, making it impossible to judge the influence of light, temperature and moisture on appearance, dissolution and content. In addition, unreasonable packaging materials with insufficient moisture and oxygen resistance directly affect the safety and quality of tablets.

2.8. Non-standard production management and process traceability

There are also some problems in production management and process traceability of oral tablets [9]. Some enterprises do not strictly implement GMP, with incomplete and untrue process parameter records. The range of critical process parameters is not clear, and operation mainly depends on production experience. Incomplete equipment cleaning increases the risk of pollution. Incomplete batch production records and quality traceability system make it impossible to trace problems. Inadequate personnel quality and non-standard operation lead to human accidents.

3. Systematic strategies for process optimization and quality control of oral tablets

3.1. Formulation optimization strategy: Scientific design to ensure quality from the source

To optimize the production process and improve quality control of oral tablets: First, carry out compatibility test of drugs and excipients, screen scientific and reasonable excipient combinations through appearance, content and other indicators to avoid compatibility reactions. Scientifically select fillers, lubricants, binders and other excipients [10]. Optimize excipient proportion and determine the optimal formulation through scientific design. Internal and external addition method can be used for disintegrants to improve disintegration speed. Scientifically control the dosage of lubricants to avoid affecting the compressibility and disintegration of tablets. Second, strengthen micromeritic evaluation, conduct in-depth research on angle of repose, fluidity and particle size distribution to lay a foundation for granulation and tableting. In addition, equal incremental mixing method can be used for low-dose drugs, even core granulation or solvent dispersion method to ensure uniform drug content.

3.2. Granulation process optimization strategy: Refined control to stabilize granule quality

(1) Wet granulation optimization

Clarify the concentration, dosage and adding speed of binders to ensure uniform particle size and moderate tightness.

(2) Drying process optimization

Scientifically control ambient temperature, wind speed and time to ensure optimal moisture content of granules, effectively avoiding component degradation, moisture absorption, softness or hardness.

(3) Fluidized bed granulation optimization
Scientifically control air inlet temperature, atomization pressure and spray rate to realize integration of mixing, granulation and drying, improving granule uniformity.

(4) Dry granulation optimization
Scientifically adjust roller pressure, gap, and speed to find the optimal balance range for granule density, friability, compressibility, and drug release behavior.

(5) Real-time control of granule quality
Comprehensively detect friability, bulk density and fluidity. Only qualified products can enter the tableting process to lay a foundation for improving drug production quality.

3.3. Tableting process optimization strategy: Stable forming to eliminate appearance and internal defects

First, adjust tableting pressure, speed and filling depth to ensure moderate hardness and complete appearance. Improve granule fluidity by adding appropriate glidant to reduce tablet difference.

Second, scientifically adjust granule moisture, lubricant, tableting speed and pre-pressure to reduce splitting, sticking and capping. In addition, do a good job in equipment maintenance, regularly inspect and maintain equipment to ensure good condition.

Finally, improve online monitoring mechanism by using modern technology. Digital sensors and cameras can be used to build an online monitoring mechanism, and artificial intelligence and big data can be used to realize data abnormality early warning.

3.4. Coating process optimization strategy: Improve appearance, moisture resistance and stability

First, optimize coating formulation. Select the most suitable coating materials, plasticizers and pigments to improve the uniformity and continuity of coating film. Accurately control process parameters to ensure accurate spray pressure, air outlet temperature and air inlet temperature. Second, scientifically control coating weight gain to ensure functions such as moisture protection, light shielding, and taste masking are achieved without negatively impacting disintegration and dissolution. Online monitoring technology can be used to monitor coating status in real time to avoid peeling, spots and cracking. Note that low-temperature and high-efficiency coating can be used for heat-moisture unstable drugs to improve stability.

3.5. Quality standard improvement strategy: Establish a comprehensive, scientific and controllable quality evaluation system

First, establish a complete quality standard including traits, dissolution, content uniformity and assay to ensure comprehensiveness and integrity. Second, adopt professional and accurate detection methods and complete methodological verification to ensure true and accurate test results. Third, conduct in-depth research on dissolution. A variety of pH dissolution media can be used to draw dissolution curves to evaluate intra-batch and inter-batch consistency. Meanwhile, conduct consistency evaluation of generic and original drugs. Finally, strictly control related substances and clarify the limits of single impurity and total impurity to

ensure medication safety. Uniformity inspection is also required for low-dose tablets to ensure accurate and uniform drug content.

3.6. Whole-process quality control strategy: Realize GMP standardization and traceability

First, establish a whole-process quality control system to strictly control the whole process from raw material warehousing, granulation to release. Determine Critical Process Parameters (CPP) and Critical Quality Attributes (CQA), implement process control and trend analysis. Strictly control temperature, humidity, pressure difference, cleanliness and other factors of the production environment. Complete all records in time to ensure true, accurate and complete data. A variety of methods can be used for verification to ensure stable production process without cross-contamination.

3.7. Stability research strategy: Scientific evaluation to determine reasonable packaging and shelf life

First, strictly carry out stress test, accelerated test and long-term test in accordance with pharmacopoeia to comprehensively evaluate tablet stability. Second, conduct stability inspection, focusing on disintegration time limit, content, microbial limit and other key indicators. Select appropriate packaging materials and storage conditions. Scientifically evaluate the barrier properties of different packaging materials according to drug characteristics to effectively isolate light, oxygen, moisture and other external factors. For example, light-sensitive, moisture-sensitive or easily oxidized drugs should prefer packaging materials with excellent light avoidance, moisture resistance and oxygen isolation performance, with desiccant if necessary.

3.8. Intelligent and digital upgrading strategy: Improve quality control accuracy and production efficiency

First, introduce Process Analytical Technology (PAT). Near-infrared spectroscopy (NIRS) is used for online monitoring of moisture, content and particle size, as well as online tablet weight, hardness and thickness. Second, use orthogonal test, response surface method, neural network and other models to optimize process parameters and improve R&D and production efficiency. Finally, build a digital production management system to realize centralized data collection, trend analysis, risk early warning and continuous improvement. In this way, automated, closed and continuous production is realized, human interference is reduced, and stability and uniformity are improved.

3.9. Supporting strategy for generic drug consistency evaluation: Ensure *in vitro* and *in vivo* equivalence

First, take the original drug as the reference preparation, conduct multi-medium dissolution curve comparison to ensure that the f2 similarity factor meets the requirements. Second, optimize formulation and process to highly match dissolution behavior and improve the success rate of bioequivalence test. Finally, establish in vitro-in vivo correlation to improve the scientificity and reliability of preparation research and development.

3.10. Optimization strategy for personnel, equipment and management system

First, improve the personnel training mechanism, carry out regular training to improve professional quality and comprehensive ability, strictly implement GMP and operating procedures to reduce human error.

Second, strengthen equipment maintenance and verification to ensure high stability and accuracy. Establish and improve risk assessment, deviation handling and corrective and preventive measures system. Finally, strengthen supplier management, material management and warehouse management to ensure stable quality from the source.

4. Conclusion

In short, as the most widely used solid dosage form in clinical practice, process optimization and quality control of oral tablets are important ways to ensure drug safety, stability and effectiveness. At present, there are many problems in tablet production, such as unreasonable coating formulation, extensive granulation process, tableting and coating defects. These problems directly affect production quality, drug safety and clinical efficacy. Therefore, in the new era, we should continuously promote process innovation, quality control upgrading and management standardization, continuously improve the R&D and production level of oral tablets, provide safer, more effective and quality-controllable drugs for clinical use, and promote China from a big pharmaceutical country to a powerful pharmaceutical country.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Feite Company, 2026, Safety and Closed Technology Practice in the Production of High-Active Drug Tablets. Flow Industry, 2026(02): 32–34.

[2] Li H, Zheng P, Yue Z, et al., 2026, Research on National Drug Standards of Leucogen Raw Materials and Tablets. Herald of Medicine, 1–12.

[3] Tang J, Li X, Jin S, 2025, Application Analysis of Wet Mixing Granulator in Tablet Production. Proceedings of Academic Exchange in Mechanical and Electrical Technology & Seminar on High-quality Development of Scientific and Technological Talents: 647–653.

[4] Xian W, Xu G, Zhou Y, et al., 2025, Preparation of 48% Propaneamidine · Fluazinam Water Dispersible Tablets and Its Control Effect on Gray Mold. Journal of Northwest A&F University (Natural Science Edition), 53(12): 128–136.

[5] Liao J, Wan X, Zhu W, et al., 2025, Research Progress and Countermeasures of Dissolution Behavior of Traditional Chinese Medicine Tablets Based on New Technology. Chinese Traditional and Herbal Drugs, 56(10): 3699–3711.

[6] Wu H, Zhang Z, Song Z, et al., 2025, Research on Preparation Process of Sweet Orange Flavor Vitamin A Tablets. China Fruits & Vegetables, 45(03): 23–27 + 50.

[7] Wang X, 2024, Design and Quality Research of Fluralaner Oral Tablets, thesis, Shanghai Institute of Technology.

[8] Zeng X, 2024, Co-crystal Development, Pharmacokinetic Study of Apixaban and Its Application in Oral Tablets, thesis, Chongqing University of Technology.

[9] Zhao Y, Fang Y, Wang Y, et al., 2022, Practice and Exploration of Quality Control Circle to Improve the Accuracy of Oral Tablet Dose Division for Children. Journal of Pediatric Pharmacy, 28(12): 13–16.

[10] Zeng W, Wang X, Chen J, et al., 2022, Current Situation and Countermeasure Analysis of Oral Tablet Dose Division in a Maternal and Child Health Hospital. Journal of Guangdong Pharmaceutical University, 38(06): 25–30.

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Protective Effects of Melatonin on the Female Reproductive System

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Abstract: Melatonin (MT) is an indoleamine hormone secreted predominantly by the pineal gland and exhibits diverse biological activities, including antioxidant, anti-inflammatory, anti-apoptotic, immunomodulatory, and mitochondrial-protective effects. In recent years, increasing attention has been paid to the role of MT in the regulation of female reproductive function and in the prevention and treatment of disorders of the female reproductive system. Accumulating evidence indicates that MT is involved in follicular development, oocyte maturation, sex steroid secretion, embryonic development, and pregnancy maintenance by scavenging reactive oxygen species, improving mitochondrial function, and modulating the hypothalamic–pituitary–gonadal axis and related signaling pathways. This review summarizes the biological properties and principal mechanisms of action of MT, with a focus on recent advances in its roles in ovarian function preservation, maintenance of oocyte quality, improvement of embryonic development, and intervention in pregnancy-related disorders.

Keywords: Melatonin; Female reproductive system; Oxidative stress; Follicular development; Embryo quality; Mitochondrial protection

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1. Introduction

Melatonin (MT) is an indoleamine hormone predominantly synthesized and secreted by pinealocytes, and as an endogenous free-radical scavenger, it has excellent radical-scavenging activity and thus exerts potent protective effects against oxidative damage. While MT is classically recognized for its role in regulating seasonal and circadian rhythms, it is now unequivocally established that MT has active, diverse functions in female reproduction, innate immunity, radioprotection, antitumor defense, and anti-ageing processes. Therefore, this section will present a focused, systematic review of the protective actions of MT in the female reproductive system, including its relevant biological properties and functional significance.

2. Biological properties of melatonin

Melatonin (N–acetyl–5–methoxytryptamine, molecular weight 232 Da) was first isolated from bovine pineal glands in 1957 by Aaron B. Lerner, a dermatologist at Yale University, and thereafter thoroughly characterized by him [1]. From a structural point of view, melatonin can be described in a clear, elegant manner: it consists of three distinct and well-defined elements, namely a 5–methoxy group, a 3–position acetamidoethyl side chain, and an indole ring core (**Figure 1**).

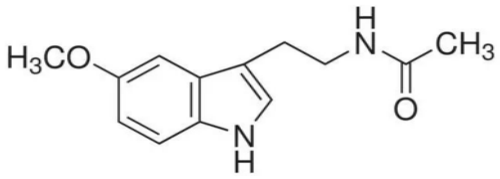


Figure 1. Molecular structure of melatonin.

Tryptophan is the classic, well-established precursor for MT biosynthesis, first being converted to serotonin (5-hydroxytryptamine, 5-HT) by tryptophan hydroxylase (TPH), then decarboxylated, followed by acetylation catalyzed by arylalkylamine N-acetyltransferase (AANAT) to form N-acetylserotonin, which is finally methylated to give MT. Although the pineal gland is the principal site of MT production, it is now unambiguously clear that MT can also be synthesized and secreted by several extrapineal tissues, including the retina, bone marrow, thymus, gastrointestinal tract, and ovary [2,3].

Pineal AANAT activity has a well-established, robust circadian rhythm that is inhibited by light; therefore, MT secretion rises sharply during the dark phase. Even more importantly, MT plays an essential role in the synchronization of reproduction in photoperiodic animals [4]. In the ovary, MT can reach the tissue either through the systemic circulation or be synthesized locally by granulosa cells, including cumulus granulosa cells. The text first makes clear that MT is present not only in oocytes, but then goes on to report that MT concentrations in human preovulatory follicular fluid are markedly higher than those in peripheral blood, with follicular-fluid MT levels in large follicles being approximately threefold the serum levels [5,6]. Most importantly, hamster ovaries actively take up and retain circulating tritium-labeled MT (^3H–MT), thus providing direct, unambiguous evidence that ovarian MT can be derived from the bloodstream and likely has a genuine physiological role in follicular development and ovulation [7].

3. Physiological activities and mechanisms of action of melatonin

3.1. Antioxidant effects of melatonin

Melatonin (MT) is an endogenous, direct free-radical-scavenging antioxidant that protects cells against oxidative injury by attenuating oxidative stress (OS) through clear, well-characterized multiple mechanisms: it directly neutralizes endogenous reactive oxygen species (ROS) and reactive nitrogen species (RNS), including superoxide anion ($O_2 \bullet -$), hydroxyl radicals (• OH), singlet oxygen ($^1O_2$), and hydrogen peroxide (H_2O_2) [8,9]. More importantly, MT and its metabolites, such as N^1–acetyl–5–methoxykynuramine (AMK), initiate a potent antioxidant cascade that dramatically lowers intracellular ROS levels and thereby actively maintains cellular redox homeostasis [10].

MT exerts indirect antioxidant effects by promoting the expression and activation of antioxidant

enzymes such as superoxide dismutase (SOD) and glutathione peroxidase (GSH–Px), and by inhibiting the expression of pro - oxidant enzymes such as nitric oxide synthase (NOS) [10]. More specifically, SOD catalyzes the dismutation of $O_2 \bullet -$ into peroxide and molecular oxygen, and the generated H_2O_2 is then promptly and effectively scavenged by GSH–Px. Since this enzymatic cascade is so fundamental for maintaining intracellular redox balance and dealing with oxidative stress, it is quite logical to state that NOS is the main enzyme responsible for nitric oxide (NO) synthesis, and that oxidative stress can induce NOS uncoupling, thereby increasing superoxide generation [11,12]. Therefore, MT may restore the balance between NO and superoxide production, thus ameliorating oxidative stress-induced cellular injury [13].

OS is defined by the excessive generation of ROS, which damage cellular lipids, proteins, and DNA, and thus lead to a variety of pathological changes, including enzyme inactivation, DNA strand breaks, and cell death [14]. Mitochondria are not only the major intracellular source of ROS but also the primary targets of ROS-mediated damage [15]. Therefore, it is particularly important to note that MT protects mitochondrial morphology and function, the ion acts through several clearly defined and logically related mechanisms to inhibit mitochondrial permeability transition, regulate mitochondrial electron flux, reduce mitochondrial electron leakage, enhance the activity of uncoupling proteins (UCPs), and therefore modulate adenosine triphosphate (ATP) production in a way that limits ROS generation. In addition, MT promotes mitochondrial biogenesis, directly favoring mitochondrial integrity and function [16].

OS causes oxidative DNA damage, and 8–Oxo–2'–deoxyguanosine (8–oxo–dG), a major product of DNA oxidation, is now widely accepted as the most reliable and unequivocal biomarker of oxidative DNA damage and oxidative stress [17,18]. Moreover, several by-products of lipid peroxidation are themselves direct inducers of DNA damage [19]. Most importantly, the free-radical-scavenging activity of MT and its protective effect against oxidative DNA damage have been amply demonstrated. Liang et al were the first to clearly and convincingly show that MT protects somatic-cell nuclear transfer-derived porcine embryos from oxidative-stress-induced DNA damage, and subsequent work has nicely extended this finding: continuous MT supplementation for 90 days increases the total antioxidant capacity of semen and reduces oxidative DNA damage in sperm [20,21]. Most importantly, the literature now contains very strong, well-characterized evidence that MT inhibits oxidative-stress-induced DNA damage in mammalian oocytes: MT decreases ROS accumulation and DNA damage in oocytes from aged cows, and in mouse oocytes, it lowers ROS levels and directly suppresses 8-oxo-dG formation, thereby offering direct protection to DNA against oxidation [22,23].

3.2. Anti-apoptotic effects of melatonin

MT inhibits apoptosis in various biological processes mainly by downregulating the expression of pro-apoptotic proteins, as elegantly demonstrated by its ability to protect hippocampal neurons from radiation-induced injury by suppressing the apoptosis-related protein caspase 3 [24]. But even more importantly, MT exerts clear, well-characterized anti apoptotic effects via autophagy: it promotes the degradation of intracellular autophagosomes, thereby correcting cellular injury caused by dysregulated autophagy and offering potent neuroprotection in neurodegenerative diseases [25].

3.3. Anti-inflammatory effects of melatonin

since mT can ameliorate cognitive impairment by promoting activation of the nuclear factor erythroid 2-related factor 2 (Nrf2) pathway, thereby increasing cellular antioxidant capacity and protecting tissues

against oxidative, inflammatory damage, it is even more significant to note that a large and growing body of evidence now supports the idea that MT modulates the immune system both directly, by acting on leukocytes with melatonin receptors, and indirectly, by affecting other hormones, opioids, or cytokines [26–28].

3.4. Endocrine-regulatory effects of melatonin

Since MT modulates the hypothalamic–pituitary–gonadal (HPG) axis, it has direct, well-defined regulatory effects on female reproductive function, including follicular development, pregnancy, and lactation, which is why MT holds considerable therapeutic promise for a number of pregnancy-related syndromes and reproductive disorders, such as preeclampsia, polycystic ovary syndrome, and endometriosis [29]. Because MT supplementation has been unequivocally shown to lower androgen levels, improve ovulatory function in polycystic ovary syndrome (PCOS), and also promote proper pancreatic development and regulation of physiological rhythms, it is now well established that MT can ameliorate sodium-propionate-induced circadian rhythm disruption and impaired pancreatic development by modulating the thyroid system [30].

4. Protective effects of melatonin on the female reproductive system

4.1. Protective effects of melatonin on follicular development and ovarian function

Follicular development from primordial, primary, and secondary follicles to mature oocytes is a highly intricate process that is superbly regulated by endocrine, paracrine, and autocrine mechanisms. More importantly, steroid hormones secreted by granulosa cells into the follicular fluid are not only necessary for follicular growth and maturation but also exert direct regulatory effects on the secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH). The text provides a very clear, logical overview of how MT affects follicular development, beginning with the original report by Adriaens et al that treatment of mouse preantral follicles with MT for 12 days dramatically increased progesterone and androstenedione secretion, and then proceeds to discuss the well-established functions of MT in antral follicles: regulation of sex steroid production, LH mRNA expression, Bcl-2 and caspase-3 expression, and sex-steroid-related insulin-like growth factor (IGF) and transforming growth factor-β (TGF- β) signaling [31,32]. More importantly, it presents two distinct, beautifully delineated mechanisms:

(1) MT enhances follicular responsiveness to LH by increasing LH receptor mRNA expression in human granulosa cells, and

(2) MT protects granulosa cells from endoplasmic-reticulum-stress-induced apoptosis [33].

Because reactive oxygen species (ROS), reactive nitrogen species (RNS), and other oxidants generated during follicular development regulate molecular and biochemical pathways of folliculogenesis, they have a direct and clear effect on mature follicle development as well as follicular atresia. In female animals, ovarian ageing occurs with age, and oxidative stress is a well-established cause of follicular atresia. MT present in follicular fluid reduces both oocyte number and quality, but far more importantly, it attenuates oxidative stress and therefore protects oocytes and granulosa cells [34]. Moreover, MT delays ovarian ageing and preserves oocyte quality by activating the SIRT1 signaling pathway [35]. As a potent antioxidant, MT provides direct and robust protection against free-radical-induced oxidative damage: it lowers ROS levels in oocytes, improves the oxidative-stress status of oocytes, decreases early apoptosis, restores mitochondrial integrity, facilitates proper spindle assembly and chromosome alignment, and ultimately promotes meiotic maturation [36].

MT has well-documented, clearly defined protective effects against chemotherapy-induced ovarian

injury, namely that MT protects ovarian tissue from cisplatin- and cyclophosphamide-induced damage by reducing ROS generation and inhibiting apoptosis [37]. Even better, the combination of MT with growth hormone has been convincingly shown to prevent chemotherapy-induced follicular damage more effectively and to preserve normal ovarian function [38].

4.2. Protective effects of melatonin on oocyte quality and embryonic development

Since fertilization leads to high circulating concentrations of MT, which in turn stimulate progesterone secretion by luteal cells, activate oocyte maturation-promoting factors, and promote blastocyst hatching, all of which are conducive to successful pregnancy, it is now firmly established that MT has an unequivocally important role in embryo implantation and early embryonic development [39]. More importantly, during *in vitro* embryo culture, Since MT protects embryos from oxidative-stress-induced injury by suppressing ROS production and experimental data unambiguously demonstrate that MT lowers ROS levels in embryos, it follows logically that MT improves developmental competence and embryo quality [40]. Therefore, MT not only increases the rate of oocyte maturation but also greatly enhances embryonic developmental capacity, raising both cleavage and blastocyst formation rates [41].

Because MT has very clear, well-documented effects on the regulation of mitochondrial function, and since mitochondria are the principal sites of cellular energy metabolism whose functional integrity directly determines oocyte quality and developmental potential, it is straightforward to conclude that MT improves oocyte quality and developmental competence by increasing mitochondrial membrane potential and properly distributing mitochondria [42]. More remarkably, under oxidative stress, MT restores mitochondrial bioenergetic function by reducing ROS accumulation and elevating intracellular glutathione levels, thereby directly enhancing oocyte maturation and blastocyst formation rates [43].

MT has a thoroughly documented, important role in regulating ovarian function and delaying ovarian ageing because it scavenges excessive free radicals, thereby protecting oocytes from oxidative injury and thus directly regulating ovarian function while simultaneously attenuating ovarian senescence [38]. More remarkably, MT enhances oocyte developmental competence by modulating relevant gene expression and signaling pathways, as elegantly shown by its ability to reverse mycotoxin-induced abnormal embryonic development in mice via the BMP4/MAPK signaling pathway [44].

MT has a well-established, thoroughly documented role in female reproductive health: human preovulatory follicular fluid contains MT at concentrations approximately threefold higher than those in peripheral blood, and MT levels are higher in large follicles than in small ones [5]. Soares et al. provided clear, elegant evidence that pinealectomy increases the number of atretic follicles, raises estrogen levels, and lowers progesterone levels [40]. More crucially, they demonstrated that progesterone concentrations in human preovulatory follicular fluid are directly and positively correlated with MT levels, and progesterone itself regulates LH secretion [5]. Hence, it is now unequivocally established that MT is involved not only in follicular development but also in pregnancy and lactation.

4.3. Effects of melatonin on pregnancy and placental function

Since the placental metabolic pathways of MT have such clear and important implications for pregnancy outcomes, it is quite natural and logical to propose that placental tryptophan metabolism produces several bioactive metabolites, including MT, which regulate immune tolerance, vascular function, oxidative balance,

and fetal neurodevelopment [45]. More importantly, MT promotes endometrial receptivity and therefore increases embryo implantation rates by reducing oxidative stress and directly activating its membrane receptors, MT1 and MT2 [46].

MT has clear potential as an adjuvant therapy for gestational hypertension and pre-eclampsia because it reduces maternal and neonatal complications, and there is now robust evidence that MT and other antioxidants can ameliorate placental oxidative injury and improve selected perinatal outcomes [47]. More importantly, its protective effects are not restricted to the placenta but may directly benefit fetal neurodevelopment. This is because the balance of placental metabolic pathways during early pregnancy directly determines the fetal exposure to neuroactive metabolites [45].

4.4. Potential roles of melatonin in female reproductive disorders

MT has therapeutic promise in several gynecological and reproductive disorders, namely gestational hypertension, polycystic ovary syndrome (PCOS), and endometriosis, and moreover, there is now well-established, convincing evidence that MT supplementation protects pregnant women from hypertension by improving endothelial function and decreasing oxidative stress, both of which are key factors in gestational hypertension. A well-conducted study on the effects of MT in hypertensive pregnancy clearly established that MT promotes vasodilation and blood-pressure regulation via Ca^{2+}-activated K^{+} channels, hence MT supplementation improved the hypertensive phenotype, restored uterine artery endothelial function, increased uterine blood flow, and ameliorated hypertension-induced vascular dysfunction [2,48]. Building directly on these findings, a subsequent study showed that MT administered during pregnancy prevents hypertension in offspring by modulating the gene expression of the renin–angiotensin system, thereby providing robust evidence that MT has both immediate maternal blood pressure benefits and long-term protective effects for offspring.

Because MT is a robust antioxidant and anti-inflammatory agent, it is both logical and well supported to consider that MT can ameliorate many metabolic and reproductive manifestations of PCOS. Indeed, MT has been clearly shown to reduce hyperandrogenism and restore menstrual regularity in women with PCOS, thereby directly and favorably affecting reproductive health [49]. More strikingly, MT inhibits endometriosis development by interfering with mitochondrial function and regulating transfer-RNA-derived small RNAs, specifically tRNA-derived RNA fragments (tiRNAs), which are known to promote ectopic endometrial cell proliferation [50].

5. Conclusions and perspectives

Melatonin has well-documented, multifaceted protective effects on the female reproductive system mediated by antioxidant, anti-apoptotic, anti-inflammatory, mitochondrial-protective, and endocrine-regulatory mechanisms, which is why its potential applications in reproductive medicine are extremely promising. However, a prudent and necessary caution is that most of the existing evidence comes from basic experimental studies and animal models, so high-quality, large-scale randomized controlled clinical trials are still lacking. Consequently, the optimal dose, timing of administration, and long-term safety of MT in different populations remain to be determined.

Because future studies can easily employ multi-omics approaches to construct complete regulatory networks of MT action, it is both logical and highly desirable to develop sustained-release formulations and

combination therapies in parallel, which would therefore greatly accelerate the clinical application of MT in ovarian function preservation and in the prevention/treatment of female reproductive disorders.

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References

[1] Hwang S, Jung Y, Song Y, et al., 2021, Enhanced Anti-Angiogenic Activity of Novel Melatonin-Like Agents. Journal of Pineal Research, 71(1): e12739.

[2] Sun T, Liu X, Yang S, et al., 2020, Melatonin Inhibits Oxidative Stress and Apoptosis in Cryopreserved Ovarian Tissues via Nrf2/HO-1 Signaling Pathway. Frontiers in Molecular Biosciences, 7: 163.

[3] Cheng L, Sun T, Liu X, et al., 2021, Melatonin Induction of HSP90 Expression Exerts Cryoprotective Effect on Ovarian Tissue. Cryobiology, 98: 134–138.

[4] Liu X, Sun T, Li H, et al., 2020, Antioxidative Effect of Melatonin on Cryopreserved Ovarian Tissue in Mice. Cryobiology, 96: 99–105.

[5] Ezzati M, Velaei K, Kheirjou R, 2021, Melatonin and Its Mechanism of Action in the Female Reproductive System and Related Malignancies. Molecular and Cellular Biochemistry, 476(8): 3177–3190.

[6] Nakamura Y, Tamura H, Takayama H, et al., 2003, Increased Endogenous Level of Melatonin in Preovulatory Human Follicles Does Not Directly Influence Progesterone Production. Fertility and Sterility, 80(4): 1012–1016.

[7] Tamura H, Jozaki M, Tanabe M, et al., 2020, Importance of Melatonin in Assisted Reproductive Technology and Ovarian Aging. International Journal of Molecular Sciences, 21(3): 1135.

[8] Chang C, Huang T, Chen H, et al., 2018, Protective Effect of Melatonin Against Oxidative Stress-Induced Apoptosis and Enhanced Autophagy in Human Retinal Pigment Epithelium Cells. Oxidative Medicine and Cellular Longevity, 2018: 9015765.

[9] Mortezaee K, Khanlarkhani N, 2018, Melatonin Application in Targeting Oxidative-Induced Liver Injuries: A Review. Journal of Cellular Physiology, 233(5): 4015–4032.

[10] Reiter R, Tan D, Galano A, 2014, Melatonin Reduces Lipid Peroxidation and Membrane Viscosity. Frontiers in Physiology, 5: 377.

[11] Giuca M, Pasini M, D'Ercole S, et al., 2015, Comparison of Salivary Antioxidant Enzyme Activity Between Ex-Smokers and Subjects Who Had Never Smoked. Journal of Biological Regulators and Homeostatic Agents, 29(1): 239–243.

[12] Chen C, Wang T, Varadharaj S, et al., 2010, S-Glutathionylation Uncouples eNOS and Regulates Its Cellular and Vascular Function. Nature, 468(7327): 1115–1118.

[13] Islam M, Rauf A, Fahad F, et al., 2022, Superoxide Dismutase: An Updated Review on Its Health Benefits and Industrial Applications. Critical Reviews in Food Science and Nutrition, 62(26): 7282–7300.

[14] Paschos A, Pandya R, Duivenvoorden W, et al., 2013, Oxidative Stress in Prostate Cancer: Changing Research Concepts Towards a Novel Paradigm for Prevention and Therapeutics. Prostate Cancer and Prostatic Diseases, 16(3): 217–225.

[15] Reiter R, Tan D, Gitto E, et al., 2004, Pharmacological Utility of Melatonin in Reducing Oxidative Cellular and Molecular Damage. Polish Journal of Pharmacology, 56(2): 159–170.

[16] Cruz M, Leal C, Cruz J, et al., 2014, Essential Actions of Melatonin in Protecting the Ovary from Oxidative Damage. Theriogenology, 82(7): 925–932.

[17] Yu Y, Cui Y, Niedernhofer L, et al., 2016, Occurrence, Biological Consequences, and Human Health Relevance of Oxidative Stress-Induced DNA Damage. Chemical Research in Toxicology, 29(12): 2008–2039.

[18] Roszkowski K, Jozwicki W, Blaszczyk P, et al., 2011, Oxidative Damage DNA: 8-oxoGua and 8-oxodG as Molecular Markers of Cancer. Medical Science Monitor, 17(6): CR329–CR333.

[19] Massey T, Jones L, 2018, The Central Role of DNA Damage and Repair in CAG Repeat Diseases. Disease Models & Mechanisms, 11(1): dmm031930.

[20] Liang S, Jin Y, Yuan B, et al., 2017, Melatonin Enhances the Developmental Competence of Porcine Somatic Cell Nuclear Transfer Embryos by Preventing DNA Damage Induced by Oxidative Stress. Scientific Reports, 7(1): 11114.

[21] Torabi F, Malekzadeh Shafaroudi M, Rezaei N, 2017, Combined Protective Effect of Zinc Oxide Nanoparticles and Melatonin on Cyclophosphamide-Induced Toxicity in Testicular Histology and Sperm Parameters in Adult Wistar Rats. International Journal of Reproductive BioMedicine, 15(7): 403–412.

[22] Sun W, Jang H, Park M, et al., 2021, N-Acetyl-L-Cysteine Improves the Developmental Competence of Bovine Oocytes and Embryos Cultured In Vitro by Attenuating Oxidative Damage and Apoptosis. Antioxidants, 10(6): 860.

[23] Lan M, Zhang Y, Wan X, et al., 2020, Melatonin Ameliorates Ochratoxin A-Induced Oxidative Stress and Apoptosis in Porcine Oocytes. Environmental Pollution, 256: 113374.

[24] Li J, Zhang G, Meng Z, et al., 2016, Neuroprotective Effect of Acute Melatonin Treatment on Hippocampal Neurons Against Irradiation by Inhibition of Caspase-3. Experimental and Therapeutic Medicine, 11(6): 2385–2390.

[25] Luo F, Sandhu A, Rungratanawanich W, et al., 2020, Melatonin and Autophagy in Aging-Related Neurodegenerative Diseases. International Journal of Molecular Sciences, 21(19): 7174.

[26] Zhao X, Wang N, Hao H, et al., 2018, Melatonin Improves the Fertilization Capacity and Developmental Ability of Bovine Oocytes by Regulating Cytoplasmic Maturation Events. Journal of Pineal Research, 64(1): e12445.

[27] Jumnongprakhon P, Govitrapong P, Tocharus C, et al., 2015, Melatonin Protects Methamphetamine-Induced Neuroinflammation Through NF-κB and Nrf2 Pathways in Glioma Cell Line. Neurochemical Research, 40(7): 1448–1456.

[28] Manka S, Majewska E, 2016, Immunoregulatory Action of Melatonin: The Mechanism of Action and the Effect on Inflammatory Cells. Postepy Higieny i Medycyny Doswiadczalnej, 70: 1059–1067.

[29] Li Q, Zheng T, Chen J, et al., 2024, Exploring Melatonin's Multifaceted Role in Female Reproductive Health: From Follicular Development to Lactation and Its Therapeutic Potential in Obstetric Syndromes. Journal of Advanced Research, 70: 223–242.

[30] Xu Y, Zhang S, Bao Y, et al., 2024, Melatonin Protects Zebrafish Pancreatic Development and Physiological Rhythms from Sodium Propionate-Induced Disturbances via the Hypothalamic-Pituitary-Thyroid Axis. Journal of

the Science of Food and Agriculture, 104(12): 7454–7463.

[31] Sun H, Zheng M, Liu J, et al., 2023, Melatonin Promoted Osteogenesis of Human Periodontal Ligament Cells by Regulating Mitochondrial Functions Through the Translocase of the Outer Mitochondrial Membrane 20. Journal of Periodontal Research, 58(1): 53–69.

[32] Tao J, Zhang X, Zhou J, et al., 2021, Melatonin Alleviates Hypoxia-Induced Apoptosis of Granulosa Cells by Reducing ROS and Activating MTNR1B-PKA-Caspase8/9 Pathway. Antioxidants, 10(2): 184.

[33] Shiroma M, Botelho N, Damous L, et al., 2016, Melatonin Influence in Ovary Transplantation: Systematic Review. Journal of Ovarian Research, 9(1): 33.

[34] Zhang L, Zhang Z, Wang J, et al., 2019, Melatonin Regulates the Activities of Ovary and Delays the Fertility Decline in Female Animals via MT1/AMPK Pathway. Journal of Pineal Research, 66(3): e12550.

[35] Paulino L, Barroso P, Silva B, et al., 2022, Immunolocalization of Melatonin Receptors in Bovine Ovarian Follicles and In Vitro Effects of Melatonin on Growth, Viability and Gene Expression in Secondary Follicles. Domestic Animal Endocrinology, 81: 106750.

[36] Zhang M, Dai X, Lu Y, et al., 2017, Melatonin Protects Oocyte Quality from Bisphenol A-Induced Deterioration in the Mouse. Journal of Pineal Research, 62(3): e12396.

[37] Xing F, Wang M, Ding Z, et al., 2022, Protective Effect and Mechanism of Melatonin on Cisplatin-Induced Ovarian Damage in Mice. Journal of Clinical Medicine, 11(24): 7383.

[38] He J, Ye T, Xu K, et al., 2025, Melatonin: A Potential Target for Regulating Ovarian Function. Archives of Gynecology and Obstetrics, 312(3): 721–731.

[39] Nadri P, Zahmatkesh A, Bakhtari A, 2024, The Potential Effect of Melatonin on In Vitro Oocyte Maturation and Embryo Development in Animals. Biology of Reproduction, 111(3): 529–542.

[40] Martinez C, Cuello C, Parrilla I, et al., 2022, Exogenous Melatonin in the Culture Medium Does Not Affect the Development of In Vivo-Derived Pig Embryos but Substantially Improves the Quality of In Vitro-Produced Embryos. Antioxidants, 11(6): 1177.

[41] Li S, Chen L, Li Y, et al., 2026, Effect of Melatonin and Epigallocatechin-3-Gallate Combination on In Vitro Maturation of Mouse Oocytes. International Journal of Molecular Sciences, 27(2): 1089.

[42] Zhang H, Yang B, Zhang P, et al., 2025, Combined Treatment With IGF1, CoQ10, and Melatonin Improves the Quality of Bovine Oocytes and Heat-Shocked Blastocysts. Biology of Reproduction, 113(2): 307–320.

[43] Kim H, Bang S, Han A, et al., 2025, Ultrastructural and Functional Recovery of Mitochondria and Improved Developmental Competence by Melatonin in Oxidatively Stressed Porcine Oocytes. Mitochondrion, 84: 102060.

[44] Wang M, Pu Z, Zhang J, et al., 2025, Melatonin Mediates the BMP4/MAPK Signaling Pathway to Alleviate Zearalenone-Induced Abnormal Embryonic Development in Mice. Ecotoxicology and Environmental Safety, 294: 118068.

[45] Karahoda R, Walker D, Abad C, et al., 2026, The Placental Tryptophan Pathway Across Gestation: Implications for Pregnancy Outcomes. Human Reproduction Update, 32(3): 356–379.

[46] Novinbahador T, Abroon S, Motlagh K, et al., 2026, The Influence of Maternal Melatonin on Embryo Implantation: A Crucial Factor in Reproductive Outcomes. Birth Defects Research, 118(2): e70021.

[47] Cheng D, Yang S, Wang C, et al., 2026, Reactive Oxygen Species in Fetal Growth Restriction Mechanisms and Therapeutic Directions. International Journal of Molecular Medicine, 57(5): 121.

[48] Reiter R, Sharma R, 2021, Central and Peripheral Actions of Melatonin on Reproduction in Seasonal and Continuous Breeding Mammals. General and Comparative Endocrinology, 300: 113620.

[49] Park S, Ham J, Yang C, et al., 2023, Melatonin Inhibits Endometriosis Development by Disrupting Mitochondrial Function and Regulating tiRNAs. Journal of Pineal Research, 74(1): e12842.

[50] Lee J, Paull T, 2021, Cellular Functions of the Protein Kinase ATM and Their Relevance to Human Disease. Nature Reviews Molecular Cell Biology, 22(12): 796–814.

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Study on the Key Points of Perioperative Nursing in Endoscopic Mucosal Resection

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Abstract: *Objective*: To explore the key points of perioperative nursing in Endoscopic Mucosal Resection (EMR), optimize preoperative, intraoperative and postoperative nursing measures, further improve the nursing effect, and help patients recover as soon as possible. *Methods*: A total of 200 patients treated with EMR in Affiliated Hospital of Gansu University of Chinese Medicine from June 2025 to December 2025 were analyzed. According to different nursing methods, the patients were divided into the control group and the observation group, with 100 cases in each group. The control group received conventional perioperative nursing, while the observation group adopted high-quality nursing mode. The postoperative complication rate, hospital stay and nursing satisfaction score were compared between the two groups. *Results*: The postoperative complication rate of the observation group was lower than that of the control group, the hospital discharge time was shorter than that of the control group, and patient satisfaction was higher than that of the control group. *Conclusion*: The high-quality nursing mode has obvious advantages in perioperative nursing of EMR. It can effectively reduce the incidence of postoperative complications, shorten the length of hospital stay, improve patients' satisfaction with nursing services, and has promotion value in clinical practice.

Keywords: Endoscopic mucosal resection; Perioperative nursing; Key nursing points; High-quality nursing mode

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1. Introduction

Endoscopic Mucosal Resection (EMR) is a minimally invasive technology for the treatment of early gastrointestinal tumors and precancerous lesions. It can completely resect the lesion mucosa in the digestive tract through endoscopy, which can not only avoid the huge trauma caused by open surgery, but also retain the function of the digestive tract, thus shortening the patient's rehabilitation cycle. The operation of EMR is sophisticated and requires high-standard perioperative nursing, which directly affects the surgical safety, postoperative rehabilitation and incidence of complications of patients. Perioperative nursing includes three stages: preoperative, intraoperative and postoperative. It is necessary to complete preoperative preparation and psychological counseling for patients, do a good job of intraoperative coordination to ensure standardized operation, properly handle possible intraoperative complications such as bleeding and perforation, and

implement standardized postoperative nursing to improve patients' prognosis.

2. Materials and methods

2.1. General data

A total of 200 patients receiving EMR treatment in Affiliated Hospital of Gansu University of Chinese Medicine from June 2025 to December 2025 were selected in this study and divided into the control group and the observation group, with 100 cases in each group. In the control group, there were 55 males and 45 females, with an average age of (54.1 ± 11.2) years old. In the observation group, there were 57 males and 43 females, with an average age of (54.3 ± 11.4) years old. There was no statistically significant difference in general data between the two groups ($p > 0.05$).

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

First, all patients were aged 18 to 70 years old, clinically diagnosed with gastrointestinal mucosal lesions and in line with EMR surgical indications; all patients received EMR surgery for the first time without severe digestive system diseases. Second, all patients had no severe functional insufficiency of vital organs such as heart, lung, liver and kidney.

2.2.2. Exclusion criteria

Patients suffering from gastrointestinal perforation, intestinal obstruction and other diseases; patients with severe cardiovascular and cerebrovascular diseases, hematological diseases or malignant tumors; patients with coagulation disorders; pregnant and lactating female patients.

2.3. Nursing methods

2.3.1. Nursing methods of the control group

The control group was given conventional perioperative nursing, divided into preoperative, intraoperative and postoperative stages.

Preoperatively, nurses introduced relevant knowledge of EMR surgery to patients and their families, including preoperative contraindications, surgical procedures, possible complications and preventive measures, guided patients to conduct preoperative diet and intestinal preparation, and reminded patients to fast and refrain from drinking water for 8 to 12 hours to relieve their tension. Nurses assisted patients in completing preoperative examinations and comprehensively evaluating their physical conditions to meet EMR surgical indications [1].

Intraoperatively, nurses assisted patients in taking a proper surgical position, established venous access, connected monitoring instruments such as monitors, and closely observed patients' intraoperative conditions. Nurses prepared surgical instruments and drugs, and cooperated with doctors to complete surgical operations.

Postoperatively, nurses monitored patients' vital signs such as blood pressure, heart rate and blood oxygen saturation, observed the healing of surgical wounds, reminded patients to keep a light diet after surgery, patiently inquired about patients' postoperative feelings, and provided psychological comfort [2].

2.3.2. Nursing methods of the observation group

The observation group adopted a high-quality nursing mode and implemented personalized nursing according to patients' characteristics to further optimize the preoperative, intraoperative and postoperative nursing processes, so as to improve the perioperative nursing quality of EMR [3].

First, nurses completed preoperative evaluation of patients. On the one hand, they understood patients' basic information such as past medical history, allergy history and surgical history, conducted basic monitoring of blood glucose, blood pressure and heart rate before surgery, and evaluated whether patients met surgical standards. On the other hand, nurses evaluated patients' psychological state and conducted psychological counseling to eliminate their tension and anxiety [4].

Second, nurses implemented comfortable nursing during the operation. They reasonably adjusted the temperature and humidity of the operating room, timely used thermal blankets and infusion heaters to reduce the risk of intraoperative hypothermia, and kept a close eye on changes of patients' vital signs to prevent adverse reactions in a timely manner.

Third, nurses provided postoperative rehabilitation guidance. They implemented analgesic nursing according to patients' postoperative vital signs to relieve postoperative pain, encouraged patients to get out of bed after gastric tube removal, and guided patients to maintain a light diet to help them recover as soon as possible [5].

2.4. Observation indicators

First, nurses recorded various information of patients from the operation day to the discharge day, such as occurrence of infection, bleeding and other complications, and clarified the hospital stay of each patient [6]. By comparing the hospital stay of the two groups, medical staff could evaluate the perioperative nursing effect of EMR. Shorter hospital stays indicated faster recovery and higher nursing quality, while longer hospital stay might suggest complications and inadequate postoperative nursing.

Second, nurses carefully observed whether patients had postoperative complications such as bleeding, perforation, infection, nausea and vomiting, so as to objectively evaluate the safety of EMR surgery. By comparing the incidence of postoperative complications between the two groups, medical staff could assess the impact of nursing methods and clarify the role of high-quality nursing mode.

Finally, medical staff comprehensively evaluated the satisfaction of patients and their families with perioperative nursing work. The evaluation was carried out from nursing technology, nursing attitude, health guidance and psychological counseling. The higher the score, the higher the satisfaction of patients and their families with perioperative nursing work [7].

2.5. Statistical methods

SPSS 26.0 statistical software was used for data analysis. Measurement data were expressed as mean ± standard deviation and tested by *t*-test; enumeration data were expressed as percentage and tested by Chi-square test. $p < 0.05$ indicated that the difference was statistically significant.

3. Results

3.1. Comparison of hospital stay

The hospital stay of the observation group was significantly shorter than that of the control group, and the

difference was statistically significant ($p < 0.05$). See **Table 1**.

Table 1. Comparison of hospital stay between two groups ($\overline{x} \pm s$, Unit: d)

Group	Number of cases	Hospital stays
Observation group	100	5.23 ± 1.56
Control group	100	7.89 ± 2.34
t Value	–	9.458
p Value	–	< 0.001

3.2. Comparison of postoperative complications

The incidence of postoperative complications in the observation group was significantly lower than that in the control group, and the difference was statistically significant ($p < 0.05$). See **Table 2**.

Table 2. Comparison of postoperative complication incidence between two groups (Case, %)

Group	Cases	Bleeding	Perforation	Infection	Nausea & vomiting	Total incidence
Observation group	100	2 (2.00)	0 (0)	1 (1.00)	3 (3.00)	6 (6.00)
Control group	100	8 (8.00)	2 (2.00)	4 (4.00)	9 (9.00)	23 (23.00)
χ^2 value	–	3.790	2.020	1.846	3.192	9.735
p value	–	0.051	0.015	0.174	0.074	0.001

3.3. Comparison of nursing satisfaction scores

The nursing satisfaction score of the observation group was higher than that of the control group, and the difference was statistically significant ($p < 0.05$). See **Table 3**.

Table 3. Comparison of nursing satisfaction scores between two groups ($\overline{x} \pm s$, Unit: Point)

Group	Cases	Nursing technique	Nursing attitude	Health guidance	Psychological counseling	Total satisfaction score
Observation group	100	4.82 ± 0.65	4.79 ± 0.71	4.78 ± 0.72	4.80 ± 0.69	23.96 ± 1.42
Control group	100	4.21 ± 0.78	4.15 ± 0.82	4.22 ± 0.80	4.16 ± 0.77	20.82 ± 1.89
t Value	—	6.543	6.012	5.976	6.251	9.735
p Value	—	< 0.001	< 0.001	< 0.001	< 0.001	0.001

4. Discussion

4.1. Conduct preoperative evaluation and optimize preoperative nursing process

Medical and nursing staff shall conduct comprehensive preoperative evaluation for patients undergoing EMR surgery. Nurses collect patients' basic information, especially past medical history, surgical history and allergy history, and evaluate whether patients meet surgical requirements [8].

First of all, nurses provide personalized nursing according to patients' health conditions to help them adjust physical conditions to meet surgical standards [9]. For hypertensive patients, nurses remind them to take antihypertensive drugs on time and control blood pressure below 140/90 mmHg. For diabetic patients, nurses

monitor fasting blood glucose and 2-hour postprandial blood glucose, keeping blood glucose at about 7.0 mmol/L, so as to avoid massive intraoperative bleeding and poor wound healing caused by hyperglycemia. At the same time, nurses introduce the surgical process to patients and their families, evaluate their psychological state, and provide psychological counseling to eliminate negative emotions such as anxiety and fear towards surgery [10].

Secondly, nurses complete adequate preoperative preparation, including four parts: gastrointestinal preparation, drug preparation, instrument preparation and patient preparation. Meanwhile, nurses remind patients to stop taking drugs affecting coagulation function such as aspirin and warfarin one week before surgery in accordance with medical advice to avoid massive intraoperative bleeding. Finally, nurses prepare surgical instruments and conduct aseptic treatment as required, guide patients to change surgical gowns, and establish venous access to facilitate intraoperative drug administration and fluid infusion [11].

4.2. Standardize intraoperative nursing to ensure surgical safety

Firstly, nursing staff implement positional nursing according to the surgical site, helping patients adjust their positions to ensure comfort and convenient surgical operation for doctors. For example, patients undergoing upper gastrointestinal surgery should take the left lateral position with pillows under the shoulders and slightly bent knees to avoid abdominal compression [12].

Secondly, nurses monitor patients' vital signs during the operation, recording heart rate, blood pressure, blood oxygen saturation and breathing every 5 to 10 minutes. Once the blood oxygen saturation drops below 95% or respiratory depression occurs, nurses shall report to doctors in a timely manner and assist with tracheal intubation and oxygen inhalation.

Thirdly, nurses are proficient in the EMR surgical procedure, accurately deliver surgical instruments such as injection needles, snares and hemostatic clips according to doctors' instructions, timely suction gastrointestinal secretions and blood to avoid affecting the surgical field of vision, and assist doctors in submucosal injection to elevate lesion tissues for mucosal dissection [13].

Fourthly, nurses make preparations for intraoperative emergency treatment, assist doctors in handling intraoperative bleeding, constantly monitor patients' blood pressure and heart rate, and conduct blood transfusion timely to prevent hypovolemic shock. Once intraoperative perforation is found, nurses shall report to doctors immediately, suspend the operation, and implement endoscopic gastrointestinal repair to ensure patients' surgical safety.

4.3. Optimize postoperative nursing process and improve nursing quality

After surgery, nurses transfer patients to the observation room, continuously monitor vital signs such as heart rate, blood pressure, breathing and blood oxygen saturation, and observe patients' facial expression, consciousness and abdominal symptoms, especially the bleeding of surgical wounds. Once symptoms such as accelerated heart rate, decreased blood pressure, hematemesis and melena occur, nurses shall report to doctors timely and cooperate with emergency treatment.

Within 24 to 72 hours after EMR surgery, patients need to fast and refrain from drinking water. After no complications are observed, patients can drink a small amount of water and take liquid diet, avoiding spicy, hard and greasy food to promote wound healing [14]. Nurses supervise patients to stay in absolute bed rest for 3 to 7 days after EMR surgery, avoiding strenuous exercise, coughing and straining defecation to prevent

wound bleeding. Nurses guide patients to take acid-suppressive and hemostatic drugs in accordance with medical advice. Meanwhile, nurses monitor patients' body temperature regularly, provide routine wound nursing to keep the wound clean, and inquire about abdominal pain and abdominal distension. Once patients have fever, chills, abdominal pain, wound swelling, redness and purulent discharge, antibiotics shall be used as required to prevent condition deterioration.

Nurses also provide discharge guidance, reminding patients and their families to avoid overwork, take medicine strictly in accordance with medical advice with clear medication time and dosage, guide patients to maintain a light diet, inform the next reexamination time, answer rehabilitation-related questions, and provide humanistic care to help patients recover soon [15].

5. Conclusion

In conclusion, medical and nursing staff shall jointly formulate high-quality perioperative nursing plans for EMR, clarify the key points of preoperative, intraoperative and postoperative nursing, standardize the operational procedures of each link, enhance nurses' sense of responsibility, and provide humanized nursing for patients so as to improve the quality of nursing services. Nurses should complete preoperative evaluation and psychological counseling to eliminate patients' fear and tension towards surgery, monitor vital signs, cooperate with operations and handle emergencies during surgery to assist doctors in completing operations, and implement postoperative observation and health guidance to prevent complications, guide healthy diet and scientific exercise. It can effectively improve the success rate of EMR surgery and patients' prognosis quality.

Disclosure statement

The author declares no conflict of interest.

References

[1] Guo L, 2025, Analysis of Perioperative Nursing Key Points and Patient Satisfaction of Endoscopic Mucosal Resection. Medical Forum Basic Level, 29(26): 114–116.

[2] Zhu N, Ying P, Hu X, 2025, Application of Targeted Nursing in Preoperative Anxiety Intervention of Patients Undergoing Endoscopic Mucosal Resection. Zhejiang Traumatic Surgery, 30(08): 1591–1593.

[3] Liang W, Liu J, Zhang M, 2025, Nursing Cooperation of One Case of Early Gastric Cancer Treated by Endoscopic Single Band Ligation Mucosal Resection. Lingnan Journal of Emergency Medicine, 30(04): 500–502.

[4] Cheng W, 2025, Perioperative Nursing of Painless Endoscopic Intestinal Polypectomy. Contemporary Medical Symposium, 23(20): 189–192.

[5] Zhou T, 2025, Application Effect of Humanistic Care Nursing in Patients Undergoing Painless Endoscopic Mucosal Resection. Chinese Community Doctors, 41(19): 82–84.

[6] Zhang R, Lin Y, Dai Y, 2025, Application of Zero-defect Nursing Mode in Operating Room for Patients Undergoing Endoscopic Mucosal Resection. Chinese and Foreign Medical Research, 23(12): 86–89.

[7] Zhang H, 2025, Analysis of the Effect of Multi-dimensional Collaborative Intervention on Patients Undergoing Gastric Polyp Endoscopic Mucosal Resection. Contemporary Medical Symposium, 23(04): 138–141.

[8] Xu R, Xing N, Meng Q, 2025, Application Advantages of Integrated Medical and Nursing Care in Patients with Gastrointestinal Polyps Undergoing Endoscopic Mucosal Resection. Heilongjiang Medical Science, 48(01): 81–82.

[9] Xu R, Hong Y, Jiang W, 2024, Observation on the Effect of Individualized Comprehensive Nursing Assisted Endoscopic Mucosal Resection in the Treatment of Colon Polyps. Chinese General Practice, 22(12): 2167–2171.

[10] Zheng Q, Zhang W, 2024, Influence of Nursing Based on Enhanced Recovery After Surgery Concept on Postoperative Complications and Sleep Quality of Patients Undergoing Endoscopic Mucosal Resection. World Journal of Sleep Medicine, 11(11): 2563–2565 + 2569.

[11] Gu W, Li N, 2023, Influence of Comprehensive Nursing on Adverse Surgical Events of Colon Polyps Treated by Endoscopic Mucosal Resection. Clinical Research and Practice, 8(08): 148–150.

[12] Guo N, 2023, Application Effect of Clinical Nursing Path in Patients with Colon Polyps Undergoing Digestive Endoscopic Mucosal Resection. Chinese Community Doctors, 39(36): 133–135.

[13] Nie H, Zhang L, Hu Q, 2023, Application Effect of High-quality Nursing in the Nursing of Colon Polyps Patients Undergoing Endoscopic Mucosal Resection. Chinese and Foreign Medical Treatment, 42(34): 166–170.

[14] Xu S, 2023, Analysis of the Application Effect of Rehabilitation Nursing on Patients Undergoing Endoscopic Mucosal Resection for Gastric Polyps. Chinese Community Doctors, 39(23): 134–136.

[15] Feng Y, Lv Y, Feng L, 2022, Research on the Application of Enhanced Recovery Concept in Perioperative Period of Patients Undergoing Gastric Polyp Endoscopic Mucosal Resection. Shenzhen Journal of Integrated Traditional Chinese and Western Medicine, 32(13): 1–4.

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Systematic Review of Risk Factors for Cognitive Dysfunction and Nursing Intervention Models in Elderly Patients with Type 2 Diabetes Mellitus

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Abstract: *Background*: Type 2 diabetes mellitus (T2DM) is a common chronic metabolic disorder among the elderly, with a significantly higher incidence of cognitive dysfunction compared to the general population. *Objective*: To systematically evaluate the risk factors for cognitive dysfunction and the efficacy of nursing interventions in elderly T2DM patients, providing a basis for early clinical identification and comprehensive care. *Methods*: Literature was retrieved from databases including China National Knowledge Infrastructure (CNKI), Wanfang Data Knowledge Service Platform, and PubMed, encompassing Chinese and English publications on risk factors and nursing interventions for cognitive dysfunction in elderly T2DM patients from 2024 to 2026. Two researchers independently conducted literature screening and data extraction. *Results*: A total of 17 studies were included. Independent risk factors for cognitive dysfunction in elderly T2DM patients included elevated glycated hemoglobin (HbA1c), prolonged diabetes duration, advanced age, high triglycerides, elevated low-density lipoprotein cholesterol (LDL-C), hypertension, and increased serum inflammatory markers. Regarding nursing intervention models, specialized community-based interventions and hyperbaric oxygen therapy combined with Baduanjin exercise effectively improved cognitive function. *Conclusion*: Clinical practice should emphasize glycemic control in elderly T2DM patients, strengthen early screening for high-risk populations, and adopt diversified nursing intervention approaches to delay cognitive decline.

Keywords: Type 2 diabetes mellitus; Cognitive dysfunction; Risk factors; Nursing intervention; Systematic review

Online publication: May 31, 2026

1. Introduction

Type 2 diabetes mellitus (T2DM) is a common chronic metabolic disorder among the elderly, with a significantly higher incidence of cognitive dysfunction compared to the general population. The primary manifestations include memory impairment, attention deficits, and declined executive function, with severe cases progressing to dementia. Cognitive dysfunction not only compromises patients' ability to self-manage diabetes but also increases the risk of adverse events such as hypoglycemia. Chronic hyperglycemia can

induce microvascular lesions, oxidative stress, and neuroinflammatory responses in the brain, leading to damage in cognition-related brain regions such as the hippocampus and prefrontal cortex. He et al. employed quantitative magnetic resonance imaging (MRI) combined with diffusion tensor imaging (DTI) to demonstrate the presence of iron deposition and white matter microstructural damage in T2DM patients with cognitive dysfunction. Liu Cuicui et al. found that the increased perivascular space distribution in patients with T2DM-associated cerebrovascular disease is closely associated with cognitive dysfunction. In recent years, numerous clinical studies have explored the risk factors and nursing intervention strategies for cognitive dysfunction in elderly T2DM patients from various perspectives; however, systematic synthesis and integration remain lacking. Therefore, this study conducted a systematic literature review to provide insights for early clinical identification and comprehensive nursing care.

2. Materials and methods

2.1. Retrieval strategy

In May 2026, searches were conducted across the China National Knowledge Infrastructure (CNKI), Wanfang Data Knowledge Service Platform, and PubMed databases, covering the period from 2024 to 2026. The Chinese search terms were “elderly type 2 diabetes mellitus” AND “cognitive impairment” AND “risk factors/nursing intervention”, while the English search terms were “elderly type 2 diabetes mellitus” AND “cognitive impairment” AND “risk factors/nursing intervention”.

2.2. Inclusion and exclusion criteria

The inclusion criteria stipulated that study subjects must be T2DM patients aged ≥ 60 years, with research content focusing on the analysis of risk factors for cognitive dysfunction or the evaluation of nursing intervention efficacy. Exclusion criteria included subjects with other confirmed etiologies potentially contributing to cognitive impairment, as well as review articles, conference abstracts, and duplicate publications.

2.3. Literature screening and data extraction

The literature search, screening, and data extraction were independently conducted by two researchers, with discrepancies resolved through discussion. The extracted data included the first author, publication date, study type, sample size, research objectives, and primary outcomes.

2.4. Literature quality evaluation

The Newcastle-Ottawa Scale was employed to evaluate the quality of the included studies, covering three aspects: participant selection, intergroup comparability, and outcome measurement, with a total score of 9 points. Scores ranging from 5 to 6 indicate moderate quality, while scores of 7 or higher indicate high quality.

3. Results

3.1. Literature search results

A total of 20 articles were retrieved, with 2 duplicates excluded. After reviewing the titles and abstracts, 2 irrelevant articles were discarded. Following full-text review, 3 review articles were excluded, resulting in a

final inclusion of 17 articles.

3.2. Basic characteristics of the included literature

Among the 17 included studies, the minimum sample size ranged from 60 cases to a maximum of 399 cases. The research content covered risk factor analysis, predictive value of biomarkers, and evaluation of nursing intervention efficacy. The basic characteristics of the included studies are summarized in **Table 1**.

Table 1. Basic characteristics of included literature

Order number	The first author	Publication date	Research type	Sample size	Purpose of research
1	Li Jinsheng and others [1]	2026	Cross section	100 cases	Metabolomic differences in cognitive impairment among patients with T2DM
2	Liu Cuicui and others [2]	2026	Cross section	116 cases	Correlation between EPVS distribution and MCI
3	Yan Jichun and others [3]	2026	Cross section	60 cases	The predictive value of IL-6 and CRP for cognitive impairment
4	Wang Yan et al. [4]	2026	Cross section	244 cases	Construction of MCI risk factors and predictive models
5	He Pingqing [5]	2025	Cross section	90 cases	QSM combined with DTI for MCI risk assessment
6	Li Dongping et al. [6]	2025	Cross section	180 cases	Factors influencing mild cognitive impairment
7	Water-sensitive, etc. [7]	2025	Cross section	80 cases	The correlation between TIR and cognitive dysfunction
8	Zhang Xiaoyan et al. [8]	2025	Cross section	180 cases	The impact of self-management behaviors on mci
9	Wang Xiaoxiao [9]	2025	Cross section	180 cases	Understanding the influencing factors of cognitive impairment
10	Zhang Fang et al. [10]	2025	Cross section	96 cases	Correlation between urinary albumin/ creatinine ratio and mild cognitive impairment (aMCI)
11	Zhang Wen et al. [11]	2025	Summarize	-	Research Progress on the Relationship Between Sarcopenia and Cognitive Dysfunction
12	Zhu Ruxia et al. [12]	2025	Cross section	120 cases	The predictive value of visceral fat area and LDL-C
13	Cao Mengyuan and others [13]	2025	Cross section	233 cases	The predictive value of urinary AD7c-NTP combined with HbA1c
14	Fan Fangsong et al. [14]	2025	Cross section	118 cases	The predictive value of serum Nesfatin-1 and Klotho
15	Ma Jian et al. [15]	2025	Cross section	186 cases	Correlation analysis between decorin and biglycan
16	Zhang Ling et al. [16]	2024	Cross section	198 cases	Correlation between urinary albumin/ creatinine ratio and mild cognitive impairment (aMCI)
17	Wang Lina et al. [17]	2024	Cross section	160 cases	Correlation between 1,5-dehydroraffinose and MCI

3.3. Risk factors for cognitive dysfunction in elderly patients with T2DM

Through comprehensive analysis of the included literature, the independent risk factors for cognitive

dysfunction in elderly patients with type 2 diabetes mellitus (T2DM) can be summarized as follows.

3.3.1. Factors related to blood glucose control

Elevated HbA1c levels are the most frequently reported independent risk factor, with multiple studies confirming a positive correlation between HbA1c and the risk of cognitive dysfunction through logistic regression analysis (ref. 247910131517). Based on data from 399 patients, Ma Jia et al. found that individuals with HbA1c levels between 7% and 9% had a 2.349-fold higher risk of developing mild cognitive impairment (MCI) compared to those with normal levels; this risk increased to 5.106-fold when HbA1c exceeded 9% [18]. Shui Min et al. demonstrated a positive correlation between TIR levels and MoCA scores, showing that each 1% increase in TIR reduced the risk of cognitive impairment by 2.4% [7]. Wang Lina et al. reported that decreased levels of 1,5-dehydroglucitol serve as a protective factor against MCI [17]. These findings collectively indicate that chronic poor glycemic control is the primary driver of cognitive impairment.

3.3.2. Demographic and disease characteristics

Advanced age and prolonged duration of diabetes are widely recognized risk factors. Wang Yan et al. found that age exceeding 70 years is an independent risk factor for mild cognitive impairment (MCI) [4]. Years of education serve as a protective factor; Ma Jia et al. reported that individuals with over 12 years of education had a 0.243-fold higher risk of developing MCI compared to those without education [18]. Concurrent hypertension significantly increases the risk; Liu Cuicui et al. reported that hypertensive patients had a 5.058-fold higher risk of MCI than non-hypertensive individuals [2]. Zhang Ling et al. demonstrated that both microalbuminuria and macroalbuminuria are associated with an elevated risk of amnestic-type mild cognitive impairment, highlighting the intrinsic link between diabetic kidney disease and cognitive dysfunction [16].

3.3.3. Abnormal lipid metabolism

Multiple studies have confirmed that elevated triglycerides and increased low-density lipoprotein cholesterol (LDL-C) are independent risk factors. Zhu Ruxia et al. found that visceral fat area and LDL-C exhibit high predictive value for cognitive impairment [12]. Wang Xiaoxiao reported that high-density lipoprotein cholesterol serves as a protective factor [9]. Li Dongping et al. also identified elevated homocysteine, increased uric acid levels, and reduced folate levels as associated with cognitive impairment, suggesting the multifactorial contribution of metabolic disturbances [6].

3.3.4. Serum biomarkers

Yan Jichun et al. identified IL-6 and CRP as independent risk factors, with a combined detection area under the curve (AUC) of 0.892 [3]. Fan Fangsong et al. reported that decreased levels of Nesfatin-1 and Klotho were associated with mild cognitive impairment (MCI) [14]. Ma Jian et al. found that reduced decorin levels and elevated biglycan levels were closely linked to cognitive impairment, with a combined predictive AUC of 0.903 [15]. Cao Mengyuan et al. demonstrated that combined detection of urinary AD7c-NTP and HbA1c improved predictive accuracy [13]. Li Jinsheng et al. identified 15 differential metabolites through metabolomics analysis, involving multiple metabolic pathways such as the tricarboxylic acid cycle [4]. See **Figure 1**.

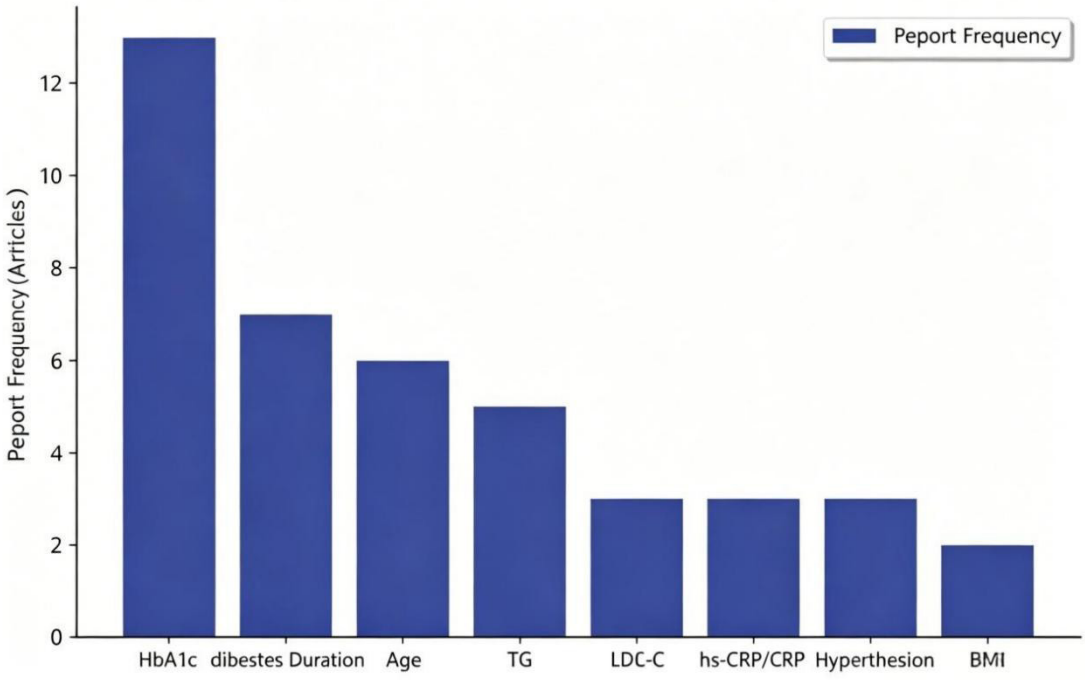


Figure 1. Frequency of reporting cognitive dysfunction risk factors across different studies.

3.4. Nursing intervention model

3.4.1. Targeted community intervention

Ma Jia et al. randomly divided 96 patients into a control group and a study group, with 48 cases in each group. The study group received additional personalized health education, cognitive training, dietary guidance, and exercise prescriptions on top of conventional interventions. Post-intervention, the study group demonstrated higher MoCA scores than the control group, lower fasting blood glucose and HbA1c levels, as well as superior improvements in total cholesterol and triglyceride levels compared to the control group. This study indicates that targeted community interventions can simultaneously improve both cognitive function and metabolic parameters.

3.4.2. Hyperbaric oxygen therapy combined with Baduanjin exercise

Shen Haili et al. divided 60 patients into a control group and an observation group, with 30 cases in each group [19]. The observation group received hyperbaric oxygen therapy three times per week for four consecutive weeks. The observation group showed higher scores in the visuospatial and executive function, delayed memory, attention, and total scores on the MoCA scale compared to the control group. Additionally, levels of glucagon-like peptide-1 (GLP-1) were elevated, while levels of IL-10 and hypersensitive C-reactive protein (CRP) were reduced, confirming that this regimen improves cerebral oxygenation and reduces inflammation, thereby protecting cognitive function.

3.4.3. Self-management behavioral intervention

A study conducted by Zhang Xiaoyan et al involving 180 patients across 8 pairs revealed that the presence of hypertension or hyperlipidemia, a history of hypoglycemia, sleep disorders, and fewer than 3 weekly physical activities were all risk factors for mild cognitive impairment (MCI) [8]. The area under the curve for diabetes

self-management behaviors in predicting MCI was 0.825, with an optimal cutoff value of 17.28 points, indicating that enhancing patients' self-management capabilities have a positive effect on reducing the risk of cognitive impairment. See **Figure 2**.

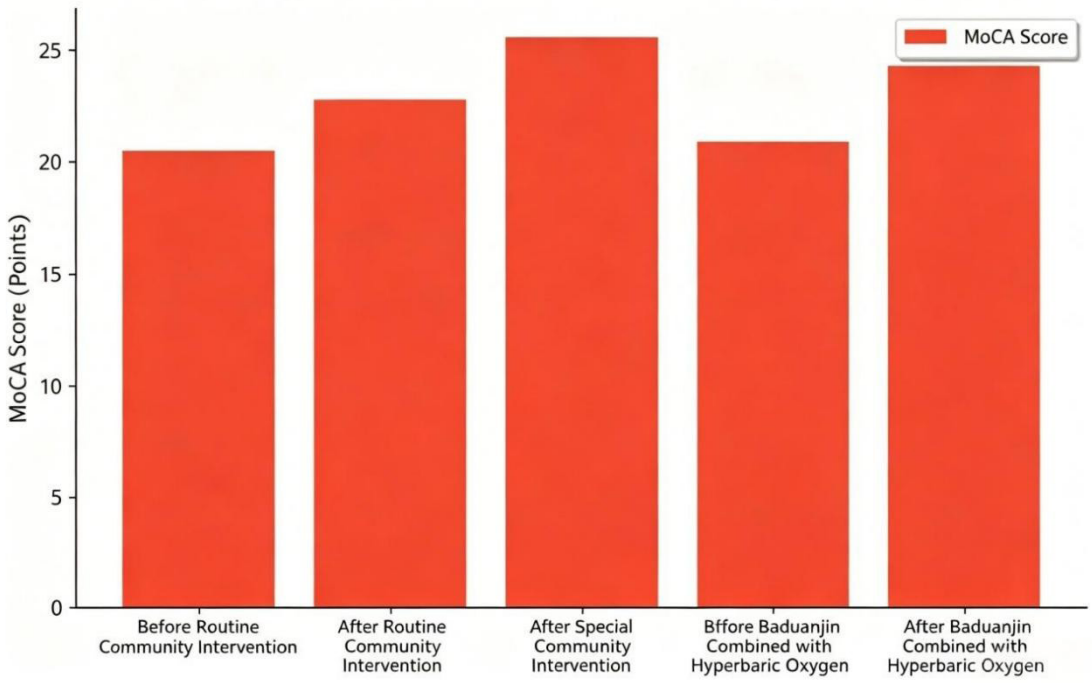


Figure 2. Impact of different nursing intervention models on patients' MoCA scores.

4. Discussion

4.1. Risk factor analysis

The results of this review indicate that elevated HbA1c was confirmed as an independent risk factor in over half of the included studies. Chronic hyperglycemia impairs cognitive function through mechanisms such as promoting the formation of advanced glycation end products, damaging the blood-brain barrier, and exacerbating neuroinflammation. Advanced age, prolonged disease duration, and low educational attainment constitute baseline risks, while concomitant hypertension and dyslipidemia further aggravate cerebrovascular injury. Zhang Wen et al. demonstrated an association between sarcopenia and cognitive dysfunction, suggesting that reduced physical activity and chronic mild inflammation may share a common pathological basis [11]. Zhang Ling et al. and Zhang Fang et al. validated from large-sample perspectives that abnormal urinary albumin-to-creatinine ratios are correlated with cognitive impairment [10,16]. Regarding novel biomarkers, decreased levels of Nesfatin-1 and Klotho indicate weakened neuroprotective mechanisms [14]. Alterations in decorin and biglycan levels are associated with cerebral microvascular lesions; and elevated urinary AD7c-NTP may suggest a tendency toward Alzheimer's disease progression [13,15]. The predictive model developed by Wang Yan et al., based on multiple factors, achieved an area under the curve of 0.853, demonstrating promising clinical application potential [4].

4.2. Analysis of nursing intervention models

The studies included in this review demonstrate the efficacy of diversified intervention strategies. Targeted community interventions integrate health education, cognitive training, and exercise guidance at the community level; research by Ma Jia et al. confirmed their simultaneous improvement of cognitive function and metabolic indicators. Hyperbaric oxygen therapy combined with Baduanjin exercise exerts a synergistic protective effect by enhancing cerebral oxygenation and reducing inflammation [19,20]. Self-management behavioral interventions emphasize patient-centered approaches, while regular exercise plays a critical role in maintaining cognitive function [8]. The three intervention models provide solutions at three levels, namely the community management, integrated traditional Chinese and Western medicine, and behavioral modification; where clinicians may flexibly select or combine them based on individual patient needs.

4.3. Limitations

The literature included in this review is predominantly based on cross-sectional studies, making it difficult to establish clear causal relationships, and there are variations in the assessment tools used across studies. There is limited literature on nursing interventions, all of which are single-center studies with relatively short intervention durations. Future research should conduct more high-quality multicenter randomized controlled trials to verify the independent effects of various factors and the long-term outcomes of interventions.

In conclusion, cognitive dysfunction in elderly patients with type 2 diabetes mellitus (T2DM) results from the combined effects of multiple factors. Elevated HbA1c levels, prolonged disease duration, advanced age, dyslipidemia, and increased serum inflammatory markers are the primary independent risk factors. Clinicians should prioritize glycemic control, enhance early screening, and select appropriate nursing intervention strategies tailored to individual patient conditions.

5. Conclusion

This systematic review identified multiple independent risk factors for cognitive dysfunction in elderly patients with T2DM, with elevated HbA1c being the most consistently reported. Advanced age, prolonged disease duration, dyslipidemia, hypertension, and elevated serum inflammatory markers further contribute to cognitive decline. Among nursing intervention models, targeted community-based programs and hyperbaric oxygen therapy combined with Baduanjin exercise demonstrated meaningful improvements in cognitive function. Given that current evidence is largely derived from cross-sectional, single-center studies with limited sample sizes, future multicenter randomized controlled trials with longer follow-up periods are warranted to establish causal relationships and validate the long-term efficacy of these interventions.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li J, Zhang Y, Che Y, et al., 2026, Study on Metabolomic Differences in Cognitive Dysfunction Among Elderly Patients with Type 2 Diabetes Mellitus. China Journal of Diabetes, 34(04): 264–270.

[2] Liu C, Yang Y, Wang J, et al., 2026, Correlation Between Enlarged Perivascular Space Distribution and Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. Chinese Journal of Geriatric Cardiovascular and Cerebrovascular Diseases, 28(04): 496–500.

[3] Yan J, Zhang X, 2026, Predictive Value of Serum Interleukin-6 and C-Reactive Protein for Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. China Contemporary Medicine, 33(06): 39–42.

[4] Wang Y, Zhang X, Bu L, 2026, Risk Factors and Predictive Model Construction for Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus. Journal of Practical Clinical Medicine, 30(01): 92–98.

[5] He P, Liu Y, Li Y, et al., 2025, Application Study on the Assessment of Mild Cognitive Impairment Risk in Patients with Type 2 Diabetes Mellitus Based on QSM Combined with DTI. Ningxia Medical Journal, 47(12): 1053–1057.

[6] Li D, Bao X, Tian L, et al., 2025, Factors Influencing Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus. Diabetes New World, 28(21): 8–12.

[7] Shui M, Zhao D, Wei J, 2025, Study on the Correlation Between TIR and Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. Chinese Journal of Health Care Medicine, 27(05): 824–827.

[8] Zhang X, Xu P, Han Z, 2025, The Impact of Diabetes Self-Management Behavior on the Risk of Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus. International Journal of Nursing, 44(20): 3689–3694.

[9] Wang X, 2025, Influencing Factors of Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. Diabetes New World, 28(19): 30–32 + 48.

[10] Zhang F, Xu N, Fan K, 2025, Influencing Factors of Amnestic Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus. Diabetes New World, 28(15): 48–51.

[11] Zhang W, Jiang L, Wu J, 2025, Research Progress on the Relationship Between Sarcopenia and Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. Chinese Journal of Diabetes, 17(04): 510–514.

[12] Zhu R, Liu C, He Y, et al., 2025, Study on the Predictive Value of Visceral Fat Area and Low-Density Lipoprotein Cholesterol in Cognitive Dysfunction Among Elderly Patients with Type 2 Diabetes Mellitus. China Medical Guide, 23(09): 1–5.

[13] Cao M, Gao X, Liu B, 2025, Predictive Value of Urinary AD7c-NTP Combined with HbA1c for Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. Corps Medical Journal, 23(01): 35–40.

[14] Fan F, Liu C, Xing H, et al., 2025, Serum Levels of Nesfatin-1 and Klotho in Elderly Patients with Type 2 Diabetes Mellitus and Their Predictive Value for Secondary Mild Cognitive Impairment. International Journal of Laboratory Medicine, 46(05): 553–557.

[15] Ma J, Yu Y, Han X, et al., 2025, Correlation Analysis of Serum Decorin and Biglycan with Cognitive Dysfunction in Elderly Patients with Type 2 Diabetes Mellitus. Health Care Medical Research and Practice, 22(01): 41–47.

[16] Zhang L, Wang Y, Kan L, et al., 2024, Study on the Correlation Between Urinary Albumin/Creatinine Levels and Amnestic Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus. China Journal of Neuropsychiatric Diseases, 50(12): 719–725.

[17] Wang L, Jia X, Guo Y, et al., 2024, Correlation Between 1,5-Dehydroraffinose Levels and Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus. Chinese Journal of Behavioral Medicine and Brain Science, 33(07): 618–623.

[18] Ma J, Zhang M, Zhang S, et al., 2024, Study on the Influencing Factors of Mild Cognitive Impairment in Elderly Patients with Type 2 Diabetes Mellitus Under Community Management. China General Practice, 27(16): 1984–1989.

[19] Shen H, Meng Z, Hou Y, et al., 2024, Efficacy of Hyperbaric Oxygen Therapy Combined with Baduanjin Exercise in Elderly Patients with Type 2 Diabetes Mellitus and Mild Cognitive Impairment. Jiangsu Medical Journal, 50(06): 614–617.

[20] Ma J, Zhang M, Zhang S, 2024, Community Intervention Study on Elderly Patients with Type 2 Diabetes Mellitus and Mild Cognitive Impairment. Jilin Medical Journal, 45(07): 1587–1591.

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The Impact of Calligraphy and Painting Training on the Self-Esteem Level of Patients with Schizophrenia in the Rehabilitation Phase

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Abstract: *Objectives*: This study analyzes the value of calligraphy and painting training in enhancing the self-esteem level of patients with schizophrenia in the rehabilitation phase. *Methods*: A total of 100 patients with schizophrenia were selected as research subjects and randomly divided into two groups using a random number table method. The control group, consisting of 50 patients, underwent routine rehabilitation training interventions in the ward, while the experimental group, also consisting of 50 patients, received professional calligraphy and painting training in the rehabilitation therapy department in addition to routine rehabilitation training. The self-esteem levels of patients in both groups were evaluated before intervention and after 24 weeks of intervention. *Results*: Both groups had low scores on the self-esteem scale and the deficit scale before intervention, which improved to varying degrees after intervention. The experimental group had significantly higher scores on the self-esteem scale and the deficit scale after 24 weeks of intervention compared to the control group ($p < 0.05$). *Conclusion*: Strengthening calligraphy and painting training for patients with schizophrenia in the rehabilitation phase can effectively enhance their self-esteem levels, reduce their deficit levels, and have a positive impact on the rehabilitation of patients with schizophrenia.

Keywords: Calligraphy and painting training; Schizophrenia; Rehabilitation phase; Self-esteem level

Online publication: May 31, 2026

1. Introduction

Schizophrenia is a group of chronic mental disorders with an unclear specific etiology. After onset, patients may exhibit manifestations such as incoordination in mental activities, mental disability, and decline. At present, medication is the primary means of treating schizophrenia, and when patients receive appropriate treatment and their main symptoms are controlled, they will enter the rehabilitation phase if they possess insight into their condition. Due to prolonged hospitalization and social disconnection, patients in the rehabilitation phase who rely solely on medication have limited recovery in terms of social functioning and self-management abilities [1]. Research has found that as the functionality of patients with schizophrenia

severely declines, their corresponding physical and mental health are also affected, necessitating enhanced rehabilitation interventions during the rehabilitation phase [2]. In recent years, occupational and recreational therapy has gradually been applied in the rehabilitation treatment of schizophrenia. This method involves using work, labor, entertainment, and other avenues to assist patients in improving their mental state, enhancing physical fitness, boosting self-confidence, improving social skills, and life skills, thereby helping them better adapt to society and resume normal social activities [3]. Calligraphy and painting training is an art therapy approach and one of the most representative forms of occupational and recreational therapy. Since ancient times in China, there has been a viewpoint of "the common origin of calligraphy and painting", where the fluidity, rhythm, and lively lines of calligraphy are skillfully integrated into painting creation, forming a unique artistic language [4]. As an intuitive and emotional form of expression, painting provides patients in the rehabilitation phase of schizophrenia with new perspectives and avenues [5]. Studies have shown that calligraphy and painting training interventions are primarily used clinically for patients with mental illnesses and have achieved favorable application outcomes [6]. Based on this, this study aims to maximize the assistance for patients in the rehabilitation phase of schizophrenia through calligraphy and painting training interventions, helping them reduce or eliminate negative emotions, build confidence, and enhance self-esteem levels.

2. Materials and methods

2.1. General information

The study subjects were patients with schizophrenia, with a total sample size of 100 cases. Inclusion criteria: Patients were diagnosed with schizophrenia according to the "Chinese Classification and Diagnostic Criteria for Mental Disorders, Third Edition (CCMD-3)"; patients had reached the rehabilitation phase criteria after prior pharmacological treatment (with main symptoms under control and possessing insight); patients were able to cooperate in completing assessments using relevant scales; and the study met the informed consent requirements of both patients and their families. Exclusion criteria: Patients with coexisting multiple types of mental disorders; those with physiological defects or who had experienced significant stressful events recently; those with physical, visual, or hearing impairments that prevented them from cooperating in calligraphy and painting training; and patients with a history of drug dependence. The 100 patients were randomly assigned into two groups, with 50 cases in each group. In the control group, there were 39 males and 11 females, with an age range of 30–69 years, and an average age of (54.24 ± 9.59) years. In the experimental group, there were 40 males and 10 females, with an age range of 30–69 years, and an average age of (54.24 ± 9.50) years. The differences in the listed data between the two groups were small ($p > 0.05$), meeting the comparability requirements.

2.2. Methods

A questionnaire on general patient information was uniformly designed for the study period, and staff were trained in the assessment methods using the Self-Esteem Scale and the Feelings of Inadequacy Scale. The initial assessments using these scales were conducted on the 100 enrolled patients to clarify the training objectives and develop training plans and schedules.

2.2.1. Control group

Patients received conventional rehabilitation guidance, including medication adherence as prescribed, enhanced cognitive training, psychological counseling, and behavioral training. Patients were guided and encouraged to participate in daily life activities, such as dressing, grooming, toileting, and item counting, and were given spiritual or material rewards to improve their enthusiasm for behavioral training, thereby facilitating rapid recovery of social functioning.

2.2.2. Experimental group

Patients entered the calligraphy and painting studio in the rehabilitation department and received calligraphy and painting training under the guidance of professional artists.

2.2.3. Study design

The training plan was strictly implemented, with interventions conducted once a day, five days a week, for a total of 24 consecutive weeks, with each session lasting 1 hour. Patients were encouraged to actively cooperate in the calligraphy and painting training projects through demonstration, instruction, and sharing. During the training process, active communication and interaction with patients were promoted to facilitate mutual communication among patients, healthcare providers, and fellow patients. The psychological status of patients was promptly understood, and psychological counseling was provided to alleviate negative anxiety. Training effects and responses were evaluated, and the training plan was adjusted accordingly. After 24 weeks, the Self-Esteem Scale and the Feelings of Inadequacy Scale were used again to assess changes in patients' self-esteem levels.

2.3. Observation indicators

The assessment results of the Self-Esteem Scale and the Feelings of Inadequacy Scale before and after intervention in the control and experimental groups were compared. Specifically, the Rosenberg Self-Esteem Scale (SES) and the Feelings of Inadequacy Scale (FIS) were used. The SES consists of 10 items, and patients were asked to select a number from 1 to 4 based on the actual situation of each item, with corresponding scores ranging from 10 to 40. Higher scores indicated higher self-esteem levels. The FIS consists of 36 items, with each item evaluated using a 7-point rating scale. The total score ranged from 0 to 216, with higher scores indicating lower feelings of inadequacy and stronger self-esteem.

2.4. Statistical methods

The assessment results at different time points were statistically analyzed using genuine SPSS 26.0 software. The corresponding data were measured data, expressed as mean ± standard deviation, with paired *t*-tests conducted within groups and independent *t*-tests conducted between groups. $p < 0.05$ was used as the criterion for statistically significant differences.

3. Results

3.1. Self-esteem scale scores before and after intervention

The differences in Self-Esteem Scale scores betwe1en the two groups at enrollment were small ($p > 0.05$). After 24 weeks of intervention, the Self-Esteem Scale score in the control group was lower than that in the

experimental group, with a significant difference ($p < 0.05$). The difference in scores between enrollment and 24 weeks of intervention in the control group was small ($p > 0.05$), while the difference in the experimental group was significant ($p < 0.05$). The data are shown in **Table 1**.

Table 1. Self-esteem scale scores before and after intervention ($\overline{x} \pm s$, n = 50, points)

Item	Group	Self-esteem scale score	*t*	*p*
Enrollment	Experimental group	23.22 ± 11.57	1.365	0.175
	Control group	20.06 ± 11.57		
24-week Intervention	Experimental group	35.24 ± 11.44	6.086	0.001
	Control group	20.54 ± 12.68		

3.2. Scores on the feelings of inadequacy scale before and after intervention

There was a minimal difference in the scores on the Feelings of Inadequacy Scale between the two groups at the time of enrollment ($p > 0.05$). When comparing the scores on the Feelings of Inadequacy Scale (24 weeks after intervention), the control group scored lower than the experimental group ($p < 0.05$). Both groups showed improved scores after 24 weeks of intervention, but the experimental group demonstrated a significantly greater improvement, with a notable difference ($p < 0.05$). The data is presented in **Table 2**.

Table 2. Scores on the feelings of inadequacy scale before and after the intervention ($\overline{x} \pm s$, n = 50, points)

Item	Group	Feelings of inadequacy scale score	*t*	*p*
Enrollment	Experimental group	67.06 ± 11.09	0.000	1.000
	Control group	67.06 ± 10.98		
24-week Intervention	Experimental group	172.16 ± 16.96	31.302	0.001
	Control group	78.76 ± 12.55		

4. Discussion

The specific pathogenesis of schizophrenia remains unclear, but numerous studies suggest that its onset is attributed to brain dysfunction caused by the interplay of multiple factors. In recent years, there has been an upward trend in the number of clinically diagnosed schizophrenia patients. Patients in the acute phase may exhibit aggressive behavior, but standardized treatment can help control symptoms and stabilize the condition. Due to the long treatment duration and high recurrence rate of such diseases, patients in the rehabilitation phase can benefit from rehabilitation methods to facilitate the recovery of relevant functions and enable an earlier return to normal life [7].

With advancements in clinical research on rehabilitation treatment for schizophrenia, occupational and recreational therapy has gradually been applied, forming a relatively mature theoretical framework. Its basic theories consist of two aspects: first, the recovery concept, which focuses on the patient themselves, understanding and respecting their differences. It aims not only to help patients eliminate symptoms and control the disease but also to leverage their self-efficacy, actively guiding and assisting them in discovering the meaning of life, filling them with hope, and recognizing their own value. Second, the case-centered approach involves establishing a collaborative partnership between staff and the case, encouraging the case to actively participate in goal setting, assessment, intervention, and feedback processes to enhance their

occupational performance [8]. Occupational and recreational therapy encompasses various specific methods in practice, with calligraphy and painting training being a researched approach. Through calligraphy and painting training, patients in the rehabilitation phase of schizophrenia can promote their own recovery in practical applications, with three practical values: Firstly, as an important intervention measure, calligraphy and painting training requires patients to use both their hands and minds. During implementation, it can guide patients' thinking, help them diverge their thoughts, calm down, and allow inner emotions to be vented through calligraphy and painting training, providing an effective emotional outlet. Different calligraphy and painting training sessions help patients break free from self-perception, redefine their self-perception and value, thereby achieving emotional catharsis and rebuilding self-perception. Secondly, during calligraphy and painting training, staff provide targeted guidance to help patients feel the meaning and value of life through their creations, truly understand the essence of life, love life, and protect themselves. Additionally, by appreciating the calligraphy and painting works of other patients or renowned artists, patients can diverge their thinking, learn to analyze and consider problems from multiple perspectives, break free from fixed self-thinking patterns, no longer dwell on certain issues, cherish life, fulfill responsibilities, and realize self-worth. Thirdly, calligraphy and painting training is a creative process without fixed patterns or requirements. Patients can integrate creativity and imagination into calligraphy and painting training through divergent thinking and understanding of relevant content. This creative process helps stimulate innovative thinking, cultivate imagination, and problem-solving abilities [9].

The data results show that both the control group and the experimental group had low scores on the self-esteem scale and the sense of deficiency scale before intervention, indicating that insufficient self-esteem and a strong sense of self-deficiency are prevalent among schizophrenia patients and require correction [10]. Analysis: Due to the long course of schizophrenia and disconnection from society during long-term hospitalization, patients are unable to participate in work, household chores, etc. Over time, they not only lose their ability to work but also experience a decrease in life confidence, leading to feelings of inferiority and self-doubt. After 24 weeks, the data showed that the control group, through conventional rehabilitation treatment, had slightly improved scores on the self-esteem scale and the sense of deficiency scale, but the changes were not significant. This indicates that conventional rehabilitation training has a promoting effect on improving patients' self-esteem levels, but the overall effect is not strong. The experimental group, on the other hand, showed significantly improved scores on the self-esteem scale and the sense of deficiency scale after professional guidance training by painters, indicating that calligraphy and painting training has a positive effect on enhancing the self-esteem levels of patients in the rehabilitation phase of schizophrenia. Analysis: Calligraphy and painting training can effectively release inner pressure and soothe emotions; immersive creation helps patients improve concentration and endurance; patients' works have the opportunity to participate in exhibitions after assessment and selection, providing them with a sense of participation and accomplishment; staff analyze patients' psychological dynamics through their works, enabling targeted psychological counseling and providing effective support and guidance to achieve the goal of enhancing rehabilitation effects.

5. Conclusion

In summary, strengthening calligraphy and painting training for patients in the rehabilitation phase of schizophrenia can effectively enhance their self-esteem levels, reduce their sense of deficiency, and have a

positive impact on the rehabilitation of schizophrenia patients.

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References

[1] Wang X, Su X, 2024, Application Effect of Nursing Measures Based on Occupational and Recreational Therapy in Patients with Schizophrenia in the Rehabilitation Phase. Reflexology and Rehabilitation Medicine, 5(04): 118–121.

[2] Liu W, 2022, Effects of Music Therapy and Group Psychotherapy on Psychiatric Symptoms and Social Function in Patients with Chronic Schizophrenia. Heilongjiang Science, 13(02): 92–93.

[3] Kang X, Li W, Liu Y, 2024, Analysis of the Effect of Group Painting Therapy on Hospitalized Patients with Schizophrenia in the Rehabilitation Phase. Psychological Monthly, 19(22): 102–104.

[4] Huang J, Liang T, Li P, et al., 2025, Research Progress on the Application of Mandala Painting in the Rehabilitation of Schizophrenia. International Journal of Psychiatry, 52(4): 1023–1025.

[5] Shan F, Yuan Q, Sun L, 2024, Application Effect of Painting Art Intervention Combined with Social Skills Training in Patients with Schizophrenia. Journal of Practical Clinical Medicine, 28(19): 145–148.

[6] You H, Niu Z, Wu X, 2023, Effects of Group Painting Intervention Combined with Aripiprazole on Psychiatric Symptoms and Cognitive Function in Patients with Schizophrenia. Chinese Journal of Convalescent Medicine, 32(6): 577–581.

[7] Pu C, Cao S, Zhang X, 2023, Exploring the Efficacy of Group Painting Therapy in Patients with Schizophrenia in the Rehabilitation Phase. Psychological Monthly, 18(23): 114–116.

[8] Wang Y, Ma L, Li D, et al., 2024, Therapeutic Effects of Group Painting Therapy on Negative Symptoms, Social Function, and Insight in Hospitalized Patients with Schizophrenia in the Rehabilitation Phase. Neurological Diseases and Mental Health, 24(4): 255–259.

[9] Liu L, Shen Y, Feng M, et al., 2025, Improvement Effect of Morita-Style Painting Therapy on Social Function in Patients with Schizophrenia. Chinese Journal of Convalescent Medicine, 34(12): 60–63.

[10] Guo W, Zeng H, Zhu J, 2022, Effects of Occupational and Recreational Painting Therapy on Cognitive Function and Quality of Life in Patients with Schizophrenia in the Rehabilitation Phase. Journal of Clinical Psychosomatic Diseases, 28(04): 125–127 + 145.

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Effects of Ergonomic Interventions and Assistive Devices in Nursing Practice: A Systematic Review

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Abstract: *Objective*: To systematically evaluate the effects of ergonomic interventions and assistive devices on work-related musculoskeletal disorders (WMSDs), physical workload, and nursing safety during nursing procedures. *Methods*: This systematic review was conducted in accordance with the PRISMA 2020 statement. Eleven electronic databases were searched from inception to November 2025. Randomized controlled trials (RCTs) and quasi-experimental studies were included. The PICO framework was used to establish the research question. Study quality was assessed using the Cochrane Risk of Bias Tool and JBI Critical Appraisal Tool. *Results*: A total of 67 studies were included (32 RCTs and 35 quasi-experiments). Engineering control interventions (e.g., transfer equipment, height-adjustable hospital beds) significantly reduced lumbar load and the incidence of WMSDs. Comprehensive interventions combining equipment, training, and workflow optimization achieved the most stable and sustained effects. Single training interventions showed limited effectiveness. Although some devices slightly prolonged operation time, they reduced long-term injury risks. *Conclusions*: Assistive devices based on engineering controls are core strategies for preventing occupational musculoskeletal injuries among nurses. Wider implementation is limited by compliance and organizational barriers. Future research should strengthen intelligent equipment applications and implementation science to improve sustainability and clinical adaptability.

Keywords: Ergonomics; Nursing procedures; Work-related musculoskeletal disorders; Low back pain; Assistive devices; Occupational safety

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1. Introduction

It has been fully recognized that nursing work carries occupational health risks. When nurses perform tasks, they need to keep their bodies in mandatory positions for a long time. The back lumbar region, neck, shoulders and limbs are the main affected parts [1]. But this scope review highlights a problem: there is a lack of research evidence to support specific preventive interventions. The issue of absenteeism and employee retention proves one thing, the human and economic costs associated with back injuries have worsened

nursing work, threatened the sustainability of the health care system, and the development of effective interventions has become an urgent matter. In all kinds of research designs, low compliance and the loss of follow-up action are great, which brings an inherent challenge to the table: it is difficult to formulate interventions that nurses are willing to incorporate into the daily routine.

Meta analysis shows that the prevalence of musculoskeletal diseases in clinical nurses in China has reached 85.5%, the annual prevalence is 81.0%, and the weekly prevalence is 65.0% [2]. To sum up, medium and high-level musculoskeletal risks are common in nursing work, and it is urgent to be dealt with through systematic ergonomic intervention. From objective risk assessment to the development and application of various assistive devices, there is evidence that multi-level intervention strategies can improve the working posture of medical staff, reduce the body load, and ultimately improve their health level and patient safety. However, how to select and optimize these interventions according to different clinical scenarios, job roles and individual differences requires more high-quality research to integrate evidence and clarify best practices, so as to lay a solid scientific foundation for building a more resilient medical working environment.

2. Methods

2.1. Literature search

The computer retrieves Web of Science, PubMed, Cochrane Library, Embase, ScienceDirect, CINAHL, SinoMed, China Knowledge Network, Wanfang Database, the full-text database of the Chinese Medical Association and the VIP database, and search for the relevant literature on ergonomic intervention and auxiliary methods in nursing operations published from November 2025. Use the combination of "thematic word + free word" to construct search words. The Chinese search words are "nursing operation/comfortable nursing", "ergonomics/ergonomic principles/ergonomics intervention", "nursing aids/auxiliaries configuration/auxiliaries/medical device design/medical equipment ease of use/operation efficiency/safety", etc. Use Boolean logic characters (AND/OR) to match the search words, and supplement the missing literature with manual retrieval and literature traceability.

2.2. Study selection

Guide all the retrieved entries into the NoteExpress literature management software. The first step is to eliminate duplicate documents. After this operation is completed, two researchers will read the topics and abstracts respectively, complete the initial screening independently, and eliminate those documents that do not meet the standards at first glance. After the initial screening, the literature left may meet the inclusion requirements. Next, the full text should be read carefully to complete the second screening. In this process, if there is a difference of opinion between the two researchers, they can discuss it first. If the discussion is fruitless, they should find a third-party researcher for arbitration to reach an agreement.

2.2.1. Inclusion criteria

(1) Research subjects

Active registered nurses or nursing staff with corresponding qualifications.

(2) Intervention measures

Nursing operation methods designed according to the principle of ergonomics, such as the optimization of nursing postures, the use of ergonomic tools, and some auxiliary equipment that can improve nursing

efficiency and patient comfort, such as rehabilitation nursing utensils, displacement equipment, etc., and ergonomic training courses to prevent musculoskeletal diseases in nurses.

(3) Results

It can reflect the efficiency of nursing operations, the comfort of patients, and the changes of some related indicators of nurses' low back pain after the use of ergonomic intervention or assistive.

(4) Publication

Published in peer-reviewed journals.

2.2.2. Exclusion criteria

(1) Literature review

(2) Conference summary

(3) Intervention program formulation research and gray literature

2.3. Data extraction

Two researchers independently participated in this data extraction work, using a standardized Excel data extraction table designed in advance. The extraction content will cover the first author, the year of publication, the country or region where the research institute is located, the purpose of the research, the type of research design, the intervention measures and implementation duration, the sample size, as well as the outcome indicators and the main research results. After the extraction work is completed, the two people will do a cross-check and reach an agreement through discussion.

2.4. Quality assessment

In order to evaluate the quality of the included papers, this study used the Cochrane risk bias assessment tool for randomized controlled trials to evaluate the bias risk; for experimental studies and experimental studies, the evaluation tool of the JBI evidence-based health care center was used for evaluation.

3. Results

3.1. Basic characteristics of included studies

There are 67 articles finally included in the literature. In terms of research types, there are 32 randomized controlled trials (RCT) articles and 35 experimental studies. The two are basically the same in quantity. The publication year has been from establishment to 2024. Among them, 61 articles have been published since 2011, suggesting that this field has been a research hotspot for more than ten years.

The research covers 16 countries. China has the most research, 41 articles, the United States and Denmark have 4 articles each, and the remaining 18 articles are scattered in other countries. The research sites are mainly concentrated in hospitals, and high-intensive departments such as ICUs, operating rooms and neurosurgery are the most common. Only one study was placed in community nursing institutions, and the other four were completed in elderly nursing institutions.

The research subjects are clinical nurses (n=48), and the rest of the studies include nursing staff, medical assistants, nursing interns and other nursing-related practitioners. The sample range is large, and the sample size of a single group is 10~594 cases.

3.2. Study quality

Among the 32 randomized controlled experiments included, only 3 scores were below 6 (out of 10) [3–5]. Most of the studies used random sequence grouping, and the lack of blindness and distribution has become the most common quality problem.

3.3. Classification of ergonomic interventions

3.3.1. Engineering controls

In the primary prevention strategy system, engineering control is regarded as the most effective measure to prevent musculoskeletal diseases. Its core logic is to directly eliminate exposure to hazards in the workplace with the help of technology, or to control it at an acceptable level when it cannot be eliminated. In terms of the medical environment, such measures are usually implemented as the redesign or modification of work equipment and workstations and to make fundamental adjustments at the level of physical conditions to achieve the most direct reduction in biomechanical load. Engineering control has an outstanding advantage, that is, the protection effect does not depend on the continuous compliance of employees, and reliability and durability can be guaranteed. Specifically at the operational level, the procurement of patient handling auxiliary equipment, adjusting the height of the workbench, optimizing the layout of the workstation and other measures can reduce the biomechanical load caused by manual lifting and handling activities from the source.

3.3.2. Administrative controls

When engineering control cannot completely eliminate the hazards, administrative control will intervene as a secondary strategy to reduce the degree of risk exposure and its consequences through management and organizational means. Such measures do not change the harm itself, but adjust the contact mode between personnel and hazards. In routine nursing work, administrative control covers the formulation and implementation of safe patient handling policies, regular ergonomics training (such as correct body mechanics education, risk assessment training), and optimizing work scheduling to avoid excessive fatigue of employees. The effect of administrative control largely depends on management execution and employee compliance, which generally requires continuous supervision and resource investment, and the protection effectiveness is eventually weaker than engineering control.

3.3.3. Behavioral controls

The idea of behavior control intervention is to change the behavior, habits and cognition of individual workers in order to enhance their ability to cope with residual risks. Specifically, nurses will be educated and trained to master the correct body mechanics and posture, such as teaching them to use their legs instead of leaning on their waists when carrying patients; at the same time, they will encourage or require them to wear personal protective equipment such as suitable support belts; regular inter-work lumbar and back muscle exercises will also be promoted to enhance the strength and endurance of the core muscle group. After the introduction of cognitive behavior training, nurses can learn to identify the work pressure or thinking patterns that bring bad postures, and master a set of coping strategies. Teamwork methods such as the “three-person handling method” are also included in behavior control, which standardizes the team operation process and reduces the burden of individuals. However, the effect of behavior control largely depends on whether the individual’s compliance can be sustained, and it is always a supplement to engineering control and

administrative control, not a substitute.

3.4. Types and applications of assistive devices

3.4.1. Patient transfer and handling equipment

Patient transfer and transportation is one of the most physical loads in nursing work, and it is also the most likely to cause musculoskeletal damage. With the help of mechanical assistance, all kinds of transfer equipment can move patients from one place to another smoothly and safely, which greatly reduces the physical burden of nursing staff. The ceiling lift operates through a track system fixed on the ceiling. With it, patients can be transferred without barriers between the whole room and even adjacent rooms. It is especially suitable for scenes with limited space but frequent and long-distance movement, such as intensive care units or home care environments for long-term bedridden patients. Floor-standing hydraulic or electric lifts are more flexible. The base generally has pulleys, which can be pushed between different rooms. It is suitable for places such as hospital wards and rehabilitation centers that require multi-point transfer. The transfer skateboard or shifter mainly responds to the short-distance translation between the bed and the chair. It relies on low-friction materials to reduce the movement resistance, which is easy and fast to operate. The systematic use of these devices can significantly reduce the risk of lumbar and back injuries for nursing staff. The rational configuration and use of patient transfer equipment has become a core strategy to prevent occupational musculoskeletal diseases in nursing staff.

3.4.2. Positioning equipment

Position management involves a comfortable and therapeutic lying position, and regular turning over for patients to prevent pressure sores. These tasks have high requirements for the physical strength and skills of nursing staff. Take the adjustable electric bed as an example, the height and angle of its backboard and leg plate can be easily adjusted through the electric controller. The nursing staff can maintain a good working posture when doing oral care, changing sheets or helping the patient sit up. The bending and excessive stretching are reduced, and the patient's autonomy and comfort are also improved. For special groups such as newborns, there is a modified neonatal bed, which integrates the operation height more ergonomically, and the side panel is also designed to be easier to approach, so that the neck and waist strain caused by long-term bending operation of medical staff can be alleviated. Turn-over aids are also a way, such as turn-over cloths with handles or suspenders, and self-made handle-type turn-over cotton pads. They can allow nurses to use the lever principle and team cooperation to safely turn over the patient with relatively small force, which avoids the huge shear force and lumbar torque generated by moving the patient's torso with bare hands. There is also a decompression mattress. Take the alternating inflatable mattress as an example, which can automatically and continuously change the pressure of the body contact point, which can not only effectively prevent pressure sores in patients, but also reduce the frequency and intensity of manual turning over by medical staff, which is equivalent to reducing the risk of fatigue from the source. These devices work together, turning the original high-intensity and high-risk manual work into a safer and more labor-saving process. While ensuring the safety and comfort of patients, it has also become a kind of tool to protect nursing staff and reduce them from repetitive fatigue and acute and chronic musculoskeletal diseases.

3.4.3. Other assistive tools

In addition to large-scale transfer and body position equipment, many auxiliary tools for specific daily

operations can also effectively prevent micro-injuries and repetitive fatigue. For example, when standing for a long time, such as surgery or long-term infusion monitoring, wearing a pair of unstable shoes or laying an anti-fatigue mat can mobilize the micro-regulation of the calf muscles, improve the blood circulation of the lower limbs, and relieve the static load. Wearing improved stretchable card sleeves for pediatric patients reduces the number of times nurses bend over when checking, and also saves the trouble of frequent loss and replacement. When doing fine operations such as venipuncture, use a small table that can be folded and height-adjustably to support the patient's arm, which can keep the operator's elbows close to the body and the wrists naturally neutral, and the static muscle load of the shoulder, neck and wrist is reduced. The ergonomic nursing cart has an easy-to-grasp pusher, a flexible steering wheel and a reasonable layered space for placing items. The resistance is less when pushing, and there is less unnecessary body twisting. These tools look inconspicuous, but they target repeated movements in nursing work, such as bending over, reaching out, twisting and maintaining a static posture for a long time. After optimizing the tool design and working environment, the daily accumulated work emanics exposure can be systematically reduced, which is exactly necessary to build a comprehensive musculoskeletal injury prevention system.

3.5. Effects of ergonomic interventions

3.5.1. Ergonomic training and posture intervention

According to some studies, the ergonomics training will take human mechanics, the concept of no lifting, labor-saving handling, the theory of knowledge-faith-action, and the theory of protection motivation as the core content. Through theoretical propaganda, operation demonstration, practical drills and individualized guidance, it will correct the bad working posture of nurses and reduce the physical load. The Back School systematic chemical chemistry training done by Jaromi et al. has lowered the VAS score of chronic low back pain nurses, and the body posture has also improved [6]. Tang Linqi and others engaged in position management training based on the concept of "no lifting", and the subjective fatigue level and pain visual simulation score of the nursing staff were significantly reduced [3]. Wang Jingjing and others introduced the British manual handling method training, the theoretical level of nurses and operation standardization improved, and the error rate in practice also decreased [7]. An Mengying and Liu Li used the principle of labor-saving mechanics to the placement of the surgical body position, which reduced the physical consumption of nurses when moving and lifting, and the risk of lumbar muscle strain was also reduced [8]. In addition, that kind of diversified training, taking human mechanics knowledge, back pain prevention and control, position management, and handling skills as the core content, can play a role in reducing the incidence of back pain and musculoskeletal diseases in nurses. The scores of pains and dysfunction such as VAS and RMDQ will go down, and high-risk physical exposure will also be reduced [1,2,8].

3.5.2. Application of assistive devices

Assistive devices are the core means of engineering control. They can directly reduce the biomechanical load on the spine. The protective effect of this intervention is the most stable, and the consistency of relevant evidence is also the highest. The friction reduction devices such as sliding cloth, turning over sheet, sliding pad, and effort-saving sheet can significantly reduce the frequency of lifting, bending and twisting the waist. The medium and heavy labor intensity has been reduced by more than 50%, and the time required for body position placement has also been shortened. The VAS/NRS pain score has been reduced by 30–50%, and the physical function and quality of life (SF-36) have also been improved [9–12]. In terms of lifting and shifting

devices, such as Binder, Eagle, and Maxi Air, can reduce the electromyoelectric activity (EMG) of the lumbar and back muscles by 34% to 47%, and the subjective physical consumption will also be reduced. However, some devices will slightly extend the operation time [13]. This is the case with adjustable height beds, but it can reduce the load on the waist muscles, lower the risk score of REBA posture, and play a role in optimizing the working posture. Belt protection and lumbosacral support devices can relieve low back pain in the short term, and the JOA function score has also been improved [14]. However, long-term continuous use may lead to lumbar muscle atrophy and decreased lumbar mobility, so it should be treated with caution [15].

3.5.3. Workflow and environmental optimization

Process optimization is adjusted through these four aspects, how to match personnel, how to do the work, whether the equipment is suitable, and whether the environment can be changed. The purpose is to reduce the exposure of bad posture and improve the operation efficiency and safety. Some studies combined the elastic scheduling and the double-bridge movement rollover method, and found that the patient's NRS pain score and RMDQ dysfunction score were down [16]. Another study on the improved bed sheet handling method showed that there were five or six people to move a patient. After the change, two to four people were enough, and the probability of catheter falling off was also reduced, and the efficiency of team cooperation was significantly improved [17]. For example, the foldable small table was used in the scene of venous puncture, and the time of the nurse's bending operation was directly cut by 55.1%. On the other hand, the proportion of completing the operation without bending was increased by 23.0%; with the modification of the newborn bed, the incidence of nurses' low back pain and the fatigue symptoms of the night shift were alleviated [18,19]. There are also some studies that have been verified from other perspectives, such as the Bobath handshake turning method, the improved mobile patient technology, and the sliding board and the electric patient transfer equipment. They are really effective in improving the safety of nursing and making the operation more convenient, providing a basis for the continuous improvement of the workflow [20–22].

3.5.4. Physical exercise and cognitive behavioral intervention

Methods such as lumbar and back muscle exercise, core training, stretching training and cognitive behavioral intervention can improve pain and function from both physiological and psychological ways. Tian Suzhai et al. designed a set of graded lumbar and back muscle exercises using the action research method [23]. As a result, it was found that this set of exercises reduced the Oswestry dysfunction index (ODI) and VAS scores of ICU nurses, improved the exercise compliance, and the pain relief rate was also improved. Zhang Zhao et al. built an exercise plan based on the theory of protection motivation, which can reduce nurses' fear-avoidence (FABQ-CHI) score and improve chronic low back pain; physical training such as Tai Chi, yoga, and four-section stretching system can also relieve muscle fatigue, improve lumbar function and physical tolerance [16,24–27].

3.5.5. Multidisciplinary comprehensive intervention

The idea of multidisciplinary comprehensive intervention packages the strategies of ethic adjustment, physical training, cognitive behavioral therapy, aids, process optimization and health education together, which is in line with the biological-psychological-social medicine model. In the long run, this packaged approach has a more stable and lasting protective effect than only a single measure. Fang Yuxia et al. did a study to confirm that participatory engineering, physical training, coupled with cognitive behavioral

intervention, can shorten the duration of musculoskeletal diseases, reduce the intensity of pain, and reduce the cost of diagnosis and treatment [27]. The research of Rasmussen et al. also shows that after comprehensive intervention, low back pain can be reduced by 0.8 days per month, and the pain intensity can be reduced by 0.4 points [28]. Traditional Chinese medicine physiotherapy, flexible scheduling, environmental transformation, and the promotion of healthy lifestyle can also be included in the comprehensive intervention. In the long-term follow-up, it can be seen that its protective effectiveness is maintained quite stable and lasting.

4. Discussion

This systematic review evaluates the improvement of ergonomic interventions and assistive devices on the occupational health of nursing staff and the safety of patients. The discussion is held from the aspects of major findings, evidence quality, practical significance and research prospects.

4.1. Key findings and comparison with existing knowledge

This review has a very consistent finding that the most direct way to reduce the lower back load and injury risk of nursing staff is to introduce and correctly use patient transfer and position management equipment, such as lifts and electric hospital beds. This just confirms the concept of prioritizing “engineering control” in the hierarchical control model, that is, eliminating harm from the source is much more useful than relying on personal behavior changes. Research also shows that it is not enough to have equipment alone. It is not possible to guarantee that it will be used. It requires mandatory use policies, training to embed the workflow, and enough manpower. Only by combining these three things can obstacles such as time pressure and habit resistance be overcome, so that the engineering control measures can really continue. This truth is in line with the implementation science that “intervention measures need to be embedded in the existing system”. As with the existing understanding, this review finds that it is difficult to maintain the effect for a long time by taking physical mechanics training alone for intervention, which also exposes the fact that in a complex working environment, only changing individual knowledge without changing the physical attributes and organizational support of the task is very limited.

In addition, this review also reveals the outcome of the dual benefit of the patient of an ergonomic intervention. While protecting nursing staff, assistive devices have been associated with the decline in the incidence of patient falls and pressure sores with a more stable and safer operation process, and patient satisfaction has also increased. Some economic assessment results show that although the initial investment is considerable, the cost of work-related injuries has been compressed, the number of sick leave days has been reduced in sync with the loss of personnel, and the long-term return on investment is more likely to turn positive.

4.2. Barriers to clinical implementation

The large-scale application of assistive devices in medical scenarios has long been subject to multiple structural obstacles. Economic constraints come first, and the high initial procurement cost constitutes a dominant barrier. For small and medium-sized medical institutions under budget pressure, the practical feasibility of introducing advanced auxiliary equipment on a large scale is limited. Spatial conditions constitute the second major limitation. This problem is particularly prominent in the hospital area where the

construction date is relatively old and the functional zoning has been solidified. Some auxiliary equipment is large in size or need to be matched with special operation units, and it is difficult to delimit suitable placement points and reserve compliant operation space in the existing building layout. The problem of insufficient training is also profound, and forms a direct hedge with the high load of clinical work. In the saturated work arrangement, the time and resources that can be allocated to the systematic operation training of new equipment are significantly compressed. This gap is transmitted to the practical level, that is, after the equipment configuration is in place, the standardized utilization rate and overall acceptance are at a low level for a long time. The deeper obstacle is rooted in cultural inertia. The empirical judgment of "manual operation is faster and more direct" precipitated in long-term clinical practice has a considerable basis for behavioral inertia. Especially in high-pressure and fast-paced disposal situations, operators tend to prioritize the activation of their most skilled physical response mode, and have an instinctive tendency to avoid the time delay that may be brought about by the introduction of equipment. There are still continuous weaknesses in the maintenance and guarantee link. If daily calibration, fault repair and technical response cannot be followed up in time, once the user's trust in the reliability of the equipment is loosened, idleness tends to become an irreversible destination. The above obstacles are not isolated from each other in actual operation. They form a mutually reinforced nested structure, pointing to the "last kilometer" dilemma of assistive devices from the completion of procurement to embedding in the daily clinical path.

4.3. Facilitating factors for successful implementation

It relies on a set of systematic promotion strategies to smoothly integrate assistive devices into the workflow and overcome various obstacles in the implementation link. Strong leadership support and institutional commitment form the basis of the work. The management must raise employee safety and ergonomics to a strategic level while completing the allocation of necessary resources. The collaborative participation of multidisciplinary teams is equally critical. Members should include direct users (such as nurses and technicians), physiotherapists who provide ergonomic guidance, engineers or biomedical technicians responsible for equipment selection, maintenance and customized transformation, and safety specialists. With the help of user-centered design and selection process, the equipment can more accurately meet the needs and limitations of the actual work scenario, and the acceptance is improved. Continuous and interactive education and training should not be limited to the operation of the equipment itself, but also extend to the correct application of human mechanics, the ability to identify risks, and the specific methods of integrating the use of equipment into the standardized operation process. Overall, organizations need to deeply embed ergonomic principles in safety culture, making them the core values arranged in parallel with infection control and fire safety. This means that risk assessment should be carried out regularly, employees should be encouraged to take the initiative to report physical discomfort or potential hidden dangers, and safety practices should be integrated into the performance appraisal system, so as to create a working environment that actively prevents musculoskeletal injuries and actively accepts auxiliary technologies.

4.4. Limitations of the review

Among the 32 RCT experiments included in this study, most of them have methodological defects, such as the lack of blindness and insufficient distribution and concealment, which is relatively common, and the gray literature is not retrieved, which will cause the source of evidence to be lacking. Most of the people included

in the research are nurses, and other nursing-related personnel (such as nurses) with the same suffering from low back pain are not included. The advantage of this is to ensure the homogeneity of the study, and on the other hand, the scope of use of the research results is limited.

5. Conclusion

This systematic review examines the effect of ergonomic intervention and auxiliary application in nursing operations. Judging from the existing evidence, the introduction of auxiliary equipment (skids, elevators, etc.), the implementation of esthetic training (covering position management, handling skills, etc.), and the promotion of multi-dimensional comprehensive intervention (integrated environment optimization, physical training and cognitive behavioral therapy), the three paths have achieved significant results in reducing the incidence of nurses' low back pain, the risk of musculoskeletal diseases and labor intensity, and the long-term effects are more prominent. The compensatory effect of assistive equipment is mainly reflected in the reduction of spinal load, and the multi-dimensional comprehensive intervention scheme shows a more lasting protective effect in long-term follow-up, which has obvious advantages over single measures. On the other hand, the role of single means such as relying solely on theoretical training is limited. In addition, there are methodological limitations such as insufficient blind implementation and large sample heterogeneity in existing studies, and the quality of evidence is uneven. Subsequent research needs to further refine the intervention plan, integrate standardized risk assessment tools, and carry out a hierarchical analysis of the target population, such as examining the differentiated responses of new nurses and senior nurses respectively. The deep integration of technical assistance and clinical practice is also a direction worth exploring, so as to improve the directionality and effectiveness of intervention and provide a more reliable evidence-based basis for the occupational health management of nurses.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Krishnan K, Raju G, Shawkataly O, 2021, Prevalence of Work-Related Musculoskeletal Disorders: Psychological and Physical Risk Factors. International Journal of Environmental Research and Public Health, 18(17): 9361.

[2] Jiang F, Luo G, Xu H, et al., 2023, Prevalence and Risk Factors of Musculoskeletal Disorders Among Clinical Nurses in China: A Meta-Analysis. Journal of Environmental and Occupational Medicine, 40(11): 1307–1313.

[3] Tang L, Zhang Y, Tao H, 2022, Effect of Posture Management Training under the "No-Lift" Concept on Occupational Low Back Pain Among Nursing Staff. World Chinese Journal of Integrated Traditional and Western Medicine, 8(5): 166–168.

[4] Xia C, Xu H, Li S, 2012, Application of the Dual-Person Labor-Saving Turning Method Combined With an R-Shaped Turning Pillow in Critically Ill Patients. Modern Hospital, 12(4): 74–76.

[5] Hu J, Jiang L, Cao Y, et al., 2022, Effectiveness and Safety of Inelastic Versus Elastic Lumbosacral Orthoses on Low Back Pain Prevention in Healthy Nurses: A Randomized Controlled Trial. Spine, 47(9): 656–666.

[6] Jaromi M, Nemeth A, Kranicz J, et al., 2012, Treatment and Ergonomics Training of Work-Related Lower Back

Pain and Body Posture Problems for Nurses. Journal of Clinical Nursing, 21(11–12): 1776–1784.

[7] Wang J, Ma L, Zhao W, et al., 2014, Application Effect of the British Manual Handling Method in Occupational Low Back Pain Prevention Training for Nursing Staff. Chinese Journal of Practical Nursing, 30(12): 6–9.

[8] An M, Liu L, 2004, Application of the Principle of Force Conservation in Surgical Positioning. Journal of Xinjiang Medical University, 27(2): 190–191.

[9] Fan T, Lai Y, Deng X, 2020, Observation on the Efficacy of the Sliding Sheet-Assisted Turning Method in Improving Occupational Low Back Pain Among ICU Nurses. Electronic Journal of Practical Clinical Nursing, 5(12): 141–182.

[10] Chen M, Zhang Y, Xu M, 2023, Clinical Study of Double-Layer Sliding Sheet-Assisted Patient Mobilization in Preventing Occupational Low Back Pain. Health World, 2023(21): 114–116.

[11] Ma L, Zhuang Y, 2014, Application of Sliding Sheet Turning Method in Preventing Occupational Low Back Pain. Modern Practical Medicine, 26(11): 1455–1456.

[12] Lin Q, Lin T, Ye S, 2022, Effect of Transport Workers-Assisted 90° Lateral Position in Operating Room. Fujian Medical Journal, 44(1): 143–145.

[13] Sirisawasd S, Taptagaporn S, Boonshuyar C, et al., 2022, Comparison of Musculoskeletal Load Using Two Devices for Manual Height Adjustment of the Hospital Bed. International Journal of Occupational Safety and Ergonomics, 28(1): 519–527.

[14] Mo C, Xing J, Xu H, 2019, Comparison of Back Belt and Back Muscle Exercise on Occupational Low Back Pain. Industrial Health and Occupational Diseases, 45(3): 175–177.

[15] Hagiwara Y, Yabe Y, Yamada H, et al., 2017, Effects of a Wearable Type Lumbosacral Support for Low Back Pain Among Hospital Workers: A Randomized Controlled Trial. Journal of Occupational Health, 59(2): 201–209.

[16] Zhou T, Zhang W, Xue Y, 2018, Application of Multidisciplinary Intervention in Reducing Low Back Pain Among ICU Nurses. Journal of Qilu Nursing, 24(11): 4–6.

[17] Wan C, Yang X, Li Q, 2018, Application of Sheet Lifting Method in Transporting Critically Ill Patients. Chinese Journal of Geriatric Health Care, 16(1): 134–135.

[18] Huang H, Chen Y, You Y, 2021, Application Value of Foldable Small Table Board in Nursing Puncture. Fujian Medical Journal, 43(3): 175–176.

[19] Pang L, Li J, Yao J, 2017, Effect of Modified Neonatal Bed on Subjective Fatigue Among Nurses. Chinese Journal of Primary Medicine and Pharmacy, 21(9): 1025–1026.

[20] Luo J, Xiao S, Liang Y, 2015, Labor-Saving Effect of Bobath Handshake and Bridging Movement During Patient Turning. Journal of Nurses Training, 2015(19): 1785–1787.

[21] Ma X, Pan W, Ding X, 2011, Improved Patient Mobilization Techniques to Prevent Occupational Low Back Pain Among ICU Nurses. Chinese Journal of Nursing, 46(5): 451–453.

[22] Law M, Ridzwan M, Ripin Z, 2022, REBA Assessment of Patient Transfer Work Using Sliding Board and Motorized Patient Transfer Device. International Journal of Industrial Ergonomics, 90: 103322.

[23] Tian S, Tang L, Ning W, 2014, Application of Action Research in Intervention of Occupational Low Back Pain Among ICU Nurses. Chinese Journal of Nursing, 29(10): 89–91.

[24] Zhang Z, Tang L, He X, 2019, Effect of Back Muscle Exercise Training Based on Protection Motivation Theory on Chronic Low Back Pain Among ICU Nurses. Chinese Journal of Modern Nursing, 25(20): 2520–2525.

[25] Tian S, Tang L, Ning W, 2014, Effect of Occupational Low Back Pain Training on Relieving Low Back Pain Among ICU Nurses. Chinese Nursing Management, 2014(8): 881–883.

[26] Lai W, Huang X, Fu F, et al., 2015, Effect of Comprehensive Interventions on Preventing Low Back Pain Among Nurses. Chinese Nursing Research, 29(9): 3416–3417.

[27] Fang Y, Chen Y, Li X, 2018, Effect of Participatory Ergonomics Intervention on Work-Related Musculoskeletal Disorders Among Nurses. Chinese Journal of Industrial Hygiene and Occupational Diseases, 36(6): 446–448.

[28] Rasmussen C, Holtermann A, Mortensen O, et al., 2014, The Effect of a Multi-Modal Intervention on Low-Back Pain Among Health Care Workers: A 12-Month Follow-Up Study. Applied Ergonomics, 45(6): 1539–1545.

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Study on the Mechanism of the Herb Pair *Astragali Radix-Angelicae Sinensis Radix* Against Cerebral Ischemia-Reperfusion Injury

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Abstract: Cerebral ischemia is a common acute cerebrovascular disease characterized by transient insufficient cerebral blood supply, manifesting as transient ischemic attacks. It has a high incidence, mortality, and disability rate, and seriously affects human health and quality of life. The pathogenesis is complex and diverse, mainly involving inflammatory response, oxidative stress, and excitatory amino acid toxicity. As traditional blood-tonifying and strengthening herbs, *Astragali Radix* (Huangqi) and *Angelicae Sinensis Radix* (Danggui) not only exert favorable effects in treating cerebral ischemia, such as alleviating neurological damage, resisting inflammation, preventing thrombosis, and inhibiting cell death, but also achieve remarkable therapeutic efficacy. Furthermore, the two herbs can be used in combination to form the classic prescription *Danggui Buxue Tang*. This paper reviews how *Astragali Radix*, *Angelicae Sinensis Radix*, and their active ingredients synergistically exert anti-hypoxic effects in the brain.

Keywords: Yiqi Huoxue herb pair; *Astragali Radix*; *Angelicae Sinensis Radix*; Cerebral ischemia; Mechanism of action

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1. Introduction

Classically, transient ischemic attack is defined as neurological impairment caused by focal cerebral ischemia, with symptoms usually resolving completely within 24 hours. In traditional Chinese medicine (TCM), cerebral ischemia is categorized as *apoplexy (zhongfeng)*, mainly attributed to Qi *stagnation and blood stasis, impaired blood circulation, or Qi deficiency failing to govern blood circulation* [1]. Many factors contribute to ischemic stroke, including wind-fire, phlegm-fluid, blood stasis, Qi deficiency, and heat-toxin; among these, blood stasis and heat-toxin are particularly prominent and closely interrelated [2,3].

As recorded in *Discourses on Syndromes and Treatments of Wind-Stroke and Arthralgia-Bi*: "Diseases due to wind-evil often manifest as hemiplegia or weakness of one arm, called bi-syndrome. A feeble and

rapid pulse indicates wind-stroke." The therapeutic principle of "dispelling wind-evil and tonifying healthy Qi" is emphasized. In summary, the onset of cerebral ischemia is most closely related to *Qi deficiency and blood stasis*.

The pathogenesis of cerebral ischemia is complex and multifaceted, including oxygen free radical injury, excessive calcium ion accumulation, effects of nitric oxide (NO) and its synthases (NOS), excitatory amino acid toxicity, damage from inflammatory cell factors, activation of death-regulating genes, and dysfunction of the ischemic penumbra [4,5]. The combination of *Astragali Radix* and *Angelicae Sinensis Radix* has the effects of *activating blood circulation and resolving stasis, tonifying Qi and nourishing blood*. It also protects nerve cells, reduces apoptosis, relieves endoplasmic reticulum stress, inhibits vascular intimal hyperplasia, and exerts anti-inflammatory effects [6,7].

Danggui Buxue Tang (formulated by Li Dongyuan in *Differentiation of Internal and External Injuries*), composed of *Astragali Radix* and *Angelicae Sinensis Radix* at a ratio of 5:1, promotes hematopoiesis, regulates immunity, and protects the cardiovascular and cerebrovascular systems [8]. Herb pairs are the core carriers of the TCM seven-emotion compatibility theory, condensing the clinical experience of physicians through the ages. Following the principle of "mutual reinforcement and mutual assistance yield good efficacy", two-herb combinations achieve synergistic effects. With relatively simple components and ease of manipulation and detection in modern experiments, herb pairs represent an important entry point for the modernization of TCM compound research [9].

This paper reviews the mechanisms of *Astragali Radix*, *Angelicae Sinensis Radix*, their components, and their compatibility against cerebral ischemia, focusing on effects on hemodynamics, the ischemic penumbra, and other molecular mechanisms.

2. Effects on hemodynamics

Numerous studies confirm that cerebral ischemia is closely related to hemodynamics. Zhou Dan's team evaluated the stenosis of intracranial arteries using CT perfusion and CT angiography of the head and carotid arteries [10]. They analyzed CT perfusion parameters, including relative mean transit time (rMTT), relative time to peak (rTTP), relative cerebral blood volume (rCBV), and relative cerebral blood flow (rCBF), in stenotic regions, along with microscopic control values, to explore the correlation between vascular stenosis and perfusion, verifying the close link between cerebral ischemia and hemodynamics.

NO and NOS are key pathogenic factors in cerebral ischemia [11]. Clinical studies show that traumatic brain injury, craniocerebral surgery, and cerebrovascular diseases can lead to cerebral ischemia-hypoxia, with elevated NO and NOS levels in serum and infarcted brain tissue, accompanied by varying neurological complications. Decompressive craniectomy reduces serum NO and NOS levels and improves clinical symptoms. Therefore, lowering NO and NOS is an important strategy for treating cerebral ischemia.

Wang Zhiwang et al. reported that serum NO and NOS levels significantly increased, and CGRP rose markedly 12 days after establishing a blood stasis-type cerebral ischemia rat model [12]. After administration of *Astragali Radix* ultrafiltrate, NO and NOS decreased significantly compared with the model group, and whole-blood viscosity was notably reduced. Clinical trials confirmed that *Astragali Radix* ultrafiltrate exerts anti-cerebral-ischemia effects by regulating hemodynamics.

Zhou Yuanpeng et al. observed blood pressure and heart rate in conscious hypertensive dogs, and hemodynamics in anesthetized dogs [13]. They found that *Angelicae Sinensis Radix* increased coronary,

cerebral, and peripheral blood flow; dilated cerebral vessels; enhanced blood flow; and reduced vascular resistance, demonstrating its vasodilatory effect.

Yang et al. used color Doppler ultrasound and pathological observation of rat aortic intimal denudation [14]. The *Astragali Radix* group and *Angelicae Sinensis Radix* group reduced vascular wall thickness, increased vascular diameter, and elevated blood flow velocity, indicating inhibition of vascular wall thickening and attenuation of intimal hyperplasia in rats with aortic endothelial denudation and restenosis. The combination of the two herbs showed stronger effects on enhancing hemodynamics.

3. Effects on the ischemic penumbra

The ischemic penumbra, surrounding the infarct core is characterized by maintained ionic balance and intact structure, representing functionally inactive but salvageable brain tissue; it holds critical clinical value as it can be rescued by treatment. The penumbra is a hallmark of cerebral ischemia, accompanied by morphological changes.

Peng Xiaolan et al. used multi-b-value DWI-MR aquaporin (AQP) molecular imaging to observe mouse cerebral ischemia models and evaluate the penumbra, deepening understanding of this region [15]. Zhang Jianjian et al. demonstrated that the percentage of apoptotic cells in the penumbra significantly increased with prolonged ischemia, confirming the key role of apoptosis in penumbral injury.

Apoptosis-regulating genes control programmed cell death under physiological and pathological conditions to maintain homeostasis. Two main categories of neuron-death-related genes are recognized: pro-apoptotic genes (e.g., *Bax*, *Bcl-XS*, *Bad*, *p53*, *caspase* family) and anti-apoptotic genes (e.g., *Bcl-2*, *Bcl-XL*).

Zhang et al counted apoptotic cells, *Bcl-2*-positive, and *Bax*-positive cells in the penumbra of sham, model, and *Angelicae Sinensis Radix* injection (25%)-treated rats using TUNEL and immunohistochemistry [16]. Compared with the model group, the treatment group showed significantly fewer apoptotic cells, increased *Bcl-2*-positive cells, and unchanged *Bax*-positive cells, indicating that *Angelicae Sinensis Radix* strongly inhibits penumbral apoptosis.

Yang Jingwei et al. similarly measured apoptotic index and *Bcl-2*/*Bax* protein expression in ischemic rat brain tissue [17]. Compared with the model group, intravenous *Angelicae Sinensis Radix* injection (50%) reduced apoptotic cells; *Bcl-2* expression in the penumbra and ischemic region was similar, while *Bax* expression was significantly decreased. These studies confirm that *Angelicae Sinensis Radix* inhibits apoptosis by downregulating *Bax* and upregulating *Bcl-2*, exerting anti-cerebral-ischemia effects.

Chen et al. used HE staining to observe penumbral morphology in rats and found that astragaloside IV treatment markedly improved tissue structure compared with the model group. Nissl staining showed increased, darkly stained, enlarged Nissl bodies with intact neuronal structure, indicating that astragaloside IV alleviates morphological damage in the ischemic penumbra [18].

Other studies found that preconditioning with astragalus riboside reduced GFAP expression, increased NeuN-positive cells, and decreased apoptotic neurons in the penumbra, suggesting mild inhibition of astrocyte activation and neuroprotection.

In a rat model of permanent middle cerebral artery focal ischemia, *Danggui Buxue Tang* (5:1 ratio) improved neuronal survival, reduced degeneration and apoptosis in the penumbra, and promoted

post-ischemic self-repair. Chen Gang et al. used TUNEL staining and measured caspase-3, caspase-12, and GRP78 expression in the perinfarct cortex. The *Astragali Radix-Angelicae Sinensis Radix* mixture (5:1) protected neurons, reduced apoptosis, and alleviated endoplasmic reticulum stress.

4. Effects on other molecular mechanisms

4.1. Oxidative stress

Oxidative stress injury plays a vital role in post-ischemic neuronal damage. An imbalance in oxygen free radical metabolism, when free radical production exceeds antioxidant capacity causes oxidative stress. Enzymes including NADPH oxidase, xanthine oxidase, aldehyde dehydrogenase, and superoxide dismutase (SOD) are modulated, leading to reactive oxygen species accumulation. Oxidative stress directly triggers cell death and promotes apoptosis and degeneration via redox signaling. Thus, antioxidation is a key therapeutic target in cerebral ischemia.

Several studies show that total flavonoids of *Astragali Radix*, astragalus polysaccharides, and astragaloside IV significantly increase SOD and glutathione peroxidase (GSH-PX) activities and decrease malondialdehyde (MDA) content compared with model controls. Yan An's team reported that angelica polysaccharides at 30 and 60 mg/kg/d significantly elevated SOD and GSH-PX levels and reduced MDA in the rat brain.

4.2. Inflammatory response

Cytokines including interleukins (ILs), tumor necrosis factor (TNF), platelet-activating factor (PAF), and colony-stimulating factors are key mediators of immunity and contribute critically to cerebral ischemic inflammation, directly or indirectly promoting inflammatory cell activation and infiltration. Studies show that IL-1β, TNF-α, IL-6, the adhesion molecule ICAM-1, and endothelial selectins are upregulated before cerebral infarction maturation.

Studies confirm that astragaloside IV, total flavonoids of *Astragali Radix*, and *Astragali Radix* extract reduce TNF-α, IL-6, and IL-1β levels in cerebral ischemia model rats, verifying the anti-inflammatory effect of *Astragali Radix*. Angelica polysaccharides and *Angelicae Sinensis Radix* injection also exert anti-inflammatory effects by lowering inflammatory factors.

Rats treated with *Danggui Buxue Tang* (5:1) at 8.4 g/kg, 11.67 g/kg, and 23.34 g/kg showed significantly reduced mRNA expression of TNF-α, IL-6, and IL-1β in serum and brain tissue after cerebral ischemia-reperfusion injury (CIRI), demonstrating the anti-inflammatory efficacy of the herb pair.

5. Conclusion

Cerebral ischemia severely threatens human health and quality of life, with rising incidence in recent years and becoming a global research focus. *Astragali Radix-Angelicae Sinensis Radix* is a classic TCM *YiQi Huoxue* (tonifying Qi and activating blood) herb pair with a long medicinal history. Its main active components, including total flavonoids of *Astragali Radix*, astragaloside IV, and angelica polysaccharides exert clear anti-cerebral-ischemia effects. Used singly or in combination, they improve cerebral function and quality of life by inhibiting penumbral apoptosis, ameliorating penumbral morphology, and regulating cerebral blood flow.

Astragali Radix-Angelicae Sinensis Radix and its active ingredients protect against cerebral ischemia mainly by regulating targets including NO/NOS, Bax/Bcl-2, caspase family, and GRP78; mediating pathways involving SOD, GSH-PX, MDA, IL-1β, TNF-α, and IL-6; and inhibiting vascular intimal hyperplasia, apoptosis, oxidative stress, and inflammation.

Current research mostly focuses on the individual mechanisms of *Astragali Radix* and *Angelicae Sinensis Radix*. Studies on their interactive and synergistic mechanisms in combination remain scarce and warrant further investigation based on single-herb research.

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References

[1] Lu J, Ren M, 2005, Updated Clinical Definition of Transient Ischemic Attack and Clinical Decision-Making. Medicine & Philosophy, 2005(10): 30–31.

[2] Wang X, Ni J, 2016, Research Progress in Cerebral Ischemia-Reperfusion Injury and Drug Therapy. Chinese Journal of New Drugs, 25(06): 659–663 + 691.

[3] Cheng X, Zhang X, Bai M, et al., 2012, Prevention and Treatment Characteristics of Promoting Blood Circulation and Removing Blood Stasis and Clearing Away Heat and Toxic Materials for Cerebral Ischemia. Acta Chinese Medicine, 27(05): 615–619.

[4] Gao Z, 2014, Study on the Effect and Mechanism of Ligustrazine on Ischemic Stroke in Rats, thesis, Beijing University of Chinese Medicine.

[5] Cui H, Wang Q, 2009, New Progress in Pathogenesis of Ischemic Cerebrovascular Disease. Journal of Changchun University of Chinese Medicine, 25(02): 291–292.

[6] Chen G, Zhou H, 2019, Effects of *Astragali Radix-Angelicae Sinensis Radix* Mixture on Nerve Cell Apoptosis and Endoplasmic Reticulum Stress After Cerebral Ischemia-Reperfusion in Rats. Acta Chinese Medicine, 34(08): 1709–1714.

[7] Fang H, Zhang H, Tao Y, et al., 2020, Research Progress on the Herb Pair *Astragali Radix-Angelicae Sinensis Radix*. Journal of Hainan Medical University, 26(08): 633–636 + 640.

[8] Fan Y, Chen X, 2006, Experimental Research Progress of Danggui Buxue Tang. Chinese Archives of Traditional Chinese Medicine, 2006(09): 1643–1646.

[9] Liu C, Geng G, 2019, Discussion on Scorpio Prescription Based on Herb Pair Compatibility. Journal of Traditional Chinese Medicine, 60(18): 1563–1566.

[10] Zhou D, Zhang W, 2023, Changes of Cerebral Hemodynamics in Patients with Chronic Cerebral Ischemia and Its Relationship with Cerebral Blood Supply Artery Stenosis. Chinese Journal for Clinicians, 51(04): 468–471.

[11] Chen C, 2013, Basic and Clinical Study on the Role of Nitric Oxide and Nitric Oxide Synthase in Cerebral Ischemia and Hypoxia, thesis, Fujian Medical University Union Hospital.

[12] Wang Z, Wei S, Liu Y, et al., 2014, Effects of *Astragali Radix* and *Hedysari Radix* Ultrafiltrates on Hemorheology and Related Regulatory Factors in Rats with Blood Stasis Complicated with Transient Ischemic Attack. Chinese Journal of Modern Applied Pharmacy, 31(10): 1182–1186.

[13] Zhou Y, Huang L, Zheng Y, et al., 1979, Effects of *Angelicae Sinensis Radix* on Hemodynamics and Myocardial Oxygen Metabolism in Dogs. Acta Pharmaceutica Sinica, 1979(03): 156–160.

[14] Yang C, Han Y, 2010, Effects of *Astragali Radix* and *Angelicae Sinensis Radix* on Ultrasonic Hemodynamics in Rats with Vascular Restenosis. Medical Journal of Chinese People's Liberation Army, 35(08): 976–978.

[15] Peng X, Yu B, Chen Q, et al., 2020, Evaluation of Ischemic Penumbra in Cerebral Ischemia by Aquaporin Magnetic Resonance Molecular Imaging. Chinese Journal of Medical Imaging, 28(01): 6–11 + 16.

[16] Zhang J, Huang J, Zhang X, 2001, Inhibitory Effect of *Angelica Sinensis* on Cell Apoptosis in the Penumbra of Cerebral Ischemia in Rats. Stroke and Nervous Diseases, 2001(01): 8–10.

[17] Yang J, Tian J, Zou F, et al., 2004, Effect of *Angelica Sinensis* on Cell Apoptosis in Focal Ischemic Brain Tissue of Rats. Journal of Wuhan University (Medical Edition), 2004(01): 4–6 + 18.

[18] Chen H, Jia Z, Zhao L, et al., 2022, Protective Effect of Astragaloside IV Combined with Ligustrazine (Components for Replenishing Qi and Activating Blood) on Neurovascular Unit in Rats with Cerebral Ischemia-Reperfusion Injury. Chinese Journal of Gerontology, 42(21): 5312–5318.

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An Analysis of Chinese Handwriting Performance Among Primary School Students in Macao

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Abstract: *Background*: Handwriting is critically important fo r school-age children in the current education system. Poor handwriting performance during primary school can negatively affect students' academic achievement and self-confidence. *Objectives*: To summarize the average Chinese handwriting performance of local primary school students in Macao using a Smart Handwriting Analysis Platform, identify students at the critical stage of Chinese handwriting difficulties, and understand the concerns of parents and teachers regarding students' Chinese handwriting. *Methods*: A cross-sectional study was conducted from 2019 to 2021. The Smart Handwriting Analysis and Recognition Platform (SHARP) was used to collect and analyze Chinese handwriting performance among 789 typically developing students (Grades 1–6) and 79 students with Special Educational Needs (SEN) in Macao. One-way ANOVA was used to examine differences in Chinese handwriting indicators across grades, and independent-samples t-tests were used to compare performance between typically developing students and SEN students. Parents of participating students completed the Handwriting Ability Checklist (HAC), and homeroom teachers or Chinese language teachers recorded students with handwriting difficulties through additional annotations. *Results*: Chinese handwriting ability among Macao primary school students showed a typical developmental trend. Significant differences were found between typically developing students and SEN students in character boundary exceeding and writing errors. Approximately 9–14% of typically developing students performed at the critical level across SHARP indicators. School teachers paid greater attention to students' writing accuracy. Combining the parent-completed HAC with SHARP results enabled more effective identification of students with Chinese handwriting difficulties. *Conclusion*: The SHARP can assist teachers and occupational therapists in the early identification of students with Chinese handwriting difficulties. By collecting Chinese handwriting performance data from local typically developing and SEN students in Grades 1–6, local norms for Chinese handwriting proficiency among Macao primary school students have been established.

Keywords: Smart handwriting analysis platform; Handwriting difficulties; Primary school students; Chinese handwriting performance; Early identification

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1. Background

Handwriting is critically important for children in the current education system. According to data released by the Education and Youth Development Bureau (DSEDJ) of Macao, the total number of students receiving primary education in the 2024/2025 academic year was 37,245 [1]. In Macao, students begin pre-writing exercises such as sticker pasting and bead threading in kindergarten. Upon entering primary school, time spent on handwriting at school gradually increases, with over 50% of school hours spent on penmanship, including copying and dictation. Children who perform poorly in handwriting during this learning period may experience negative impacts on academic achievement and self-confidence [2,3].

Previous studies have shown that 10–20% of school-age children experience some form of handwriting difficulty [4,5]. Chinese handwriting requires visual discrimination to distinguish stroke forms and positions, as well as spatial organization skills to write clear, well-proportioned characters [3,6]. Therefore, writing speed and accuracy are key indicators of students' performance in Chinese handwriting [7].

Students with different types of Special Educational Needs (SEN) face distinct challenges in learning to write. Students with Attention Deficit Hyperactivity Disorder (ADHD) show lower handwriting legibility and efficiency due to inattention [8]. Students with Autism Spectrum Disorder (ASD) struggle with character formation during writing [9]. In addition, children with Developmental Coordination Disorder (DCD) cannot write fluently due to poor motor coordination [10]. Handwriting difficulties are not typically used as diagnostic criteria for any developmental disorder, but handwriting problems are among the major functional deficits in developmental delay and dyslexia.

Beyond SEN students, typically developing students may also experience handwriting difficulties. A pilot study in November 2019 found handwriting difficulties in some typically developing primary school students. Early assessment is therefore crucial for identifying children with handwriting difficulties. Assessment of Chinese handwriting includes two dimensions: the writing process and the writing product (**Figure 1**). Traditional Chinese handwriting assessments, such as the Tseng Handwriting Speed Test, mainly judge writing speed based on the final product. Process measures include time on paper, time in air, etc., while product measures include error rate and boundary exceeding rate. These indicators are difficult to quantify through clinical observation. With advances in modern technology, computer computing and artificial intelligence enable efficient and accurate assessment of multiple dimensions of students' handwriting performance, which is the main reason for adopting the Smart Handwriting Analysis Platform in this study to collect data on Chinese handwriting performance of Macao primary school students.



Figure 1. Components of Chinese handwriting performance.

2. Research objectives

This study mainly investigated:

(1) The current Chinese handwriting performance of typically developing primary school students across grades in Macao;
(2) The average Chinese handwriting performance and differences between typically developing students and students with Special Educational Needs (SEN);
(3) The number and proportion of typically developing students at the critical stage of handwriting difficulties;
(4) The level of concern of parents and school teachers regarding the Chinese handwriting performance of primary school students.

3. Methods

A cross-sectional design with stratified sampling by region and student population was used. From 2019 to 2021, researchers selected 5 Chinese-medium primary schools and 2 education centers on the Macau Peninsula to assess Chinese handwriting in 789 typically developing students (Grades 1–6) and 79 SEN students. Assessments were conducted by occupational therapists in classrooms at participating schools and centers. Parents of participating students provided informed consent and completed the Handwriting Ability Checklist (HAC) [11]. Thirty homeroom or Chinese language teachers recorded students with handwriting difficulties via annotations, without requiring consent.

3.1. Smart handwriting analysis platform

Assessment of students' handwriting performance is usually product-oriented, with speed and accuracy as core indicators [12]. Earlier computerized handwriting assessment systems mainly analyzed products using preset algorithms [13]. In contrast, the Smart Handwriting Analysis and Recognition Platform (SHARP) (**Figure 2**) uses artificial intelligence to analyze the readability of Chinese characters. Key indicators include incorrect strokes, extra strokes, missing strokes, connected strokes, reversed strokes, and stroke order errors [13,14].



Figure 2. Smart handwriting analysis and recognition platform (SHARP).

SHARP is an objective and accurate cloud-based Chinese handwriting assessment system used to analyze the Chinese handwriting ability of primary school students, help teachers quickly screen those with handwriting difficulties, and support occupational therapists in identifying and understanding students' handwriting problems. Students completed the test at desks equipped with digital tablets and copying templates (**Figure 3**), copying 90 Chinese characters. Assessment data were transmitted via Bluetooth to a cloud platform, which output process and product data (**Figure 4**). Process measures included speed, total

writing time, time in air, time on paper, pen pressure, and standard deviation of time per character. Product measures included stroke errors, extra/missing/connected/reversed strokes, and stroke order errors, analyzed via AI to evaluate performance. SHARP effectively differentiates performance, speed, and error patterns between typically developing and SEN students. Research by the Li-Tsang team confirmed that the platform correlates significantly with core components of handwriting ability: fine motor skills, visual perception, writing process, and character formation [15].

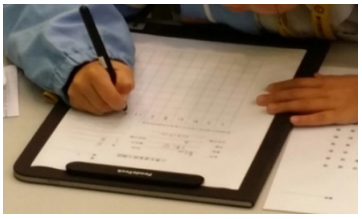


Figure 3. Digital tablet and copying template.

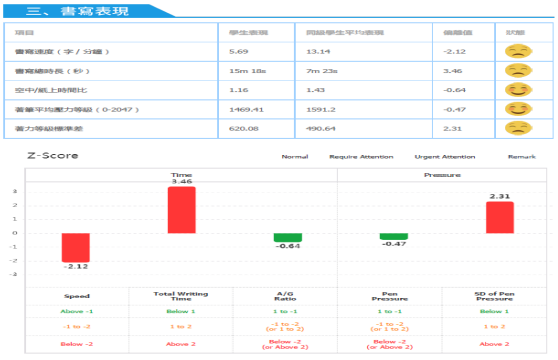


Figure 4. Chinese handwriting process data.

3.2. Inclusion and exclusion criteria

Participants were two groups of students in mainstream schools: typically developing students and SEN students. SEN students were included to compare Chinese handwriting performance with typically developing peers.

3.2.1. Inclusion criteria for typically developing students

(1) Grades 1–6 in mainstream schools;

(2) Proficiency in reading and writing Traditional Chinese.

3.2.2. Exclusion criteria for typically developing students

(1) Physical disability;

(2) Diagnosed neurodevelopmental disorder.

3.2.3. Inclusion criteria for SEN students

Officially identified as having special educational needs by DSEDJ and enrolled in mainstream schools.

3.3. Ethical considerations

Schools were approached to recruit participants, with parental informed consent obtained for all students. To protect privacy, all student data were stored using coded identifiers and registered with the Office for Personal Data Protection of Macao (Ref.: 0737/GPDP/2021). Ethical approval was granted by the Ethics Committee of Yew Chung College of Early Childhood Education (Ref.: 2024/25_ER02-PC03).

3.4. Statistical analysis

Statistical analyses were performed using SPSS 20. Outliers were identified and removed using boxplots. One-way ANOVA compared handwriting indicators across grades among typically developing students. Independent-samples *t*-tests compared typically developing vs. SEN students; non-normally distributed continuous data were analyzed using the Mann–Whitney U test. A p-value < 0.05 was considered statistically significant.

3.5. Sample size calculation for typically developing students

Based on the Hong Kong norm study by Li-Tsang et al. (2013), effect size = 0.2277, $\alpha = 0.05$, power = 0.99 [13]. The study covered Grades 1–6, with 16 indicators analyzed per grade. The required total sample size was 734 students.

4. Results

Only 361 typically developing students were recruited in 2019, insufficient for local norm establishment. Data collection planned for 2020 was suspended due to the COVID-19 pandemic. In 2021, an additional 429 students were assessed. In total, 789 typically developing students and 79 SEN students in Grades 1–6 was included from 2019 and 2021.

4.1. Descriptive statistics for typically developing students

Table 1 presents demographic data (grade, gender, mean age) for 789 typically developing students and 79 SEN students.

Table 1. Demographic characteristics of typically developing and SEN students

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Male n (%)	TD:109 (55), SEN: 11 (73)	TD: 67 (52), SEN: 13 (76)	TD: 111 (58), SEN: 17 (89)	TD: 53 (59), SEN: 13 (86)	TD: 31 (39), SEN: 5 (100)	TD: 44 (49), SEN: 6 (75)
Female n (%)	TD: 91 (45), SEN: 4 (27)	TD: 63 (48), SEN: 4 (24)	TD: 82 (42), SEN: 2 (11)	TD: 37 (41), SEN: 2 (14)	TD: 55 (61), SEN: 0 (0)	TD: 46 (51), SEN: 2 (25)
Mean age	TD: 6y8m, SEN: 7y	TD: 7y11m, SEN: 7y8m	TD: 8y8m, SEN: 8y7m	TD: 9y10m, SEN: 10y6m	TD: 11y1m, SEN: 11y3m	TD: 12y2m, SEN: 12y

One-way ANOVA revealed significant differences across grades for all indicators *except* stroke order errors (**Table 2**). Writing speed increased with grade, while writing time, boundary exceeding, and errors decreased.

Table 2. Chinese handwriting performance of typically developing students (Grades 1–6) in Macao

Measure	G1 mean (SD)	G2 mean (SD)	G3 mean (SD)	G4 mean (SD)	G5 mean (SD)	G6 mean (SD)	*p*
Writing process							
Speed (char/min)	5.50 (1.64)	7.70 (2.57)	10.15 (2.53)	13.67 (3.13)	16.18 (3.78)	17.15 (3.34)	< 0.0001***
Total time (s)	1060.86 (314.94)	769.33 (249.48)	563.14 (151.34)	415.83 (97.44)	348.44 (81.80)	322.76 (59.25)	< 0.0001***
Time in air (s)	642.75 (204.71)	457.58 (161.72)	329.00 (103.09)	229.75 (63.57)	205.44 (62.23)	189.76 (47.82)	< 0.0001***
Time on paper (s)	402.10 (125.85)	307.56 (115.87)	239.69 (90.37)	182.68 (48.48)	145.77 (33.56)	135.15 (27.98)	< 0.0001***
Air/Paper ratio	1.67 (0.54)	1.55 (0.49)	1.44 (0.40)	1.30 (0.34)	1.40 (0.32)	1.42 (0.33)	< 0.0001***
Pen pressure	1578.27 (248.50)	1586.89 (263.05)	1595.09 (258.00)	1600.66 (246.75)	1512.66 (264.15)	1446.47 (298.81)	< 0.0001***
Pen pressure SD	501.53 (68.66)	486.21 (67.61)	477.35 (65.59)	475.20 (62.76)	478.12 (50.05)	460.90 (50.20)	< 0.0001***
Time per char SD	6.57 (2.66)	4.54 (2.29)	3.13 (1.25)	2.07 (0.68)	1.75 (0.63)	1.47 (0.47)	< 0.0001***
Result of writing							
Boundary exceeding	28.93 (20.22)	21.18 (18.30)	20.43 (18.93)	18.53 (17.04)	8.63 (9.75)	6.69 (9.83)	< 0.0001***
Extra strokes	12.86 (7.03)	11.55 (6.92)	9.31 (6.24)	7.17 (5.32)	5.39 (4.11)	3.78 (2.88)	< 0.0001***
Connected strokes	4.06 (2.97)	4.92 (3.85)	5.92 (4.74)	6.79 (5.57)	6.59 (5.95)	6.33 (4.71)	< 0.0001***
Missing strokes	2.49 (2.39)	2.72 (2.44)	2.92 (2.93)	3.60 (2.87)	3.40 (3.08)	3.73 (2.94)	0.0012**
Reversed strokes	0.61 (0.89)	0.75 (0.99)	0.55 (0.83)	0.66 (2.03)	0.33 (0.62)	0.44 (0.72)	0.0026**
Stroke errors	10.84 (7.26)	10.09 (6.69)	8.08 (5.23)	7.98 (6.38)	6.27 (4.86)	5.71 (3.86)	< 0.0001***
Stroke order errors	4.79 (2.36)	5.17 (2.47)	4.73 (2.33)	4.81 (1.94)	4.48 (2.48)	4.87 (2.78)	0.43
Total errors	36.64 (14.35)	36.25 (14.24)	32.15 (13.18)	31.32 (15.46)	27.00 (12.96)	25.52 (10.26)	< 0.0001***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Total errors include stroke errors, extra/missing/connected/reversed strokes, and stroke order errors.

4.2. Comparison between typically developing and SEN students

Significant differences varied by grade (**Table 3**). Grade 1 showed differences in 7 measures; Grade 2 in pen pressure SD and boundary exceeding; Grades 3–4 in accuracy; Grade 5 in 3 measures; Grade 6 in 5 measures.

Table 3. Group differences (*p*-values) between typically developing and SEN students by grade

TD/SEN	G1	G2	G3	G4	G5	G6
Chinese writing process Average writing speed	0.78	0.59	0.76	0.69	0.60	0.011*
Average writing speed	0.43	0.61	0.64	0.47	0.82	0.0033**
Average time in the air	0.018*	0.53	0.93	0.73	0.97	0.09
Average time on paper	0.56	0.77	0.43	0.15	0.79	0.06
Average ratio of time in the air to time on paper	0.02*	0.18	0.65	0.10	0.51	0.80
Average pressure of writing	0.98	0.31	0.06	0.46	0.20	0.18

Average standard deviation of pressure of writing	0.26	< 0.0001***	0.89	0.27	0.84	0.39
Average standard deviation of time per character	0.33	0.23	0.58	0.07	0.87	0.96
Chinese writing result Average deviation of going off the line	0.0024**	0.0001***	< 0.0001***	0.0017**	0.14	0.0021**
Average number of additional strokes	0.55	0.31	0.56	0.74	0.20	0.27
Average number of connected strokes	0.0051**	0.011*	0.06	0.0176*	0.039*	0.84
Average number of omitted strokes	0.0014**	0.08	0.025*	0.010*	0.0086**	0.06
Average number of reversed strokes	0.92	0.45	0.73	0.48	0.09	0.38
Average number of stroke errors	0.036*	0.26	0.0005***	0.022*	0.52	0.026*
Average number of stroke sequence errors	0.99	0.79	0.66	0.15	0.60	0.56
Average number of writing errors	0.044*	0.11	0.0099**	0.033*	0.044*	0.028*

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

4.3. At-risk (critical) students

Students whose handwriting performance indicators fell between +1 to +2 SD or −1 to −2 SD were defined as at-risk (critical) handwriting difficulty students. These students are usually difficult to identify in daily school life; their handwriting is often characterized by slow speed and high error rates. The SHARP system can effectively identify such students.

Data from the 789 primary school students in this study (shown in **Table 4**) revealed that approximately 9–14% of students performed at the critical level across SHARP indicators. Among them, the number of at-risk students was relatively high in writing speed (105 students, 13%), pen pressure SD (108 students, 14%), and total errors (110 students, 14%). In contrast, fewer students were at risk in time on paper (78 students, 10%) and time per character SD (70 students, 9%). The percentage distribution by grade is shown in **Figure 5**.

Table 4. Distribution of at-risk typically developing students (Grades 1–6)

Measure	G1	G2	G3	G4	G5	G6	Total	%
Sample size	200	130	193	90	86	90	789	—
Writing process								
Speed (−1 to −2 SD)	26	14	30	14	12	9	105	13%
Total time (+1 to +2 SD)	22	14	21	10	10	7	84	11%
Time in air (+1 to +2 SD)	22	17	17	12	6	8	82	10%
Time on paper (+1 to +2 SD)	20	10	17	11	12	8	78	10%
Pen pressure SD (+1 to +2 SD)	26	16	25	15	12	9	108	14%
Time per char SD (+1 to +2 SD)	21	11	14	12	9	3	70	9%
Writing product								
Boundary exceeding (+1 to +2 SD)	36	15	25	12	10	3	101	13%
Total errors (+1 to +2 SD)	30	16	27	15	8	14	110	14%

Note: Total errors include stroke errors, extra strokes, missing strokes, connected strokes, reversed strokes, and stroke order errors.

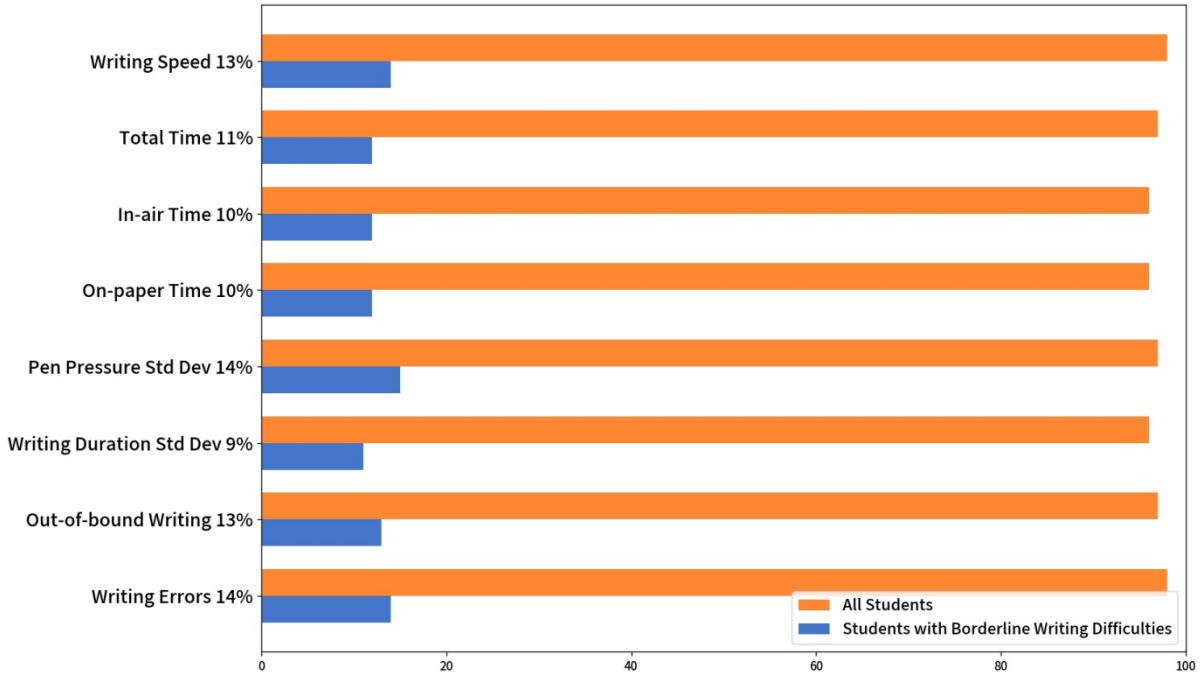


Figure 5. Percentage of at-risk typically developing students (Grades 1–6) in Chinese handwriting performance.

4.4. Parent-completed HAC vs. SHARP indicators

To evaluate parents' understanding of their children's Chinese handwriting performance, this study analyzed the Handwriting Ability Checklist (HAC) completed by parents of Grades 1–6 students from 5 schools and 1 education center. The screening criterion was: questionnaires with 3 or more unanswered items out of 10 were excluded.

Following the criterion of Tam (2008), a total score of 30 was used as the cutoff to screen for handwriting difficulties [11]. Students scoring ≥ 30 were identified as needing close attention from parents, teachers, and occupational therapists. Since no Grade 6 students scored ≥ 30, this grade was excluded from subsequent comparative analysis.

Finally, typically developing students in Grades 1–5 was divided into two groups:

(1) HAC < 30 (no special attention needed)

(2) HAC ≥ 30 (needs special attention)

The demographic distribution and valid response rates are shown in **Table 5**.

Table 5. Demographics of students with HAC < 30 vs. HAC ≥ 30

Group	G1	G2	G3	G4	G5	G6
At-risk (HAC ≥ 30)	19	12	21	8	7	0
Not at-risk (HAC < 30)	176	117	168	79	78	89
Total	195	129	189	87	85	89
Response rate (%)	98	99	97	96	98	99

Analysis in **Table 6** shows significant differences in some handwriting indicators between the two HAC groups:

Grade 2: significant difference in boundary exceeding ($p < 0.01$)

Grade 3: significant difference in time per character SD ($p < 0.05$)

Grade 4: significant differences in speed, total time, time per character SD, and total errors

Grade 5: significant difference only in total errors ($p < 0.001$)

Table 6. Differences in Chinese handwriting performance: HAC < 30 vs. HAC ≥ 30

SHARP measure	Group	G1 p	G2 p	G3 p	G4 p	G5 p
Speed	HAC < 30 / ≥ 30	0.57	0.76	0.23	0.046*	0.16
Total time	HAC < 30 / ≥ 30	0.78	0.43	0.27	0.03*	0.15
Time per char SD	HAC < 30 / ≥ 30	0.53	0.67	0.014*	0.003**	0.34
Boundary exceeding	HAC < 30 / ≥ 30	0.66	0.008**	0.40	0.77	0.82
Total errors	HAC < 30 / ≥ 30	0.15	0.077	0.22	< 0.0001***	< 0.0001***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Note: Total errors include stroke errors, extra strokes, missing strokes, connected strokes, reversed strokes, and stroke order errors.

4.5. Teacher-annotated handwriting problems vs. SHARP indicators

This section included typically developing students in Grades 1–6 from 5 schools. Students identified by teachers as having handwriting difficulties were compared with those not identified. To ensure objectivity, classes without teacher annotations were excluded. The numbers of annotated and non-annotated students by grade are shown in **Table 7**.

Table 7. Demographics of students with/without teacher-annotated handwriting problems

Group	G1	G2	G3	G4	G5	G6
Teacher-annotated	34	19	9	12	14	8
Not annotated	106	83	74	62	72	78
Response rate (%)	70	78	43	82	100	96

As shown in **Table 8**, total errors differed significantly between annotated and non-annotated students from Grade 1 ($p < 0.001$) to Grade 4 ($p < 0.05$).

Speed and boundary exceeding also differed significantly in Grades 2, 3, and 4.

Table 8. Differences in Chinese handwriting performance: annotated vs. non-annotated

SHARP measure	Group	G1 p	G2 p	G3 p	G4 p	G5 p	G6 p
Speed	Annotated / Not	0.65	0.18	0.0016**	0.29	0.35	0.85
Total time	Annotated / Not	0.58	0.19	0.096	0.28	0.45	0.82
Time per char SD	Annotated / Not	0.15	0.05	0.20	0.086	0.36	0.99
Boundary exceeding	Annotated / Not	0.29	0.0005***	0.12	0.013*	0.20	0.99
Total errors	Annotated / Not	0.0015**	0.0074**	0.008**	0.049*	0.12	0.20

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Note: Total errors include stroke errors, extra strokes, missing strokes, connected strokes, reversed strokes, and stroke order errors.

5. Discussion

5.1. Statistical norms for Macao mainstream and SEN students

The Hong Kong norm study reported an effect size of 0.2277. The present study covered 6 grades (Grades 1–6) with 16 indicators per grade [13]. To achieve 99% power and 5% Type I error, a priori GPower analysis required a total sample of 734 students. The 789 mainstream students collected in 2019 and 2021 exceeded this requirement, confirming the sample was statistically sufficient to establish local Chinese handwriting norms.

Consistent with Hong Kong students, Macao students showed increased writing speed and decreased total time and errors with grade level [13].

ANOVA showed no significant improvement in stroke order errors across grades, indicating persistent stroke order problems. Since stroke order supports character learning transfer and efficiency, the SHARP system's ability to detect this issue warrants further research and intervention.

In discriminant validity analyses, the 79 SEN students showed significant differences from mainstream students in speed, total time, time in air, boundary exceeding, connected strokes, missing strokes, stroke errors, and total errors across grades. Grade 1 SEN students showed more deficits than higher grades. No single indicator was consistently significant across all grades, reflecting the heterogeneous difficulties of SEN students. Overall, SEN students' weaknesses were concentrated in product outcomes such as stroke and boundary errors.

5.2. The role of occupational therapists for handwriting difficulties (including at-risk students)

Mainstream and SEN students differed significantly in boundary exceeding, connected strokes, missing strokes, stroke errors, and total errors. SEN students showed particular deficits in boundary control and stroke formation. Although SEN students improved with age, they still did not reach same-age standards [16]. SHARP measures help identify underlying factors affecting their handwriting.

SEN students' poor performance in strokes and boundaries likely reflects visual-perceptual and upper-limb coordination deficits, which can be further evaluated by occupational therapists through hand function, visual perception, and oculomotor assessments.

Among the 789 mainstream students, an average of 92 students (12%) were at-risk, consistent with previous literature (6–37%) [17,18] . These students are often overlooked and mislabeled as inattentive. Early identification and group training can effectively improve their handwriting.

Occupational therapists can provide interventions not only for students below average but also for at-risk students. Evidence shows appropriate school-based interventions improve handwriting [19,20]. Thus, occupational therapists play a key role in early screening, identification, and intervention for both below-average and at-risk students.

5.3. HAC and parental concerns about handwriting

The HAC was used to examine whether parental ratings matched objective SHARP measures. Students were split into "parental concern" and "no concern" groups and compared on speed, total time, SD, boundary exceeding, and errors.

For Grades 4–5, significant differences appeared in speed, total time, time per character SD, and total errors, indicating parents of older students judged handwriting objectively. This aligns with developmental

trends: speed increases in lower grades but stabilizes in Grades 4–6 [14]. Interventions for older students may include task and assessment accommodations [21].

For younger grades, only boundary exceeding (Grade 2) and time per character SD (Grade 3) differed significantly. This gap likely reflects limited parental knowledge of early handwriting development or overly high expectations, leading to subjective ratings. Combining HAC with SHARP provides a more comprehensive profile. Occupational therapy evaluation can support individualized intervention plans to improve skills and confidence.

5.4. Teachers play an important role in identifying at-risk students

About 30 homeroom or Chinese teachers annotated students with handwriting difficulties. Significantly higher total errors were found in annotated students in Grades 1–4, showing teachers accurately identified accuracy deficits in early grades.

Beyond classroom observation, SHARP provides objective data on time in air, time on paper, and pen pressure to help teachers identify difficulties earlier. Teachers can then provide in-class support or refer to occupational therapists for further assessment and intervention.

5.5. Limitations and future recommendations

The sample size of the SEN group was unbalanced relative to mainstream students. According to DSEDJ (2025), among 37,245 students aged 6–11 in 2024/2025, only 382 (around 1%) were SEN. SEN students in Grades 5–6 was fewer than in Grades 1–4 [1]. Future studies should recruit more SEN students to strengthen comparisons.

The COVID-19 pandemic severely disrupted education from December 2019 [22,23]. Remote and hybrid learning were widely adopted. In Macao, face-to-face classes were suspended for nearly four months in 2020. Chinese handwriting relies heavily on in-person guidance; remote learning likely reduced performance. Thus, the 2019–2021 combined averages should be interpreted cautiously, as pandemic-related school closures may have lowered 2021 scores.

5.6. Clinical applications

Combining the parent/teacher HAC with SHARP results:

If key indicators (speed, total errors) exceed ± 2 SD, individualized intervention and comprehensive assessment are recommended to identify core causes.

If indicators fall between ± 1 and ± 2 SD, group intervention is suggested to address underlying issues and provide ongoing monitoring.

6. Conclusion

The cloud-based Smart Handwriting Analysis and Recognition Platform (SHARP) assesses Chinese handwriting difficulties and enables early identification. By collecting data from mainstream and SEN students in Grades 1–6, local norms for Macao primary school students have been established. These norms allow teachers and occupational therapists to quickly screen for handwriting difficulties, identify underlying causes, and deliver early intervention.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Education and Youth Development Bureau, 2025, Non-tertiary Education Student Number Survey Results for the 2024/2025 School Year. Government of Macau Special Administrative Region.

[2] Feder K, Majnemer A, 2007, Handwriting Development, Competency, and Intervention. Developmental Medicine & Child Neurology, 49(4): 312–317.

[3] Tseng M, Chow S, 2000, Perceptual-Motor Function of School-age Children With Slow Handwriting Speed. The American Journal of Occupational Therapy, 54(1): 83–88.

[4] Ratzon N, Efraim D, Bart O, 2007, A Short-term Graphomotor Program for Improving Writing Readiness Skills of First-grade Students. The American Journal of Occupational Therapy, 61(4): 399–405.

[5] Rosenblum S, Weiss P, Parush S, 2003, Product and Process Evaluation of Handwriting Difficulties. Educational Psychology Review, 15: 41–81.

[6] Tan L, Feng C, Fox P, et al., 2001, An fMRI Study with Written Chinese. Neuroreport, 12(1): 83–88.

[7] Chow S M, Choy S W, Mui S K, 2003, Assessing Handwriting Speed of Children Biliterate in English and Chinese. Perceptual and Motor Skills, 96(2): 685–694.

[8] Racine M, Majnemer A, Shevell M, et al., 2008, Handwriting Performance in Children with Attention Deficit Hyperactivity Disorder (ADHD). Journal of Child Neurology, 23(4): 399–406.

[9] Fuentes C, Mostofsky S, Bastian A, 2009, Children with Autism Show Specific Handwriting Impairments. Neurology, 73(19): 1532–1537.

[10] Chang S H, Yu N Y, 2010, Characterization of Motor Control in Handwriting Difficulties in Children with or without Developmental Coordination Disorder. Developmental Medicine & Child Neurology, 52(3): 244–250.

[11] Tam H, 2008, A Validation Study on Handwriting Ability Checklist (HAC), thesis, The Hong Kong Polytechnic University.

[12] Maldarelli J, Kahrs B, Hunt S, et al., 2015, Development of Early Handwriting: Visual-Motor Control During Letter Copying. Developmental Psychology, 51(7): 879.

[13] Li-Tsang C, Wong A, Leung H, et al., 2013, Validation of the Chinese Handwriting Analysis System (CHAS) for Primary School Students in Hong Kong. Research in Developmental Disabilities, 34(9): 2872–2883.

[14] Li M, Leung H, Li T, et al., 2019, Measuring the Tilt and Slant of Chinese Handwriting in Primary School Students: A Computerized Approach. PLoS One, 14(11): e0223485.

[15] Li-Tsang C, Li T, Yang C, et al., 2022, Evaluating Chinese Handwriting Performance of Primary School Students Using the Smart Handwriting Analysis and Recognition Platform (SHARP). MedRxiv, 2022-02.

[16] Lam S, Au R, Leung H, et al., 2011, Chinese Handwriting Performance of Primary School Children with Dyslexia. Research in Developmental Disabilities, 32(5): 1745–1756.

[17] Hamstra-Bletz L, Blöte A, 1993, A Longitudinal Study on Dysgraphic Handwriting in Primary School. Journal of Learning Disabilities, 26(10): 689–699.

[18] Overvelde A, Hulstijn W, 2011, Handwriting Development in Grade 2 and Grade 3 Primary School Children with Normal, At Risk, or Dysgraphic Characteristics. Research in Developmental Disabilities, 32(2): 540–548.

[19] Poon K, Li-Tsang C, Weiss T, et al., 2010, The Effect of a Computerized Visual Perception and Visual-Motor Integration Training Program on Improving Chinese Handwriting of Children with Handwriting Difficulties.

Research in Developmental Disabilities, 31(6): 1552–1560.

[20] Weintraub N, Yinon M, Hirsch I, et al., 2009, Effectiveness of Sensorimotor and Task-Oriented Handwriting Intervention in Elementary School-aged Students with Handwriting Difficulties. OTJR: Occupation, Participation and Health, 29(3): 125–134.

[21] Lang S, Kumke P, Ray C, et al., 2005, Consequences of Using Testing Accommodations: Student, Teacher, and Parent Perceptions of and Reactions to Testing Accommodations. Assessment for Effective Intervention, 31(1): 49–62.

[22] Di Pietro G, Biagi F, Costa P, et al., 2020, The Likely Impact of COVID-19 on Education: Reflections Based on the Existing Literature and Recent International Datasets. Luxembourg: Publications Office of the European Union.

[23] Organization for Economic Co-operation and Development, 2020, Education and COVID-19: Focusing on the Long-term Impact of School Closures. OECD Publishing.

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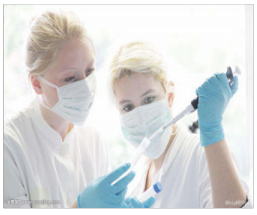


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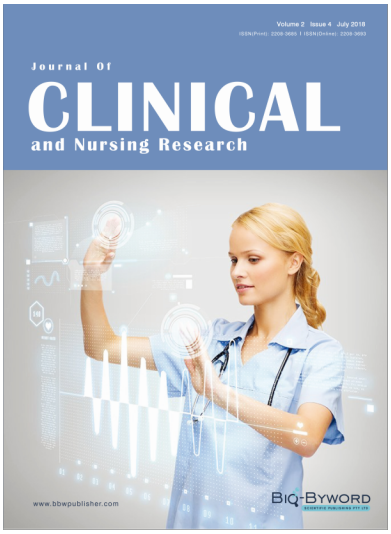
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