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Analysis of Factors Influencing Post-Traumatic Stress Disorder in Patients with Failed Assisted Reproductive Technology (ART) Pregnancy Outcomes and Development of a Predictive Model

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Abstract: *Objective:* To investigate the prevalence of posttraumatic stress disorder (PTSD) among patients who experienced pregnancy failure following assisted reproductive technology (ART) treatment, analyze the factors influencing PTSD, and develop a risk prediction model. *Methods:* A cross-sectional study was conducted, recruiting 243 patients who experienced pregnancy failure after ART treatment at a tertiary-level specialized reproductive hospital. Data were collected using general demographic information, clinical records, the Infertile Women's Motivation for Childbearing Scale, the Brief Infertility Stress Scale, the Perceived Social Support Scale, and the posttraumatic stress disorder (PTSD) scale (Civilians Version). Patients were classified into PTSD and non-PTSD groups based on PTSD scale scores. Univariate analysis (Mann-Whitney U test and chi-square tests) was used to screen variables, and a multivariate binary logistic regression model was constructed to predict PTSD. The ROC curve was used to evaluate the model's discriminatory ability. *Results:* Among 243 patients with failed ART pregnancies, 40 developed PTSD, the positive screening rate for PTSD was 16.46%. Univariate analysis revealed statistically significant differences in PTSD incidence based on household income, number of failed ART pregnancies, presence of children, fertility stress, fertility motivation and social support ($P < 0.05$). Logistic regression analysis indicated that having no children, two failed ART pregnancies, and fertility stress were risk factors for PTSD in patients with failed ART pregnancies, while social support was a protective factor. The area under the receiver operating characteristic (ROC) curve (AUC) of the constructed risk prediction model was 0.869 (95% CI [0.813, 0.924]), indicating good predictive performance, with a sensitivity of 85.0%, a specificity of 74.4%, and a cutoff value of 0.138. *Conclusion:* Having no children, two failed ART pregnancies, and fertility stress are risk factors for PTSD in patients with failed ART pregnancies. The predictive model established based on these identified risk factors can be used to assess the risk of PTSD in patients with failed ART pregnancies.

Keywords: Patients with failed pregnancies after assisted reproductive treatment; Post-Traumatic Stress Disorder; Risk factors; Predictive models

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1. Introduction

The incidence of female infertility in China has been rising year by year and currently stands at 12.5% [1]. In 2021, China fully implemented its three-child policy. We are facing more issues related to an aging population; the number of infertility patients has continued to grow, presenting China with even more severe fertility challenges. Assisted Reproductive Technology (ART), having formed a complete clinical diagnosis and treatment system after long-term practice, effectively helps numerous infertile couples overcome the difficulty of conceiving naturally [2]. ART treatment isn't cheap, and it takes a serious toll on patients' time. What makes it even harder is the constant risk of failure. Put these together, and you get an immense amount of pressure and trauma—so much so that many patients see it as one of the most threatening things they've ever faced [3]. People with Post-traumatic stress disorder (PTSD) don't just remember a traumatic event—they relive it. Again and again. They'll do whatever it takes to avoid being reminded of what happened. And deep down, they're always waiting for the next bad thing to happen [4]. Alarmingly, some patients even choose to discontinue treatment. Several earlier studies have identified risk factors for PTSD in patients undergoing ART [5-6], there has been little research on PTSD specifically among patients who have experienced pregnancy failure following ART. This study set out to answer one question: what puts ART patients who experience pregnancy failure at risk for PTSD, and what protects them from it? Our goal is to give clinicians a better basis for spotting those risks and providing psychological support.

2. Materials and methods

2.1. Subject of the study

We recruited 243 patients for this study. All of them had undergone ART treatment at a tertiary reproductive hospital in Shandong Province—and all had experienced pregnancy failure. The study period ran from June 2025 to May 2026. We included patients who fit one of two scenarios. First, they had gone through ART but ended up with no embryos to transfer after egg retrieval. Second, they had a transfer that just didn't take—meaning the pregnancy failed. We also only included patients who could communicate normally, understood the study's purpose, and voluntarily agreed to participate. Exclusion criteria: (1) Recent experience of major traumatic events other than ART failure; (2) Patients who showed low cooperation during the communication process regarding this survey. A PTSD score of ≥ 38 was used as the positive criterion, and patients were divided into a PTSD group and a non-PTSD group. This study was approved by the Ethics Committee of the Reproductive Hospital Affiliated to Shandong University.

2.2. Survey tools

2.2.1. General information questionnaire

A questionnaire was designed based on a review of the literature and the specific characteristics of ART treatment. General information includes age, number of children, place of residence, educational background, occupation, household income, and type of health insurance. We also recorded their medical history—things like previous miscarriages, why they were infertile in the first place, what kind of ART they'd tried, and how many times it had failed.

2.2.2. Post-traumatic Stress Disorder Scale—Civilian Version

We used the Posttraumatic Stress Disorder Scale—Civilian Version. It was developed by the U.S. PTSD

Research Center [7]. Scores go from 17 to 85. If a patient scored 38 or higher, we counted that as a positive PTSD diagnosis. The scale looks at three things: re-experiencing, avoidance/numbing, and hyperarousal. Patients rated each item on a 5-point Likert scale—1 meant "none," 5 meant "extremely severe." We checked the internal consistency, too. Cronbach's alpha was 0.959.

2.2.3. Fertility motivation scale for women with infertility

We used a questionnaire developed by Fang Yuying [8] specifically for women with infertility. It has 16 items and looks at two things: control-oriented reproductive motivation and autonomy-oriented reproductive motivation. We used a 5-point Likert scale. Patients rated each item from 1 (strongly disagree) to 5 (strongly agree). The higher the score, the stronger the fertility motivation; the internal consistency was good—Cronbach's alpha came out at 0.856.

2.2.4. Simplified infertility-related stress scale

The scale was originally developed by Portuguese scholar Sobral and colleagues [9]. Later, in 2022, Hu Shuang adapted it into Chinese [10]. We used this Chinese version in our study. This scale measures fertility-related stress in infertility patients. It has nine items that fall into three categories: personal, marital, and social. We used different scoring for different items. Items 1 and 2 used a 5-point Likert scale. Items 3 through 9 used a 4-point scale. The higher the score, the more fertility-related stress the patient was under. The scale was highly reliable—Cronbach's alpha came out at 0.901.

2.2.5. Perceived social support scale

We used the social support scale developed by Zimet et al. [11], later revised by Chinese scholar Jiang Qianjin. It's a widely used tool for measuring how much support people feel they have. We used a 12-item scale. It looks at three kinds of support: from family, from friends, and from others. Patients rated each item on a 7-point scale, from "strongly disagree" to "strongly agree"—that gave us scores of 1 to 7. The higher the score, the more social support patients felt they had. And the scale was highly reliable—Cronbach's alpha came out at 0.955.

2.3. Data collection

We asked a staff member to administer the questionnaire during patients' waiting time, when they weren't rushed. This gave them enough time to answer carefully and helped us maintain survey quality. We explained the questionnaire's purpose to each patient and obtained their verbal consent. Patients were also encouraged to ask questions on the spot, and we addressed them immediately. We handed out 261 questionnaires. Of those, 243 came back valid. That gave us a response rate of 93.1%.

2.4. Statistical methods

All statistical analyses were performed with SPSS 25.0. The quantitative data with a non-normal distribution are described by the median and quartiles [M(Q1, Q3)]. For univariate analysis, we employed the chi-square test and the Mann-Whitney U test. To figure out what factors influenced PTSD in these patients, we ran a multivariate logistic regression. We set the bar at $p < 0.05$ for statistical significance.

3. Results

3.1. General information

All 243 study participants were women who experienced pregnancy failure following assisted reproductive technology (ART). Most lived in urban areas (72.43%), held paid-work positions (58.85%), and had no living children (70.78%). Nearly two-thirds reported their household income matched their expenditure (67.90%). Baseline features for this cohort are provided in **Table 1**.

3.2. Status of positive PTSD screening among women after failed ART pregnancy

Among Patients Who Failed ART Treatment: Among 243 patients who failed ART treatment, 40 developed PTSD. The positive screening rate for PTSD was 16.46%.

2.3. Univariate analysis for factors related to positive PTSD screening among women with failed ART pregnancies (details shown in **Table 1**).

Table 1. Univariate analysis of factors associated with PTSD after ART failure

Variable	Category	Non-PTSD (n=203)%	PTS(n=40)%	χ^2/ Z	*P* value
Age	≤35 years old	110(54.19)	18(45.00)	1.131	0.287
	> 35 years old	93(45.81)	22(55.00)		
Having children	None	137(67.49)	35(87.50)	6.471	0.011
	Yes	66(32.51)	5(12.50)		
Place of residence	City	148(72.91)	28(70.00)	0.141	0.707
	Rural	55(27.09)	12(30.00)		
Education	≤ Junior high school	35(17.24)	11(27.50)	4.355	0.113
	High school or equivalent	38(18.72)	3(7.50)		
	≥Associate's degree	130(64.04)	26(65.00)		
Occupation	Unemployed	83(40.89)	17(42.50)	0.036	0.850
	Employed	120(59.11)	23(57.50)		
Household income	Living beyond means	24(11.82)	13(32.50)	11.486	0.003
	Living within means	142(69.95)	23(57.50)		
	Living with surplus	37(18.23)	4(10.00)		
Health insurance type	self-paid	33(16.26)	6(15.00)	0.889	0.641
	Urban employee insurance	122(60.10)	27(67.50)		
	Rural cooperative medical scheme	48(23.65)	7(17.50)		
History of miscarriage	None	88(43.35)	15(37.50)	2.274	0.321
	1	67(33.00)	11(27.50)		
	≥2	48(23.65)	14(35.00)		
Cause of infertility	Male factor	49(24.14)	5(12.50)	2.893	0.408
	Female factor	72(35.47)	18(45.00)		
	Combined	34(16.75)	7(17.50)		
	Unexplained	48(23.65)	10(25.00)		
Assisted reproductive method	IVF	76(37.44)	18(45.00)	2.025	0.567
	ICSI	38(18.72)	4(10.00)		
	PGT	52(25.62)	10(25.00)		

	Other	37(18.23)	8(20.00)		
Number of ART failures	1	78(38.42)	5(12.50)	10.008	0.007
	2	48(23.65)	13(32.50)		
	≥3	77(37.93)	22(55.00)		
Social support		60.00 (52.00，71.50)	50.00 (44.50，55.00)	-4.468	<0.001
Fertility stress		19.00 (15.00,24.00)	28.50 (24.00, 30.50)	-6.837	<0.001
Fertility motivation		56.00 (50.00，62.00)	60.00 (54.00，65.00)	-2.233	0.026

3.4. Logistic regression analysis of factors influencing the development of PTSD in patients with failed ART pregnancies

Variables with $P < 0.05$ in the univariate analysis were included in the logistic regression analysis. The results showed that having no children, two failed ART pregnancies, Fertility stress were risk factors for PTSD in patients, while social support was a protective factor (see **Table 2** for details).

Table 2. Logistic regression analysis of factors influencing PTSD in patients with failed assisted reproductive technology (ART) pregnancy

Variable	Category	β	SE	Wald χ^2	*P*value	OR	95%CI
Household income	(ref: Living within means)						
	Living beyond means	0.170	0.534	0.101	0.751	1.185	[0.416,3.375]
	Living with surplus	-0.291	0.651	0.200	0.655	0.748	[0.209,2.676]
Number of ART failures	(ref. 1)						
	2	1.625	0.657	6.112	0.013	5.078	[1.400,18.416]
	≥3	1.104	0.610	3.275	0.070	3.017	[0.912,9.979]
Having children	ref: Yes						
	No	1.235	0.612	4.064	0.044	3.437	[1.035,11.414]
Fertility stress		0.188	0.040	22.163	<0.001	1.206	[1.116,1.304]
Social support		-0.042	0.016	7.040	0.008	0.959	[0.930,0.989]
Fertility motivation		-0.019	0.026	0.577	0.447	0.981	[0.933,1.031]

3.4. Analysis of the predictive model for PTSD in patients with failed ART pregnancies

The AUC was 0.869 (95% CI: 0.813–0.924), with a sensitivity of 85.0%, a specificity of 74.4%, and a cutoff value of 0.138. This model demonstrates good predictive performance and is suitable for screening and risk assessment of PTSD. See **Figure 1**.

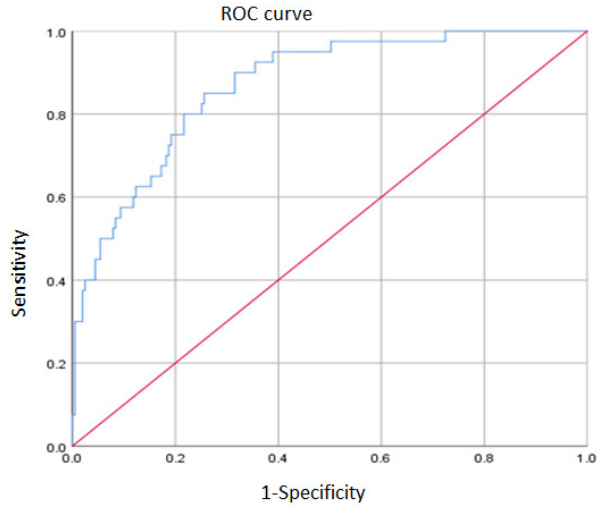


Figure 1. ROC curve for the predictive model of PTSD in patients with failed ART pregnancies.

4. Discussion

4.1. Analysis of the current status of PTSD among patients with failed ART

The results of this study show that the PTSD score for patients with failed ART was (28.15 ± 12.44), with a positive prevalence rate of 16.46%. Our findings line up with what Bai Lu [6] found in infertility patients. In their study—and in ours—PTSD rates were high, both during ART treatment and after treatment failure. ART treatment isn't cheap, and it takes up a lot of time. On top of that, there's always a real chance that it won't work. Patients put a lot of money into ART. Then it fails. That's a huge psychological hit. And here's the kicker—they often have to go right back into treatment again, just one or two months later. And here's the thing—when patients are in a bad mental state, it doesn't just stop there. It can actually hurt their chances of getting pregnant [12]. If clinical staff can identify patients at high risk for PTSD early on and provide them with psychological intervention, this will offer significant support for their subsequent treatment.

4.2. Analysis of factors affecting PTSD in patients who have experienced pregnancy failure following ART

4.2.1. The number of failed ART cycles

The number of failed ART cycles made a significant difference. Patients who had two failed cycles were much more likely to develop PTSD than those who had just one [OR = 5.078, 95% CI (1.400, 18.416)]. This outcome crushes the patient's belief that "the next time will be the one." They're left with shame, a feeling that nothing is under their control, and a profound sense of loss. All of that, we believe, further fuels the risk of PTSD. At three or more failures, something shifts. Instead of holding on to hope, some patients start protecting themselves—they pull back emotionally, brace for the worst, and expect nothing. In a way, they've learned to "adapt" to failing. Failed treatments hit patients hard emotionally [13]. And for those who've already failed twice? That's when we think they need extra support. Clinicians should really pay attention to their mental health.

4.2.2. Presence or absence of children

We found that being childless increased the risk of treatment failure [OR = 3.437, 95% CI (1.035, 11.414)]. One thing that feeds into this intolerable uncertainty is whether an ART patient already has children [14]. Unlike patients who already have a child, those without children haven't fulfilled what traditional views see as their "procreative mission." Lacking the buffer of a stable family, they face ART failure with more self-doubt and a deeper sense of loss. This combination, we argue, puts them at higher risk for PTSD. In clinical practice, this means focusing more on childless patients. We recommend assessing their reproductive stress and offering psychological support sooner rather than later.

4.2.3. Fertility stress

Fertility-related stress is what patients feel when they're trying hard to have a child but running into obstacles. It comes from pressure—society, family, marriage, even their own expectations. And here's the key: this kind of stress is bad for their quality of life [15]. We found that fertility-related stress was a key factor. Patients who reported more stress were at greater risk for PTSD following treatment failure [OR = 1.206, 95% CI (1.116, 1.304)]. Wang Qing [5] found something similar. And it's well known that PTSD is closely tied to stressful events [16]. For ART patients who don't succeed, the letdown is real—on top of all the personal, family, and social pressure they already carry. When that kind of fertility-related stress drags on and then gets hit with a traumatic failure, PTSD can follow [17]. So here's what we take away from this: don't wait. Start helping patients manage stress early on—teach them what works, or bring in a counselor. It makes a real difference for their mental health [18].

4.2.4. Social support

Social support refers to the information, comfort, and sense of security people draw from others when facing stress. Research has shown that it serves as a key protective factor against stressful events [19-20]. Our findings show that social support is protective. Patients with higher levels of support were less likely to develop PTSD after treatment failure [OR = 0.959, 95% CI (0.930, 0.989)]. We believe this is because support provides patients with more resources and helps them feel less vulnerable, both of which lower the odds of developing PTSD. In the future, we should focus on patients with limited social support. This means proactively identifying their psychological needs, providing clear medical information, and offering genuine emotional support. These steps could help reduce the incidence of PTSD. In summary, PTSD in women who have experienced pregnancy failure following ART is influenced by multiple factors. The risk prediction model developed in this study can effectively assist clinical staff in assessing PTSD risk and providing early intervention and guidance to patients at high risk. This was a single-center, cross-sectional study. That means we can't say for sure how things play out over time, and our findings need to be tested in other settings. So that's exactly what we plan to do next—follow more patients over time and validate our model in other centers.

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Disclosure statement

The authors declare no conflict of interest.

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