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Potential Profile Analysis and Influencing Factors of Reproductive Quality of Life for Patients Treated with Assisted Reproductive Technology

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Abstract:

Objective: To identify latent profiles of fertility quality of life (FertiQoL) in patients undergoing assisted reproductive technology (ART) and examine factors associated with different profiles, so as to inform individualized clinical interventions.

Methods: A convenience sample of 323 infertile patients receiving ART at the reproductive medicine department of a tertiary hospital in Jining, Shandong Province, was surveyed from December 2023 to November 2024. Data were collected using a general information questionnaire, the FertiQoL Scale, the Fertility Problem Inventory (FPI), and the Positive Psychological Capital Questionnaire (PPQ). Latent profile analysis was conducted in Mplus 8.3 with the six FertiQoL dimensions as manifest variables, and multivariate logistic regression was used to identify profile-related factors.

Results: The mean FertiQoL score was 71.71 ± 12.52. Three latent profiles were identified: physical and psychological distress group (n=43, 13.3%), moderate FertiQoL group (n=145, 44.9%), and high FertiQoL group (n=135, 41.8%). Social and sexual concerns, along with poor sleep quality, were risk factors for lower FertiQoL, whereas resilience and optimism were protective factors (all $P<0.05$). Compared with the high FertiQoL group, patients without biological children (OR=4.790) were more likely to be in the physical and psychological distress group, and urban residents (OR=2.398) were more likely to be in the moderate FertiQoL group (all $P<0.05$).

Conclusion: FertiQoL in ART patients was moderate overall and showed clear heterogeneity. Higher fertility-related stress, lower psychological capital, and poor sleep were associated with worse profiles. Clinical interventions should target high-risk groups and focus on stress management, psychological capital enhancement, and sleep improvement to improve FertiQoL.

Keywords: Assisted reproductive technology; Quality of life during reproduction; Potential profile analysis; Reproductive stress; Psychological capital; Sleep disorders

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Introduction

With the development of the social economy, the postponement of childbearing age and the influence of environmental factors [1, 2], the global incidence of infertility has continued to rise, becoming one of the key factors restricting fertility levels. The incidence of infertility in China has increased from 3% in the 1980s to 18% in 2020 [3]. Assisted Reproductive Technology (ART) is a key medical means to solve infertility and brings hope to patients. However, the treatment process is long and painful, and the results are uncertain [1, 4], which puts patients under great physiological and psychological pressure for a long time [5], seriously affecting their reproductive quality of life [4, 6–8]. Improving patients' reproductive quality of life is as important as disease

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treatment [4, 9]. Existing research shows that the reproductive quality of infertile patients may be affected by a variety of factors such as age, education level, income, work status, and years of infertility [10, 11]. A positive psychological state and high-quality social support, especially the support between couples, are protective factors for patients' reproductive quality of life [11]. Most current studies focus on variables and explore the independent impact of various influencing factors on the quality of reproductive life. They fail to analyze the differences between individuals and ignore the differences in influencing factors between different categories, thus affecting the targeting of intervention measures. Therefore, this study uses Latent Profile Analysis (LPA) [12] to identify the potential profiles of the quality of reproductive life of patients treated with ART and explore the influencing factors of different profiles, in order to provide a basis for medical staff to formulate targeted intervention measures.

Objects and Methods

Object

This study is a cross-sectional design. Convenience sampling was used to select infertile patients who had visited the reproductive medicine department of a tertiary-level hospital in Jining City, Shandong Province from December 2023 to November 2024 and had entered the ART treatment cycle as the study subjects. Inclusion criteria: **1)** meeting the clinical diagnostic criteria for infertility; **2)** being able to independently read and fill out the questionnaire; **3)** giving informed consent and voluntarily participating in this study.

Exclusion criteria: **1)** having intellectual, hearing or visual impairments that affect questionnaire responses; **2)** suffering from serious physical or mental illnesses; **3)** experiencing major life events within the past 6 months; **4)** having confirmed pregnancy at the time of the questionnaire survey. The sample size for the study of variable influencing factors should be at least 5 to 10 times the number of independent variables [13]. In this study, there were 22 independent variables. Considering that there may be about 20% invalid questionnaires during the collection process, the required sample size was finally determined to be at least 132 cases. A total of 323 cases were effectively surveyed in this study . This project has been approved by the Ethics Committee of Jining Medical College (JNMC-YX-2025-168).

Survey tools

General information questionnaire

Designed by the researchers themselves, the study included basic personal information and infertility-related details. Basic personal information included age, education level, place of residence, annual personal income, whether the individual was an only child, marital status, daily exercise level, and sleep quality. Infertility details included whether the individual had biological children, duration of infertility, type of infertility, attribution, and history of ART treatment .

Fertility quality of life scale (FertiQoL)

It is an internationally recognized tool for assessing the quality of life of infertile patients [14]. The scale has 36 items, two of which are independent items used to assess living and physical conditions respectively, and the remaining items are divided into six dimensions: emotional state, physical and mental response, marital relationship, social relationship, environment and tolerance. The scale uses a 5-point scale (0–4 points) and is converted into a percentage standard score. The higher the score, the better the quality of life of fertility. The total Cronbach 's α coefficient of the scale is 0.940. In this study, the Cronbach 's α coefficient of the scale is 0.865.

Fertility problem inventory (FPI)

by Newton et al. [15] in 1999 to assess the level of fertility-related stress in infertile patients. In 2011, Peng et al. [16] translated the scale into Chinese. The scale has 46 items, covering five dimensions: social stress, sexual stress, marital relationship, parental role requirements, and stress of not having children. The Likert 6-point (1–6 points) scoring method was used, with a total score between 46 and 276 points. The higher the score, the greater the fertility stress felt by the individual. The Cronbach's α coefficient of the Chinese version of the FPI scale is 0.867. In this study , the Cronbach 's α coefficient of the scale is 0.813.

Positive psychological capital questionnaire (PPQ)

This study uses the Positive Psychological Capital Scale developed by Luthans [17] and translated and revised by Zhang Kuo et al. [18]. It consists of 26 items, divided into four dimensions: self-efficacy, resilience, optimism, and hope. The Likert 7-point (1–7) scoring method is used, with a total score between 26 and 182. The higher the score, the higher the reserve of positive psychological capital. The overall Cronbach's α coefficient of the scale is 0.900. In this study, the Cronbach 's α coefficient of the scale is 0.829.

Data collection methods and quality control

Prior to the survey, data collection personnel received standardized training. When distributing questionnaires, standardized instructions were used to explain the research purpose, significance, and completion requirements to patients. Participants were informed that the collected data would be used solely for research purposes and would be anonymized. Informed consent was obtained from all parties, and patients received one-on-one guidance in completing the paper questionnaires. Any questions raised during the completion process were answered objectively by the data collection personnel. After the questionnaires were collected , they were double-checked and entered into the database, removing invalid questionnaires with predictable answers or obvious logical contradictions. A total of 344 questionnaires were distributed, and 323 valid questionnaires were collected, resulting in a valid response rate of 93.9%.

Statistical methods

Data processing and statistical analysis were performed using SPSS 25.0 and Mplus 8.3 software. Multiple profile mod-

Table 1 | Reproductive quality of life, reproductive stress, and positive psychological capital scores of patients undergoing ART treatment (n = 323)

Project	Number of entries	Total score (points x̄±s)	Items are evenly divided (points x̄±s)
quality of life during pregnancy	34	71.71 ± 12.52	—
Emotional state	6	70.32 ± 17.48	—
physical and mental reactions	6	71.70 ± 20.41	—
marital relationship	6	70.55 ± 15.22	—
social relations	6	77.40 ± 14.87	—
environment	6	73.45 ± 13.93	—
Endurance	4	68.44 ± 20.11	—
fertility pressure	46	130.08 ± 31.01	2.83 ± 0.67
social pressure	10	23.17 ± 8.03	2.32 ± 0.80
Sexual pressure	8	18.41 ± 7.67	2.30 ± 0.96
marital relationship	10	22.19 ± 8.85	2.22 ± 0.89
Parent role requirements	10	37.79 ± 10.19	3.77 ± 1.02
No pressure from children	8	28.52 ± 8.82	3.56 ± 1.10
Positive psychological capital	26	122.39 ± 21.19	4.71 ± 0.82
Self-efficacy	7	31.83 ± 6.90	4.55 ± 0.98
toughness	7	29.12 ± 7.57	4.16 ± 1.08
hope	6	30.56 ± 5.86	5.09 ± 0.98
optimism	6	30.87 ± 5.83	5.15 ± 0.97

Note: The total score and scores for each dimension of the Reproductive Life Quality Scale are standard scores on a 100-point scale.

els were established sequentially using the scores of the six dimensions of fertility and quality of life of ART patients as explicit variables. The model fit indices [12] included: **1)** Aike Information Criterion (AIC), Bayesian Information Criterion (BIC), and sample-corrected BIC (aBIC). The smaller the value of the above indices, the better the model fit; **2)** Entropy, with a value range of 0 to 1. The closer to 1, the more accurate the model classification. A value greater than 0.8 is considered good; **3)** Röhler-Reuben Corrected Likelihood Ratio Test (LMRT) and Bootstrap-based Likelihood Ratio Test (BLRT). When $P < 0.05$, it indicates that the fit of the k profile models is significantly improved compared with the k -1 profile models. Combining the fit indices, interpretability, and clinical practice of each model, the optimal number of profiles was determined. Based on the posterior probability, all cases were assigned to the corresponding profiles and categorical variables were generated. Further statistical description and inference were performed based on the classification results. Quantitative data were described using cmean ± standard deviation based on the normality test results, while categorical data were expressed as frequency and percentage (%). The chi-square test or F- test was used to analyze differences between groups. Using the potential profile of fertility and quality of life of ART- treated patients as the dependent variable, variables with statistically significant differences in univariate analysis were included in multivariate logistic regression to explore the influencing factors of different potential profiles of fertility and quality of life of ART- treated patients. The significance level was set at $\alpha = 0.05$.

Results

Reproductive quality of life, reproductive stress, and positive psychological capital scores of ART patients

See Table 1.

Potential profile analysis results of ART treatment patients' reproductive quality of life

The standardized scores of six dimensions of reproductive quality of life were used as explicit variables for model fitting. A total of five models were fitted, and the goodness-of-fit indices of each model are shown in Table 2. When the number of potential profiles was 3, the entropy value was >0.8, and both LMRT and BLRT were statistically significant ($P < 0.05$). The AIC, BIC, and aBIC values were all low, indicating that the model fitting results of the 3 profiles were reliable. Individuals were classified according to their different characteristics on the explicit variables. Category 1 (C1) had low scores in all dimensions except for the environment dimension, especially in the emotional state, physical and mental response, and tolerance dimensions. Therefore, it was named the " Physical and Mental Distress Group " , with 43 cases (13.3%). Category 2 (C2) had moderate scores in all dimensions, with 145 cases (44.9%). It was named the " Medium Reproductive Quality of Life Group " . Category 3 (C3) had high scores in all dimensions, with 135 cases (41.8%). It was named the " High Reproductive Quality of Life Group " , as shown in Figure 1.

Differences in three potential profiles of fertility and quality of life in patients undergoing ART treatment

Differences in scores across explicit variables for the three potential profiles of reproductive quality of life were tested.

Table 2 | LPA fitting indexes for fertility and quality of life of patients treated with ART (n = 323)

Number of sections	AIC	BIC	aBIC	Entropy	LMR T	BLRT	Profile probability
1	16457.309	16502.641	16464.578	—	—	—	1
2	15868.822	15940.597	15880.331	0.887	0.002	<0.001	0.270/0.730
3	15592.588	15690.807	15608.338	0.853	0.012	<0.001	0.133/0.449/0.418
4	15505.666	15630.329	15525.657	0.848	0.101	<0.001	0.207/0.081/0.263/0.449
5	15468.182	15619.288	15492.413	0.869	0.159	<0.001	0.087/0.003/0.207/0.461/0.241

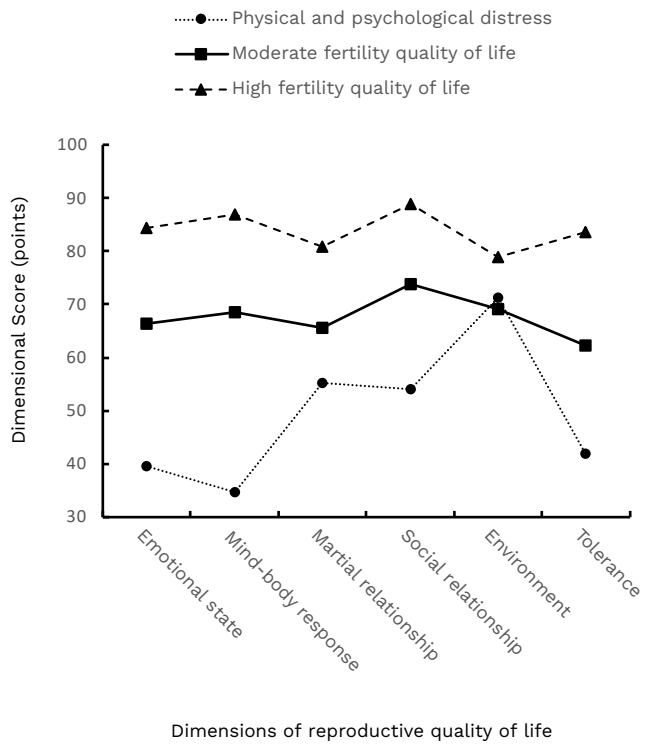
Note: **C1**: Mental and physical distress group; **C2**: Moderate quality of life with fertility group; **C3**: High quality of life with fertility group

Table 3 | Differences in total and dimension scores of fertility and quality of life among ART- treated patients across three profiles

Dimension	Overall	C1	C2	C3	F	P	Between groups
Overall score of reproductive quality of life	71.71 ± 12.52	50.15 ± 7.06	67.51 ±5 .09	83.09 ± 5.86	614.918	<0.001	C1 < C2 < C3
Emotional state	70.32 ± 17.48	39.53 ± 12.04	66.44 ± 9.39	84.29 ± 8.79	380.493	<0.001	C1 < C2 < C3
physical and mental reactions	71.70 ± 20.41	34.69 ± 13.51	68.53 ± 12.66	86.88 ± 9.43	342.915	<0.001	C1 < C2 < C3
marital relationship	70.55 ± 15.22	55.14 ± 15.90	65.60 ± 12.16	80.77 ± 10.52	95.440	<0.001	C1 < C2 < C3
social relations	77.40 ± 17.87	53.97 ± 14.00	73.76 ± 8.92	88.77 ± 7.99	243.357	<0.001	C1 < C2 < C3
environment	73.45 ± 13.93	71.22 ± 14.43	69.05 ± 12.48	78.89 ± 13.46	20.236	<0.001	C1 = C2 < C3
Endurance	68.44 ± 20.11	42.01 ± 17.43	62.24 ± 14.89	83.52 ± 11.97	166.062	<0.001	C1 < C2 < C3

Note: **C1**: Mental and physical distress group; **C2**: Moderate quality of life with fertility group; **C3**: High quality of life with fertility group.

Figure 1 | Category characteristics of three potential profiles of fertility quality of life in ART- treated patients



The results showed that, except for the environmental dimension, there were significant gradient differences in scores for all other dimensions and the total score among the three profiles (C1 < C2 < C3), and all differences were statistically significant (P < 0.001). In the environmental dimension, there was no significant difference between groups C1 and C2, but both were significantly lower than group C3 , supporting the validity of the potential profile classification . The results are shown in Table 3.

Univariate analysis of potential profiles of fertility and quality of life in patients undergoing ART treatment

The results showed that there were no statistically significant differences in age, education level, marital status, whether a patient was an only child, daily exercise volume, duration of infertility, cause of infertility, and history of ART treatment among different categories of reproductive quality of life (all P > 0.05). Items with statistically significant differences are shown in Table 4.

Multivariate logistic regression analysis of potential profiles of fertility and quality of life in ART- treated patients

Using the potential profile category of reproductive quality of life as the dependent variable and the high reproductive quality of life group (C3 group) as the reference group, multivariate logistic regression analysis was conducted with factors that had a p-value < 0.05 in the univariate analysis as independent variables. The independent variable assignments are as follows: Family residence: urban = 1, rural = 2; Annual income < 50,000 = 1, 50,000~ = 2, 100,000~ = 3; Poor sleep quality = 1, average = 2, good = 3; No biological children = 0, biological children = 1; Primary infertility = 1; Secondary infertility = 2; Original scores for each dimension of the reproductive stress and positive psychological capital scales were substituted. The likelihood ratio test value was 369.808, p < 0.001, indicating a good model fit. The results showed that, compared with the high fertility quality of life group, ART pa-

Table 4 | Basic information of patients receiving ART treatment and univariate analysis of different profiles

Project		Number of people	C1 (n = 43)	C2 (n = 145)	C3 (n=135)	x^2 / F	P
Place of residence [persons (%)]	town	233	27 (62.8)	117 (80.7)	89 (65.9)	9.737	0.008
	rural areas	90	16 (37.2)	28 (19.3)	46 (34.1)		
Annual personal income per 10,000 [person (%)]	<5	204	36 (83.7)	91 (62.8)	77 (57.0)	10.215	0.034*
	5~<10	90	6 (14.0)	40 (27.6)	44 (32.6)		
	>10	29	1 (2.3)	14 (9.7)	14 (10.4)		
Sleep quality [person (%)]	Poor	102	23 (53.5)	57 (39.3)	22 (16.3)	44.199	<0.001
	generally	157	18 (41.9)	70 (48.3)	69 (51.1)		
	very good	64	2 (4.7)	18 (12.4)	44 (32.6)		
Do you have any biological children? [persons (%)]	no	161	26 (60.5)	80 (55.2)	55 (40.7)	8.062	0.018
	yes	162	17 (39.5)	65 (44.8)	80 (59.3)		
Types of infertility [people (%)]	Primary	106	11 (25.6)	59 (40.7)	36 (26.7)	7.413	0.025
	Secondary	217	32 (74.4)	86 (59.3)	99 (73.3)		
Fertility pressure (points $\bar{x}$±s)	Total Score	130.08±31.01	162.28±31.28	136.21±25.41	113.25±25.52	63.793	<0.001
	social pressure	23.17±8.03	31.97±7.64	25.24±6.47	18.13±6.05	88.147	<0.001
	Sexual pressure	18.41±7.67	25.72±7.71	20.51±6.74	13.83±5.55	70.177	<0.001
	marital relationship	22.19±8.85	29.95±9.19	24.46±7.87	17.28±6.78	56.618	<0.001
	Parent role requirements	37.79±10.19	42.05±11.31	37.79±9.78	36.44±9.96	5.047	0.007
	No pressure from children	28.52±8.82	32.58±9.03	28.21±8.67	27.56±8.63	5.594	0.004
Positive psychological capital (points $\bar{x}$±s)	Total Score	122.39±21.19	102.44±17.99	117.80±16.18	133.67±20.44	55.728	<0.001
	Self-efficacy	31.83±6.90	27.60±6.42	30.79±6.08	34.30±6.98	20.625	<0.001
	toughness	29.12±7.57	21.56±6.14	27.42±5.47	33.36±7.35	64.725	<0.001
	hope	30.56±5.86	27.53±6.30	29.41±5.45	32.76±5.38	20.223	<0.001
	optimism	30.87±5.83	25.74±5.59	30.19±5.18	33.24±5.32	34.918	<0.001

Note: Categorical variables are expressed as frequencies (percentages), and numerical variables are expressed as mean ± standard deviation. **C1**: Mental and physical distress group; **C2**: Moderate quality of life with fertility group; **C3**: High quality of life with fertility group. ***** indicates Fisher's exact probability method.

tients with greater social and sexual stress, no biological children, and poorer sleep quality were more likely to enter the mental and physical distress group (all P < 0.05); ART patients with greater social and sexual stress, living in urban areas, and poorer sleep quality were more likely to enter the moderate fertility quality of life group (all P < 0.05), as shown in Table 5.

Discussion

Patients undergoing ART treatment have a moderate level of reproductive quality of life

The results of this study showed that the total score of fertility quality of life of patients treated with ART was (71.71±12.52), which is at a moderate level. It is higher than the scores of infertile patients in China who underwent frozen-thawed embryo transfer (64.5±14.1) [19] and in countries such as Switzerland (56.69) [20], Iran (62.57) and India (66.10) [11], and is close to the results of a study in Indonesia (72.7±14.9) [21]. This may be related to the fact that the group focused on in this study is patients who underwent ART treatment, which has increased their fertility expectations due to the application of technology, and that the psychological support for patients has been strengthened in domestic nursing work in recent years, thereby improving their psychological experience.

There is heterogeneity in the quality of life and fertility among patients undergoing ART treatment

This study identified three potential profiles of the reproductive quality of ART patients through potential profile analysis: the psychological distress group, the moderate reproductive quality of life group, and the high reproductive quality of life group, indicating that there is group heterogeneity in the reproductive quality of ART patients . The high reproductive quality of life group accounts for 41.8%. These patients adapt well to the treatment process, maintain a positive psychological state, and have less psychological distress. Stable psychological resources, effective social support, and good marital relationships may be the basis for maintaining this state. Encouraging these patients to share their personal experiences and convey positive beliefs to others can help other patients adjust their state and also enhance their own sense of value by helping others, further promoting the improvement of their reproductive quality of life. The moderate reproductive quality of life group accounts for 44.9%, which is at a moderate level in all aspects. This group has developed certain adaptive strategies, but is at the "critical point" of maintaining a fragile balance between challenges and coping resources. They have the potential to improve, but are also prone to falling into difficulties when encountering setbacks. Their core problem is insufficient coping resources [22] or lack of stress management ability. The focus of support

Table 5 | Multivariate logistic regression analysis of fertility quality of life in patients treated with ART

Project	Control group	β	SE	Wald s x^2	P	OR	95% CI
Group experiencing physical and mental distress vs. Group with high fertility and quality of life							
constant term		-4.815	3.003	2.572	0.109	—	—
social pressure		0.186	0.052	13.066	<0.001	1.205	1.089~1.333
Sexual pressure		0.146	0.057	6.615	0.010	1.158	1.035~1.294
toughness		-0.270	0.055	24.491	<0.001	0.763	0.686~0.849
optimism		-0.156	0.079	3.938	0.047	0.856	0.733~0.998
No biological children	Have biological children	1.566	0.748	4.386	0.036	4.790	1.106~2.749
Poor sleep quality	Good sleep quality	2.422	1.038	5.540	0.019	11.498	1.505~87.874
Medium quality of life with fertility group vs. high quality of life with fertility group							
constant term		-1.903	1.744	1.190	0.275	—	—
social pressure		0.101	0.032	9.670	0.002	1.106	1.038~1.178
Sexual pressure		0.075	0.035	4.516	0.034	1.078	1.006~1.155
toughness		-0.095	0.029	10.614	0.001	0.910	0.860~0.963
town	rural areas	0.875	0.386	5.142	0.023	2.398	1.126~5.107
Poor sleep quality	Good sleep quality	1.560	0.486	10.284	0.001	4.757	1.834~12.340

should be based on preventive mental health education, helping patients identify common negative emotions, improve stress management and communication skills, and assist patients in making life plans and maintaining connections with society [5], so as to enhance their overall coping ability. The proportion of the mental and physical distress group was 13.3%, and the scores of emotional state, mental and physical reaction and tolerance were significantly lower, showing severe anxiety, depression and physical symptoms, and the quality of reproductive life was seriously impaired. The proportion of those without biological children in this group was the highest. Under the background of traditional "filial piety" culture and family inheritance, they suffered greater psychological pressure and were prone to stigma and self-denial [9, 23]. Repeated treatment failures, insufficient social support, and loss of control over treatment all contributed to their emotional exhaustion. Active screening and key intervention for this group, with the focus of intervention being emotional relief and meaning reconstruction, can be used to help patients find and uphold their personal value in treatment, rather than just focusing on pregnancy outcomes, by using cognitive behavioral therapy [24], mindfulness-based stress reduction techniques [25–27].

Potential factors affecting the quality of reproductive life of ART patients

High fertility stress and poor sleep quality are common risk factors that prevent patients from maintaining a high quality of life for their children.

The results of this study show that, compared with the high fertility quality of life group, patients with high fertility stress scores and poor sleep quality are more likely to be classified into the mental and physical distress group and the moderate fertility quality of life group. Among them, the two dimensions of social stress (OR = 1.205 and 1.016) and sexual stress (OR = 1.158 and 1.078) in the fertility stress scale are statistically significant . Social stress is reflected in the worry about the outside world's gaze and social evaluation, the fear of being labeled, which leads to the patient's social withdrawal and impaired support system [28]; sexual stress is reflected in the impact of the fertility process on the intimate relationship between husband and wife, such as loss of interest in sex or feeling anxious, which damages the emotional connection and support between husband and wife [9, 29].

In addition, the results of this study show that poor sleep quality is a strong and common independent risk factor for the decline in reproductive quality of life in patients undergoing ART treatment (OR = 11.498 and 4.757) . Sufficient sleep is the basis for body repair, immune regulation and endocrine stability. Sleep disorders can lead to immune dysfunction, interfere with the hormonal rhythms related to reproduction [30], lead to fatigue, and reduce the tolerance and compliance of treatment. Sleep deprivation can also directly damage the function of the prefrontal cortex, weaken cognitive and emotional regulation abilities [31], increase susceptibility to treatment stress, easily fall into rumination, and significantly amplify negative emotions. Sleep deprivation leads to daytime functional impairment and reduced social activities, which not only reduces the patient's opportunities to obtain social support, but also deprives the patient of important psychological resources used to buffer stress, falling into a vicious cycle of "stress-sleep disorder-exacerbated physical and mental distress". As a sensitive early warning signal of declining reproductive quality of life, it also provides an operable intervention breakthrough for breaking the vicious cycle between stress and quality of life. By systematically monitoring the sleep quality index, patients with sleep problems can be identified early, and interventions such as sleep hygiene education, mindfulness training, and cognitive behavioral therapy can be implemented to improve sleep quality, thereby laying the foundation for coping with treatment stress and improving quality of life.

Positive psychological capital is a protective factor for maintaining a high quality of life for patients with high reproductive health

The results of this study show that positive psychological capital is a protective factor for the quality of life of patients undergoing ART treatment. Among them, the two dimensions that are statistically significant are resilience (OR = 0.763 and 0.910) and optimism (OR = 0.856) (among which the optimism dimension only has a statistically significant effect on the emotional distress group). Resilience is the ability of an individual to recover quickly from adversity and setbacks and maintain a positive state, avoiding being defeated by setbacks and failures; optimism helps pati ents see the positive side of things and maintain expectations for the future [18]. Self-efficacy and hope dimensions did not show statistical significance in this study, which may be because self-efficacy represents the belief that one is capable of achieving goals, but this belief is often constantly challenged in the face of reality; while hope is the individual's willingness to set goals and achieve them. Without the support of resilience and optimism, it is also easy to be exhausted in the face of setbacks. In the work, a systematic and hierarchical comprehensive intervention system can be established. At key nodes such as the start of treatment, before and after embryo transfer, and when the results are known, assessments of fertility stress and psychological capital can be carried out to achieve early identification and dynamic monitoring of risk factors. Structured psychological interventions can be provided to high-risk patients, such as using cognitive behavioral therapy to correct their irrational cognition of stigma and failure, accepting negative situations and thoughts that occur during treatment instead of being controlled by negative emotions; learning to call on social support systems [5], using mindfulness stress reduction techniques [25, 26] to cultivate and enhance the reserve of positive psychological capital and improve the ability to regulate emotions; intervening as a whole for couples, improving communication patterns, promoting emotional expression, enhancing the resilience of the couple's relationship, and strengthening the support between partners [32].

The absence of biological children is a specific risk factor for the "psychological distress group"

The results of this study show that the absence of biological children is a specific risk factor for ART patients to be classified into the mental and physical distress group (OR = 4.790) . The absence of biological children corresponds to the two dimensions of "parental role needs" and "stress of childlessness" in the reproductive stress scale. In the social culture, being a parent is a core component of adult identity [9]. The absence of children, especially when the status quo is not changed after actively seeking medical intervention, is more likely to trigger a deep crisis in terms of family inheritance, identity, self-worth, and meaning of life. This may lead to the blurring or loss of the sense of meaning in the future, causing patients to stagnate in life, lack goals, and develop a deep fear and resistance to the future. In response to this core risk that leads to mental and physical distress, intervention measures should focus on helping patients deal with the sense of loss, such as establishing peer support groups. The exchange between group members with similar experiences can effectively reduce the sense of isolation and gain unique understanding and resonance [33]. Accepting rather than resisting the painful feeling of not being able to have biological children, re-establishing personal value and meaning, and ensuring that a meaningful and dignified life can be maintained under any treatment outcome.

Urban residence is a specific risk factor for the "moderate fertility quality of life group," but it is not associated with the mental and physical distress group

The results of this study show that living in an urban area is a specific risk factor that makes ART patients more likely to be in the moderate quality of life group rather than the high quality of fertility group (OR = 2.398) . This may be related to the following factors: Although urban residents have a wider range of social interactions, their interpersonal relationships are relatively distant [34], making it difficult to obtain in-depth and stable emotional support and substantial help on fertility issues involving privacy; in addition, urban patients face a more diverse and higher standard of social evaluation system, resulting in a situation where high resources and chronic consumption coexist [35], which, although not causing serious physical and mental distress, makes it difficult to achieve an ideal life. For patients with high-risk factors living in urban areas, the choice of intervention measures should respect the patient's wishes and be based on dispelling their guard, such as providing institutional confidentiality and intervention methods involving only professional personnel; after the patient has achieved sufficient growth, more open intervention measures can be carried out.

Conclusion

ART treatment . High reproductive stress, low psychological capital, and poor sleep quality are common risk factors contributing to a decline in their quality of life. The absence of biological children is a specific high-risk factor for patients experiencing psychological and emotional distress, while urban residents are at higher risk of not achieving a high quality of life and remaining at a moderate level. This study aims to implement comprehensive interventions targeting different risk profiles, focusing on stress management, psychological capital development, and sleep improvement. Specialized and personalized psychosocial care should be provided to high-risk groups such as those without children or residing in urban areas, shifting from general support to targeted intervention. Limitations of this study include the difficulty in establishing causal relationships due to the cross-sectional design and the potential for selection bias in the sample. Future research could use longitudinal designs to track dynamic changes in patient profiles, verify the causal pathways between influencing factors and outcomes, further elucidate the psychosomatic mechanisms affecting the quality of life for fertility, and provide a basis for developing and validating targeted intervention programs.

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