



The chain mediating effects of self-efficacy and social support on family function and anxiety in male infertility patients

Ping Hu^{1#}, Xue Qin^{1,2#}, Yajie Zhu¹, Ying Zhang², Yujuan Yuan¹, Baibing Yang^{1^}, Wan Wan¹

¹Department of Andrology, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, Nanjing, China;

²Department of Andrology, Nanjing Drum Tower Hospital Clinical College of Jiangsu University, Nanjing, China

Contributions: (I) Conception and design: P Hu, W Wan, B Yang; (II) Administrative support: W Wan, B Yang; (III) Provision of study materials or patients: Y Zhu, Y Zhang, Y Yuan; (IV) Collection and assembly of data: P Hu, X Qin; (V) Data analysis and interpretation: P Hu, X Qin; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Wan Wan, MS. Department of Andrology, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, 321 Zhongshan Road, Nanjing 210008, China. Email: 1141609469@qq.com; Baibing Yang, MD, PhD. Department of Andrology, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, 321 Zhongshan Road, Nanjing 210008, China. Email: baibing.yang@njglyy.com.

Background: Infertility, an escalating public health issue, exacerbates psychological distress, especially anxiety, among affected individuals. This study explores the intricate relationships between family function, self-efficacy, and social support in moderating anxiety levels in male infertility patients. Understanding these dynamics offers valuable insights for crafting effective psychological interventions.

Methods: This study involved 202 male infertility patients through convenience sampling, employing the Self-Efficacy Scale, Social Support Rating Scale, Family Function Scale, and Anxiety Self-Rating Scale for assessment. Structural equation modeling (SEM) with Bootstrap analysis was utilized to explore the relationships among these variables.

Results: Analysis of 202 male infertility patients revealed a notable prevalence of anxiety (67.8%), with family function directly and indirectly influencing anxiety levels through self-efficacy and social support. SEM highlighted the mediating roles of self-efficacy and social support between family function and anxiety, demonstrating significant direct (family function on anxiety) and indirect effects (family function to anxiety via social support and self-efficacy). Notably, a chain mediation effect, where family function impacts anxiety through the sequential influence of social support and self-efficacy, accounted for a significant portion of the total effect on anxiety. These findings emphasize the critical role of enhancing family function, self-efficacy, and social support to reduce anxiety among this population.

Conclusions: This study underscores the significant impact of family function on the psychological well-being of male infertility patients, with self-efficacy and social support serving as pivotal mediators. Improving these factors could effectively mitigate anxiety, suggesting that interventions targeting family dynamics, self-efficacy enhancement, and social support networks are essential for addressing the psychological distress associated with infertility. Future research should consider these dynamics to develop more comprehensive treatment and intervention strategies aimed at this vulnerable group.

Keywords: Infertility; self-efficacy; family function; negative emotion; mediating effect

Submitted Apr 22, 2024. Accepted for publication Sep 01, 2024. Published online Sep 26, 2024.

doi: 10.21037/tau-24-198

View this article at: <https://dx.doi.org/10.21037/tau-24-198>

[^] ORCID: 0000-0002-5821-3741.

Introduction

Infertility has become a significant public health issue worldwide. Research indicates that the incidence of male infertility rose by 76.9% between 1990 and 2019 (1), with a noticeable decline in semen quality over time (2). Infertility not only poses reproductive challenges but also brings about substantial societal, familial, and spousal pressures. This pressure often leads to a high prevalence of psychological issues among affected individuals, with negative emotions reaching a rate of 44.39% (3).

Anxiety, characterized by tension and discomfort, arises when individuals face obstacles in achieving their goals, leading to decreased confidence and self-esteem, heightened feelings of failure, and a looming sense of dread. This emotional state can disrupt the endocrine system, leading to abnormalities in male hormone secretion that adversely affect male reproductive health and sexual function (4,5). Studies show that men with infertility often experience significant emotional distress, which can negatively affect their quality of life and interpersonal relationships (6-8). The pressure to conceive and the stigma associated with infertility contribute to elevated anxiety levels, further complicating their mental health (9).

Social determinants and socio-cultural factors significantly affect infertility patients. For example, societal expectations for men to father children can exacerbate emotional distress. Moreover, gaps in sex education, particularly the exclusion of men from comprehensive education on pregnancy and fertility, leave many men unprepared to deal with infertility issues (10).

Despite the known psychological impacts, there is limited research specifically focusing on how psychological factors such as self-efficacy and social support influence the mental health of male infertility patients. Coping mechanisms in men differ from women; men might hesitate to seek social support due to social pressure, while women are more likely to seek such support (11,12). This highlights the need for tailored interventions that consider these gender-specific coping styles.

Self-efficacy, defined as an individual's ability to self-regulate in response to events, influences emotions and behaviors in specific contexts (13). External support plays a crucial role in managing negative emotions effectively. Enhancing self-efficacy and social support aids infertility patients in handling negative emotions and actively addressing their condition (14). Family function, a metric for assessing the family system's performance (15), influences patients' emotions through various factors, though its exact impact pathway is yet to be fully understood.

This study aims to elucidate the connections between self-efficacy, social support, family function, and anxiety in infertility patients. It seeks to outline how family function affects patients' anxiety, providing a scientific foundation for enhancing family support, reducing anxiety, and developing proactive treatment and intervention strategies. We present this article in accordance with the SURGE reporting checklist (available at <https://tau.amegroups.com/article/view/10.21037/tau-24-198/rc>).

Methods

Study subjects

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study protocols were reviewed and approved by the Ethics Committee of Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School (No. NDTH-2022-EC-123). All participants were informed about the study's objectives and procedures, and written informed consent was obtained prior to participation. This

Highlight box

Key findings

- Analysis of 202 male infertility patients revealed a 67.8% prevalence of anxiety.
- Family function significantly influences anxiety levels, both directly and indirectly, through self-efficacy and social support.
- Structural equation modeling (SEM) highlighted that family function impacts anxiety through a sequential chain of social support and self-efficacy.

What is known and what is new?

- Infertility is a significant public health issue with a substantial psychological impact on affected individuals, particularly anxiety.
- This study elucidates the chain mediating effects of self-efficacy and social support on the relationship between family function and anxiety in male infertility patients, providing a deeper understanding of these dynamics.

What is the implication, and what should change now?

- The findings underscore the importance of enhancing family function, self-efficacy, and social support to reduce anxiety among male infertility patients.
- Psychological interventions should target family dynamics, self-efficacy enhancement, and the development of robust social support networks to effectively mitigate anxiety in this population.

study recruited male infertility patients who were diagnosed by clinical physicians and treated at our hospital through convenience sampling by nurses. Male infertility is defined as “the inability of a male to make a fertile female pregnant for a minimum of at least 1 year of regular unprotected intercourse” according to the World Health Organization (WHO) criteria. The inclusion criteria were as follows: (I) age ranging from 18 to 55 years, and (II) consciousness and capability to independently complete the questionnaire.

The exclusion criteria included: (I) presence of mental illnesses, (II) disorders affecting consciousness, (III) severe physical conditions such as cancer or tumors, (IV) illiteracy or significant communication barriers, and (V) missing responses for more than 10% of the items in any of the questionnaires used.

Sample size calculation was based on a ratio of 5–10 times the number of research variable items. To account for potential sample loss, the exclusion of invalid questionnaires, and to enhance model stability, an additional 10% was added to the initial estimate. Consequently, a sample size greater than 200 is generally necessary to ensure model stability (15).

Survey tools

General information questionnaire

The questionnaire, tailored by the researchers to meet the study’s requirements, gathered information on various aspects: patient’s age, place of residence, only-child status, education level, disease duration, smoking history, sperm parameters, history of orchitis, and marital status.

Anxiety Self-Rating Scale (SAS)

The SAS was compiled by W.K. Zung in 1971 (16). It has a Cronbach’s alpha coefficient of 0.842 and contains 20 items that reflect subjective feelings of anxiety. It uses a Likert 4-point scale, with scores of 50–59 indicating mild anxiety, 60–69 moderate anxiety, and over 69 severe anxiety. In this study, the scale’s Cronbach’s alpha coefficient was 0.963.

Family function scale

The Family Assessment Device (FAD) (17) has a Cronbach’s alpha coefficient of 0.81 and contains 60 items across seven dimensions: problem-solving, roles, communication, emotional response, emotional involvement, behavior control, and overall function. Each item uses a Likert 4-point scale, with scores ranging from 1 to 4. Some items are reverse-scored, with higher scores indicating lower

family function (18). In this study, the scale’s Cronbach’s alpha coefficient was 0.972.

General Self-Efficacy Scale (GSES)

The GSES (19) has a Cronbach’s alpha coefficient of 0.87 and contains 10 items. It uses a Likert 4-point scale, with higher individual scores indicating higher levels of general self-efficacy. In this study, the scale’s Cronbach’s alpha coefficient was 0.937.

Social support scale

The Social Support Rating Scale (SSRS) (20) is used to assess an individual’s level of social support. It has a Cronbach’s alpha coefficient of 0.896 and contains 10 items, including dimensions of subjective support, objective support, and support utilization. A total score of ≤ 22 indicates low social support, 23–44 indicates moderate social support, and 45–66 indicates high social support. Higher scores indicate higher levels of social support. In this study, the scale’s Cronbach’s alpha coefficient was 0.894.

Survey method

Before the survey, the research nurses were uniformly trained. After passing the training, the nurses explained the purpose, method, and confidentiality principles of this survey to the patients. After obtaining the patients’ consent, an informed consent form was signed.

Statistical analysis

Data analysis was performed using SPSS 26.0 software. Count data were described using frequency and composition ratio; measurement data that followed a normal distribution were described using mean \pm standard deviation and analyzed using one-way analysis. Pearson correlation analysis was used to analyze the correlation between variables. A P value < 0.05 was considered statistically significant.

AMOS 23.0 software was used to build structural equation modelings (SEM) for path analysis. SEM is ideal for this study because it allows for the examination of complex relationships between multiple variables, including direct and indirect effects. It integrates factor analysis and multiple regression analysis, providing a comprehensive approach to understanding the structural relationship among measured variables (21). By employing Bootstrap analysis with 5,000 resamples, we tested the mediating effects and used the maximum likelihood method for

Table 1 General information of subjects

Characteristic	Values (n=202)
Age (years)	30.43±4.99
Place of residence	
Urban	76 (37.6)
Rural	126 (62.4)
Education	
Senior (bachelor or above)	89 (44.1)
Junior (high school or below)	113 (55.9)
Marital status	
Married	187 (92.6)
Divorced	15 (7.4)
Only child	
Yes	92 (45.5)
No	110 (54.5)
Smoking	
Never	98 (48.5)
1–5 years	30 (14.8)
6–10 years	54 (26.7)
11 years and above	20 (9.9)
Progressive motility sperm rate (%)	28.2 (17.0, 55.4)
Normal morphology sperm rate (%)	3.2 (1.4, 4.5)
Sperm concentration (M/mL)	35.3 (15.5, 64.1)
Semen volume (mL)	3.0 (2.1, 4.5)
Duration of infertility	
1–2 years	100 (49.5)
Over 2 years	102 (50.5)
History of orchitis	
Yes	19 (9.4)
No	179 (88.6)
Unknown	4 (2.0)

Data are presented as mean ± standard deviation, median (quartiles) or n (%).

parameter estimation. The study controlled for common method bias through anonymous measurement and balancing the order effect of items. Harman's single factor test extracted 15 factors with eigenvalues >1, and the first factor explained 30.7% of the variance (< the critical value

of 40%), indicating no significant common method bias in this study.

Results

General information of subjects

From August 2022 to September 2023, a total of 208 questionnaires were distributed, and after excluding 6 invalid questionnaires (filled in less than 10 minutes, missing items, logical errors), 202 valid questionnaires were collected, with a valid recovery rate of 97.12%. The mean age of the 202 patients was 30.43±4.99 years. Details of the subjects are listed in *Table 1*.

Univariate analysis of the psychological health status of patients

Based on the SAS scoring criteria, the 202 infertility patients were divided into groups of no anxiety, mild anxiety, moderate anxiety, and severe anxiety. A comparison of family function, social support, and general self-efficacy among the four groups revealed that the no anxiety group had lower family function scores, and higher social support and general self-efficacy scores than other anxiety groups, with significant differences (all $P < 0.001$) (*Figure 1*).

Correlation analysis of patients' family function, self-efficacy, social support, and anxiety

Family function was negatively correlated with general self-efficacy and social support ($P < 0.001$), and positively correlated with anxiety ($P < 0.001$). General self-efficacy was negatively correlated with anxiety ($P < 0.001$), and social support was negatively correlated with anxiety ($P < 0.001$) (*Table 2*).

Analysis of the mediating effects of self-efficacy and social support between family function and anxiety

In this study, we constructed and validated an SEM to examine the relationships between family function (independent variable) and anxiety (dependent variable), with self-efficacy and social support serving as mediators. We employed AMOS 23.0 software for the analysis. Given the correlation between self-efficacy and social support ($r = 0.354$, $P < 0.001$), we opted for a chained mediation model. The model's fit was confirmed by its statistical

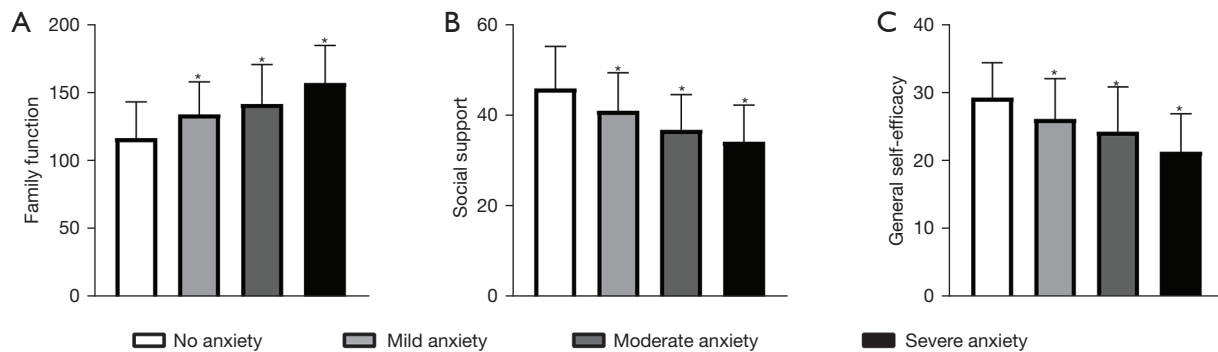


Figure 1 Single factor analysis of patients’ mental health status. Score of family function (A), social support (B) and general self-efficacy (C) were compared among patients with different levels of anxiety. Anxiety level was divided according to Anxiety Self-Rating Scale. *, P<0.001 when compared with no anxiety group.

Table 2 Correlation analysis of patients’ family functions, self-efficacy, social support, and anxiety

	Family function	Social support	General self-efficacy	Anxiety
Family function	1			
Social support	-0.435**	1		
General self-efficacy	-0.479**	0.354**	1	
Anxiety	0.497**	-0.485**	-0.467**	1

Data in the table is r value; **, P<0.001.

indicators: Chi-square (χ^2) =55.059, Chi-square/degree of freedom (χ^2/df) =1.101, Root Mean Square Error of Approximation (RMSEA) =0.022, Comparative Fit Index (CFI) =0.995, Incremental Fit Index (IFI) =0.994, Goodness of Fit Index (GFI) =0.958, Adjusted Goodness of Fit Index (AGFI) =0.934, and Normed Fit Index (NFI) =0.951. These figures, with $\chi^2/df < 3$, RMSEA <0.08, and other indices >0.9, suggest a robust model fit. The model diagram in *Figure 2* illustrates the chained mediating effects between family function and anxiety. The Family Function Observation Scale revealed factor loading coefficients across several dimensions: problem-solving (0.76), communication (0.73), role (0.74), emotional response (0.76), emotional involvement (0.77), overall function (0.74), and behavioral control (0.79). Meanwhile, the Social Support Observation Scale measured coefficients for objective support (0.83), subjective support (0.64), and utilization of social support (0.63).

Using Bootstrap analysis with 5,000 resamples to assess mediating effects significance (95% confidence interval), we found several key direct effects: family function on social support (-0.52), family function on general self-efficacy (-0.39), social support on anxiety (-0.34), general self-

efficacy on anxiety (-0.20), and social support on general self-efficacy (-0.21). Notably, the total effect of family function on anxiety was significant (0.524, P<0.001), as was the direct effect (0.248, P=0.005). The model highlighted three indirect paths: family function to anxiety via social support (0.173, P<0.001), family function to anxiety via general self-efficacy (0.080, P<0.001), and family function to anxiety via social support to general self-efficacy (0.022, P=0.01), as outlined in *Table 3*.

Discussion

In this study, we examined the relationships between family function, self-efficacy, social support and anxiety levels among 202 male infertility patients. Our analysis revealed that a substantial proportion of participants, 67.8% or 137 patients, exhibited signs of anxiety, with an average anxiety score of 56.44±12.87. SEM showed that family function was associated with anxiety, both directly (0.248) and indirectly (0.275) through self-efficacy and social support. Specifically, the relationship between family function and anxiety through social support was quantified

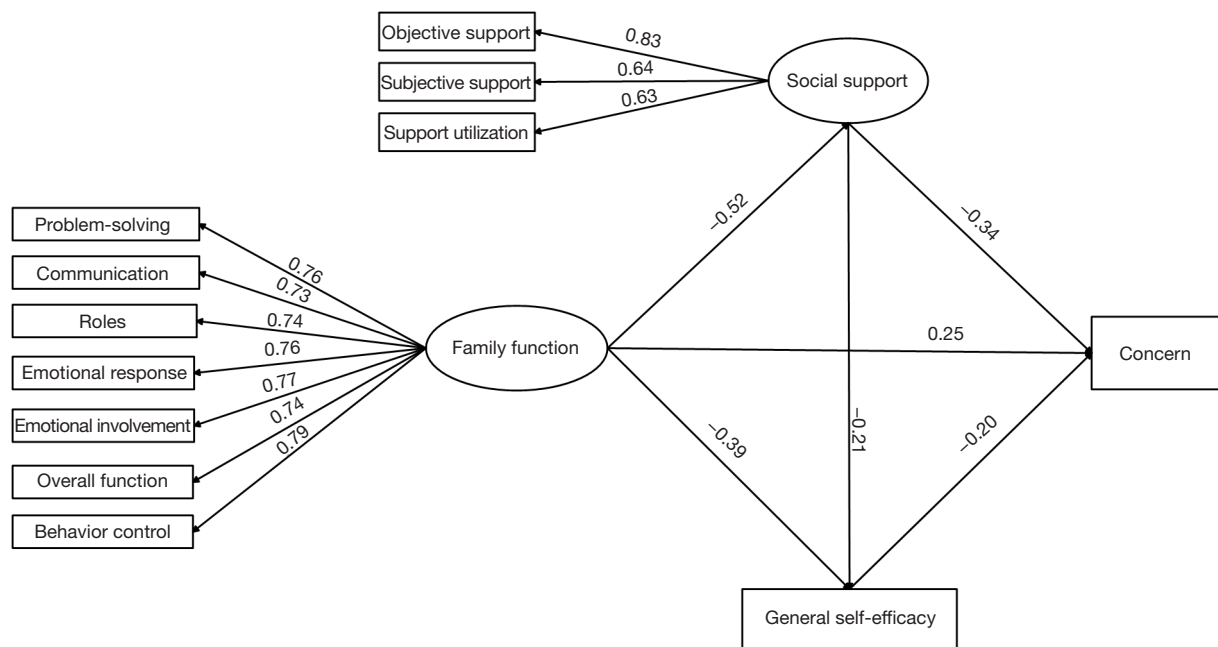


Figure 2 The chain mediation effect model of social support and self-efficacy between family function and anxiety. Major nodes (family function, social support, general self-efficacy and concern) are questionnaires, and small nodes are the dimensions of questionnaires. Number between major and small nodes showed the load factor, and number between major nodes showed the direct effect size.

Table 3 Chain mediating effects of social support and self-efficacy between family functions and anxiety in infertility patients

Path	Standardized estimate	Standard error	Standardized rate, %	t value	P value	95% CI
Family function–social support–anxiety	0.173	0.050	33.02	3.460	<0.001	0.093–0.291
Family functioning–self-efficacy–anxiety	0.080	0.031	15.27	2.581	0.001	0.031–0.158
Family functioning–social support–self-efficacy–anxiety	0.022	0.013	4.20	1.692	P=0.01	0.004–0.058
Indirect effect	0.275	0.057	52.67	4.842	<0.001	0.176–0.407
Direct effect	0.248	0.080	47.33	3.100	0.005	0.088–0.404
Total effect	0.524	0.054	100.00	9.704	<0.001	0.419–0.628

at 0.173, and through self-efficacy at 0.080. These findings highlight the association between higher levels of family function, self-efficacy, and social support with lower anxiety levels, emphasizing the importance of these factors in psychological interventions for this group.

The challenges faced by men while seeking social support are profound. Fertility challenges and psychological distress can entangle, creating a harmful cycle that intensifies infertility issues (22). Men grappling with infertility are more susceptible to adverse psychological conditions such as dysthymia, major depressive disorder,

or anxiety disorders (6). This study found that 137 patients (67.8%) suffering from infertility also experienced anxiety, with an average score of 56.44 ± 12.87 . Key factors like family function—the family’s inherent ability to operate and fulfill responsibilities—along with social support and self-efficacy, which represent external assistance and the personal capacity to manage and surmount challenges, respectively, play pivotal roles. Research shows that infertility patients with anxiety report lower levels of family function, social support, and general self-efficacy compared to those without anxiety, with higher scores in these areas

linked to less severe anxiety symptoms and reduced anxiety prevalence, aligning with prior findings (23,24). Enhanced family function can diminish the risk of psychosomatic disorders, bolster physical and mental wellbeing, mitigate negative emotions, and improve social support and coping skills. Therefore, it is vital to focus on educating the families of infertility patients, particularly spouses, to harness family support and foster effective coping strategies.

Culture plays a crucial role in shaping the experiences and coping mechanisms of infertility patients. In many cultures, masculinity is closely tied to the ability to father children, leading to significant pressure on infertile men. This cultural expectation can result in severe psychological stress and reluctance to seek support (9,25). Addressing these socio-cultural determinants is essential in developing effective support systems for male infertility patients.

The study's findings have several clinical implications. Firstly, family function exerts a significant influence on anxiety, marked by a direct effect of 0.248 and an indirect effect of 0.275, culminating in a total effect of 0.524. This demonstrates that family function can directly precipitate the onset of anxiety. Moreover, through its indirect effects, family function affects anxiety via social support, with a path coefficient of 0.173. This aligns with the findings of Wang *et al.* (26), who reported that social support and self-efficacy contribute to improving anxiety in patients undergoing radical prostatectomy and associated with the full mediation effect of self-efficacy. Social support encompasses the aid provided by others during challenging times, including subjective support, objective support, and the utilization of such support (27). Objective support refers to the tangible assistance received, whereas subjective support pertains to an individual's perceived support (20). Perceived support, especially from family, fosters communication and intimacy, thereby enhancing family functionality and resilience against adversity, which in turn alleviates negative emotions like anxiety (28). Secondly, family function influences anxiety through self-efficacy, with a path coefficient of 0.080. A significant negative relationship exists between self-efficacy and anxiety ($P < 0.001$), denoted by a standardized coefficient of -0.20 , suggesting that higher levels of self-efficacy correlate with lower anxiety levels. This supports the notion that enhanced self-efficacy can effectively diminish anxiety, corroborating the study's findings (26). Thus, healthcare professionals should employ positive psychological techniques to boost both self-efficacy and family function among infertility patients and their families. Thirdly, the chain mediating role of social support and self-efficacy

between family function and negative emotions, displaying an effect value of 0.022. According to Banik *et al.*, elevated social support can bolster or even build self-efficacy (29). The study also evidences a substantial positive impact of social support on general self-efficacy ($P < 0.001$), with a standardized coefficient of 0.21. Enhancing social support provides an external buffer, while boosting self-efficacy fortifies internal defenses, yielding a synergistic effect.

While the study employs SEM, which allows for a comprehensive analysis of complex relationships between variables, it also has limitations. The cross-sectional design limits the ability to infer causality, and the sample was drawn from a single hospital, which may limit the generalizability of the findings. This study did not include a control group, such as men undergoing vasectomy, which could provide comparative insights. Additionally, the sample was drawn from a single hospital, which may limit the generalizability of the findings. Infertility impacts both partners, and collaborative management can provide emotional support and improve treatment outcomes. Future studies should consider exploring the dynamics between partners more extensively and how joint interventions can enhance coping mechanisms and reduce psychological distress.

Conclusions

This study validates a chain mediating model of social support and self-efficacy between family function and anxiety among infertility patients, highlighting how family function directly and indirectly impacts patients' anxiety. These insights are crucial for managing anxiety in infertility patients, emphasizing the importance of spousal collaboration and effective family functioning. The study advocates for establishing robust social support systems for patients to fortify their self-efficacy, thereby mitigating anxiety and promoting more positive treatment outcomes and disease management strategies. A noted limitation is the study's focus solely on anxiety, despite other negative emotions such as depression and hostility also affecting patients' psychological well-being and treatment. Future research should explore these dimensions to offer comprehensive strategies for improving negative emotional states and long-term prognoses from a family function perspective in infertility patients.

Acknowledgments

We would like to express our gratitude to the participants

who took part in this study and to the nursing and medical staff at Nanjing Drum Tower Hospital for their support and cooperation during the research process. Special thanks are also extended to the Nursing Psychology Research Project of the Nursing Psychology Professional Committee of the Chinese Mental Health Association for their financial support.

Funding: This work was supported by the Nursing Psychology Research Project of Nursing Psychology Professional Committee of Chinese Mental Health Association (No. 2022-62-103), fundings for Clinical Trials from the Affiliated Drum Tower Hospital, Medical School of Nanjing University (No. 2021-LCYJ-PY-47), and General Topics of the Nursing Department of Nanjing Drum Tower Hospital (No. 2023-R218).

Footnote

Reporting Checklist: The authors have completed the SURGE reporting checklist. Available at <https://tau.amegroups.com/article/view/10.21037/tau-24-198/rc>

Data Sharing Statement: Available at <https://tau.amegroups.com/article/view/10.21037/tau-24-198/dss>

Peer Review File: Available at <https://tau.amegroups.com/article/view/10.21037/tau-24-198/prf>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://tau.amegroups.com/article/view/10.21037/tau-24-198/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study protocols were reviewed and approved by the Ethics Committee of Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School (No. NDTH-2022-EC-123). All participants were informed about the study's objectives and procedures, and written informed consent was obtained prior to participation.

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Cite this article as: Hu P, Qin X, Zhu Y, Zhang Y, Yuan Y, Yang B, Wan W. The chain mediating effects of self-efficacy and social support on family function and anxiety in male infertility patients. *Transl Androl Urol* 2024;13(9):1859-1867. doi: 10.21037/tau-24-198