Relationships between sexual function, mental health, and quality of life of female patients with pulmonary arterial hypertension associated with congenital heart disease

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Abstract
In recent years, the treatment of pulmonary arterial hypertension (PAH) has gradually increased, including new drugs and surgical methods, the mortality rate of PAH patients has significantly decreased, and the average survival rate has significantly improved. However, there was no obvious improvement in sexual health, mental health, and quality of life (QoL) in patients with PAH. Although an important dimension of QoL, little is known about sexual health and sexual health-related QoL of patients with PAH in China. In this study, the female sexual function index (FSFI) scale, the Symptom Checklist-90 (SCL-90), and emPHasis-10 were used to evaluate PAH associated with congenital heart disease (CHD-PAH) patients’ sexual function, mental health, and QoL. The score of sexual function in female CHD-PAH patients ranged from 4.40 to 34.80 points, and the average score was 26.80 (19.00–27.80) points. The detection rate of sexual dysfunction was 48.30%. The FSFI score of all dimensions of the sexual dysfunction group was significantly lower than that of the nonsexual dysfunction group. In addition, the scores of SCL-90 and emPHasis-10 were significantly higher than that of the nonsexual dysfunction group (p < 0.01). The sexual function was negatively correlated with mental health (r = −0.58, p < 0.01) and QoL (r = −0.62, p < 0.01) in female CHD-PAH patients. The sexual function of female patients with CHD-PAH is not optimistic. Sexual health may impact mental health and overall QoL in female PAH patients. Reasonable intervention measures should be taken to improve their sexual health, so as to improve their overall QoL.

Keywords
congenital heart disease, mental health, pulmonary arterial hypertension, quality of life, sexual function
INTRODUCTION

Pulmonary hypertension (PH) is a rare disease, characterized by increased elevated pulmonary vascular resistance, pulmonary vascular remodeling, and progressive right-ventricular failure leading to premature death.\textsuperscript{1–4} Clinically, PH is divided into five categories: (1) pulmonary arterial hypertension (PAH); (2) PH caused by left heart disease; (3) PH due to pulmonary disease and/or hypoxia; (4) chronic thromboembolic pulmonary hypertension and/or other pulmonary arterial obstructive disease PH; (5) PH caused by unknown and/or multiple factors.\textsuperscript{5,6} The fatality rate of patients with severe pulmonary vascular disease is as high as 30%–50%. Patients with severe PAH survived only 2.8 years from diagnosis to death without specific treatment.\textsuperscript{7} Currently, about half of patients still have a New York Heart Function Assessment (NYHA) classification Class III–IV, which remains a valuable clinical tool often used to describe the functional capacity of adults with congenital heart disease. These patients have significant pulmonary hemodynamic abnormalities and are frequently hospitalized repeatedly due to the deterioration of their condition.\textsuperscript{8} Congenital heart disease-PAH (CHD-PAH) is the most common cause of PAH in China.\textsuperscript{9}

PAH is characterized by progressive limitations on physical activity and health-related quality of life (QoL). Health-related QoL defects may extend beyond traditional physical activity, mental health, and emotional health to sexual health and sexual function. Seventy-two percent of partner caregivers of patients with PAH reported a decrease in sexual relationships. Caregivers feel less connected to their spouse (23%) and feel that their spouse sees them more as caregivers than lovers (18%).\textsuperscript{10} For the majority of women with PAH, the disease absorbed most of their lives, so sexual health was often ignored. Many patients also manifested feelings of inadequacy and shame, which limited their intimacy and compromised their body image.\textsuperscript{11} Many participants revealed that they had never discussed sexual behavior with health professionals and hoped to strengthen communication and discussion with providers.\textsuperscript{12} Therefore, further targeted qualitative and quantitative research is needed to better characterize and improve the sexual health-related QoL of PAH patients, especially female patients.

Although some treatments can improve the patient’s hemodynamics and exercise capacity, there are still significant problems in functional status and QoL. Therefore, mental health and QoL of PAH patients have attracted more and more attention from scholars in China and abroad, and related research has gradually increased.\textsuperscript{13–18} The QoL in patients with PAH was at a low level, and the scores of each dimension were significantly lower than the norm of the general population in China.\textsuperscript{13,14} However, researchers in China mostly use medical outcomes study 36-item short-form health survey (SF-36) to evaluate the QoL of PAH patients. Studies have shown that SF-36 was suitable for QoL assessment in patients with PAH, but lacks specificity. The emPHasis-10 was short and practical, which is convenient for patients to fill in.\textsuperscript{16} Chen Yue-Xiang translated it into Chinese version and confirmed that the Chinese version of emPHasis-10 has satisfied reliability and validity, which is suitable for the assessment of the QoL of PAH patients in China.\textsuperscript{17}

Due to the long course of the disease, severe disease, uncertainty of prognosis, physical pain, and economic burden, the mental health of PAH was seriously affected. Many studies have shown that PAH patients have different degrees of anxiety and depression symptoms. It is reported that up to 50% of PAH patients have depression and anxiety symptoms.\textsuperscript{19–22} These symptoms may have a profound impact on the QoL of patients. SF-36 score was significantly decreased in PAH patients with severe mental illness, and there was a significant negative correlation between depression, anxiety, and QoL.\textsuperscript{23,24} Psychological problems were common in PAH patients and lead to impaired QoL.\textsuperscript{25} The patient’s psychological problems such as depression and panic may reduce the sexual relationship and intimacy to some extent.\textsuperscript{26}

Sexual health is an important part of QoL. In China, sexual health is considered to be a particularly sensitive topic, which is rarely mentioned by patients, and there is no sexual behavior guidance for PAH patients.\textsuperscript{27} PAH alters women’s self-perceptions, relationships, sexual behavior, and thoughts about pregnancy.\textsuperscript{12} Patients lack comfort discussing sensitive topics and are reluctant to share intimate details of their relationships and sex lives, cultural sensitivities that make sexual activity taboo, or time constraints.\textsuperscript{28} This study investigated the sexual function of female CHD-PAH patients and assessed their QoL with emPHasis-10. The correlation between sexual function, mental health, and QoL was analyzed, so as to provide a reference for the guidance and related intervention of PAH sexual health in the future. The study hypothesized that sexual function was negatively correlated with mental health and QoL in female PAH patients.

MATERIALS AND METHODS

Study setting and population

This study was a cross-sectional study. We delivered the online questionnaire created through Google Forms to participants via WeChat groups. The first part of the
questionnaire introduces the purpose of this study, and participants are required to sign informed consent before participating in the survey. In this study, 150 female CHD-PAH patients treated in the outpatient and inpatient department of Cardiology from the Second Xiangya Hospital of Central South University in China from January 2021 to June 2022 were selected by facilitating the sampling method. We did not combine men and women for this study given the marked physiologic and psychologic differences in sexual function by sex.

Inclusion criteria were as follows: (1) female patients with CHD-PAH, confirmed by right heart catheterization in accordance with the Diagnostic criteria of the European Heart Society for PAH (mean pulmonary artery pressure, determined by right heart catheterization at the sea level at rest, mean pulmonary arterial pressure $\geq 25$ mmHg, and pulmonary arterial wedge pressure $\leq 15$ mmHg in the absence of other forms of PAH); (2) 18 years $\leq$ age $\leq$ 75 years; (3) have basic reading comprehension ability; (4) Informed consent and voluntary participation in the study. Exclusion criteria were as follows: (1) NYHA classification was Class IV and had symptoms of right heart failure; (2) complicated with other serious organ diseases; (3) never had sexual experience; (4) psychological problems caused by other diseases; (5) repeat outpatient visits or hospitalization during the study period.

The sample size was calculated by Gpower3.1 software, with an effect size = 0.6, $\alpha = 0.05$, $1 - \beta = 0.95$, and bilateral probability values. The sample size required for the nonparametric test of two independent samples was $N_1 = N_2 = 64$.

**Tools**

**General information form**

The main content includes age, marital status, per-capita income of the family, education level, occupation, medical insurance, course of disease, pulmonary artery pressure, NYHA classification, 6 min walking distance (6MWD), and comorbidities.

**Female sexual function index (FSFI)**

FSFI scale was used to assess the sexual health of females. FSFI contains 19 items and addresses women’s sexual function in six dimensions including desire, arousal, lubrication, orgasm, satisfaction, and pain, each dimension score for entry points and with the corresponding coefficient of the product. The score of each dimension is the product of the sum of the item scores and the corresponding coefficient, and the total score is the sum of the scores of each dimension, ranging from 2 to 36. A higher score in each domain indicates better status. When the FSFI score is lower than 26.55, the participant is considered to have sexual dysfunction. Cronbach’s $\alpha$-coefficient for each dimension of FSFI was greater than 0.82.29,30

**Symptom Checklist-90 (SCL-90)**

SCL-90 was used to measure an individual's mental health. It contains 90 items designed in the form of a 5-point Likert scale including somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, and other 10 dimensions. The total score is the sum of the scores of each dimension, and the score of each factor is the total score of each item/the number of items. Cronbach’s $\alpha$-coefficients were 0.862.31

**emPHasis-10**

emPHasis-10 was developed by UK academician Janelle Yorke to assess QoL in PAH patients. The Chinese version of emPHasis-10 has good reliability and validity (Cronbach’s $\alpha$-coefficient was 0.90 and retest reliability was 0.95). The 10-item scale measures energy, fatigue, independence, dyspnea, activity endurance, self-confidence, baggage, and happiness. Each item is scored from 0 to 5 on a scale from “none at all” to “always.” The full score of the total score is 50 points, and the higher the score, the worse the QoL of the patients.17

**Statistical analysis**

IBM SPSS Statistics version 23.0 was used to analyze data. In the normal sexual function group and the sexual dysfunction group, the dimensions of sexual function, mental health and QoL, did not meet the normal distribution; Mann–Whitney $U$-test was used for comparison between groups, and Spearman’s correlation analysis was used for correlation analysis.

**RESULTS**

A total of 150 questionnaires were sent out in this study, and 147 valid questionnaires were collected. Age ranged from 21 to 67 years old and the mean age was $37.94 \pm 10.56$ years old (see Table 1).
Status of sexual function in female CHD-PAH patients

FSFI has been widely used in China to assess the sexual dysfunction of female patients. Studies have confirmed that FSFI has a good sensitivity in female patients with pulmonary hypertension, and defined the total score less than 26.55 as sexual dysfunction. The score of sexual function in female CHD-PAH patients was from 4.40 to 34.80 points, and the average score was 26.80 (19.00–27.80) points. Seventy-one patients were less than 26.55 points and 76 patients were greater than or equal to 26.55 points, and the detection rate of sexual dysfunction was 48.30%. The average scores of all dimensions of FSFI in the sexual dysfunction group were significantly lower than those in the nonsexual dysfunction group, with statistically significant differences (see Table 2).

Comparison of mental health among female CHD-PAH patients with different FSFI scores

The average score of SCL-90 in female CHD-PAH patients was 135.00 (122.00–177.00) points. According to Table 2, the scores of SCL-90 factors in the sexual dysfunction group were higher than those in the nonsexual dysfunction group, and the differences between the groups were statistically significant (p < 0.01) (see Table 3).

Comparison of QoL in female CHD-PAH patients with different FSFI scores

The emPHasis-10 average score of female CHD-PAH patients was 16.00 (11.00–24.00) points. The emPHasis-10 score in the sexual dysfunction group was 22.00 (16.00–28.00) points, which was significantly higher than that in the nonsexual dysfunction group of 12.00 (8.00–17.00) points, and the difference was statistically significant (Z = −7.31, p = 0.00).
Correlation analysis of sexual function, mental health, and QoL in female CHD-PAH patients

The correlation analysis showed that sexual function was negatively correlated with mental health ($r = -0.58$, $p < 0.01$) and QoL ($r = -0.62$, $p < 0.01$) in female CHD-PAH patients (see Table 4).

**DISCUSSION**

In this study, the average score of sexual function of female CHD-PAH patients was 26.80 (19.00–27.80) points; 71 patients had sexual dysfunction, and the detection rate of sexual dysfunction was 48.30%, indicating that female CHD-PAH patients were at a low level, which was consistent with the findings of Banerjee et al.\(^{27}\) Oliveira et al.\(^{32}\) found that 71.8% of patients claimed sexual dysfunction, with FSFI score < 26.55. The impact of PAH on sexual health and function may be unique. Cardiopulmonary function of PAH patients was impaired, and increased activity will bring greater challenges to the cardiopulmonary function of patients. When the patient has sexual intercourse, the heart load will increase, and the symptoms of dyspnea will be more pronounced. Second, PAH may affect patients’ sexual function due to various treatments, such as subcutaneous injection pumps, intravenous drugs, adverse reactions of oral drugs, and discomfort caused by the disease itself.\(^{27}\) Patients (and sexual partners) are concerned about catheter displacement, treatment interruption, and pump displacement.\(^{11}\) Side effects such as vaginal dryness in patients using diuretics and massive and/or prolonged

### Table 2: Comparison of FSFI score between the sexual dysfunction group and nonsexual dysfunction group

| Variable   | Score \( \leq 26.55 \) | Score \( > 26.55 \) | Z  | \( p \) Value |
|------------|-------------------------|---------------------|----|--------------|
| Desire     | 3.00 (1.60–3.60)        | 5.00 (5.00–5.00)    | −10.39 | 0.00         |
| Arousal    | 3.00 (2.60–4.00)        | 5.00 (5.00–5.00)    | −10.40 | 0.00         |
| Lubrication| 3.00 (1.40–3.00)        | 4.80 (4.80–5.00)    | −10.08 | 0.00         |
| Orgasm     | 3.00 (1.40–3.00)        | 4.00 (3.00–5.00)    | −8.83  | 0.00         |
| Satisfaction| 3.00 (1.00–3.00)      | 4.00 (4.00–5.00)    | −10.11 | 0.00         |
| Pain       | 3.00 (2.00–4.00)        | 5.00 (5.00–5.00)    | −11.10 | 0.00         |
| Total score| 19.00 (10.00–20.00)     | 27.80 (26.80–30.00) | −10.50 | 0.00         |

**Abbreviation:** FSFI, female sexual function index.

### Table 3: Comparison of mental health of patients with different FSFI scores

| Variable           | Score \( \leq 26.55 \) | Score \( > 26.55 \) | Z  | \( p \) Value |
|--------------------|-------------------------|---------------------|----|--------------|
| Somatization       | 2.08 (1.58–2.75)        | 1.50 (1.25–1.81)    | −5.77 | 0.00         |
| Forced symptoms    | 2.00 (1.70–2.70)        | 1.40 (1.20–1.90)    | −5.39 | 0.00         |
| Interpersonal sensitivity | 1.78 (1.44–2.44) | 1.33 (1.11–1.44)    | −5.57 | 0.00         |
| Depression         | 2.00 (1.69–2.69)        | 1.46 (1.31–1.75)    | −5.54 | 0.00         |
| Anxiety            | 2.00 (1.60–2.40)        | 1.40 (1.20–1.68)    | −6.056| 0.00         |
| Hostile            | 2.00 (1.50–2.67)        | 1.33 (1.17–1.63)    | −5.99 | 0.00         |
| Fear               | 1.57 (1.14–2.00)        | 1.14 (1.00–1.429)   | −5.45 | 0.00         |
| Paranoid           | 1.50 (1.17–2.33)        | 1.17 (1.00–1.333)   | −5.60 | 0.00         |
| Psychotic          | 1.50 (1.30–2.30)        | 1.30 (1.10–1.50)    | −5.07 | 0.00         |
| Other              | 2.00 (1.71–2.43)        | 1.43 (1.29–1.71)    | −6.38 | 0.00         |
| Total score        | 165.00 (137.00–223.00)  | 125.50 (115.00–135.00) | −6.87 | 0.00         |

**Abbreviation:** FSFI, female sexual function index.
TABLE 4  Correlation of sexual function with mental health and QoL in female CHD-PAH patients

| Variable          | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      | 17      | 18      | 19      |
|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. Desire         | 0.92*   | 0.91*   | 0.79*   | 0.89*   | 0.92*   | 0.93*   | −0.48*  | −0.43*  | −0.41*  | −0.43*  | −0.45*  | −0.45*  | −0.44*  | −0.45*  | −0.38*  | −0.47*  | −0.52*  | −0.62*  |
| 2. Arousal        | 0.93*   | 0.83*   | 0.92*   | 0.94*   | −0.52*  | −0.46*  | −0.48*  | −0.47*  | −0.50*  | −0.51*  | −0.48*  | −0.50*  | −0.43*  | −0.50*  | −0.58*  | −0.61*  |       |
| 3. Lubrication    | 0.91*   | 0.97*   | 0.91*   | 0.97*   | −0.46*  | −0.43*  | −0.47*  | −0.46*  | −0.45*  | −0.44*  | −0.43*  | −0.45*  | −0.43*  | −0.50*  | −0.54*  | −0.60*  |       |
| 4. Orgasm         | 0.93*   | 0.85*   | 0.94*   | −0.46*  | −0.44*  | −0.42*  | −0.49*  | −0.44*  | −0.40*  | −0.42*  | −0.48*  | −0.50*  | −0.48*  | −0.55*  | −0.54*  |       |
| 5. Satisfaction   | 0.91*   | 0.97*   | −0.47*  | −0.43*  | −0.42*  | −0.46*  | −0.44*  | −0.43*  | −0.42*  | −0.47*  | −0.44*  | −0.49*  | −0.54*  | −0.59*  |       |
| 6. Pain           | 0.93*   | −0.48*  | −0.44*  | −0.46*  | −0.46*  | −0.48*  | −0.48*  | −0.44*  | −0.48*  | −0.44*  | −0.41*  | −0.50*  | −0.55*  | −0.59*  |       |
| 7. Sexual function| −0.50*  | −0.46*  | −0.45*  | −0.48*  | −0.46*  | −0.48*  | −0.46*  | −0.45*  | −0.50*  | −0.46*  | −0.50*  | −0.58*  | −0.62*  |       |
| 8. Somatization   | 0.66*   | 0.50*   | 0.56*   | 0.63*   | 0.60*   | 0.56*   | 0.58*   | 0.56*   | 0.54*   | 0.79*   | 0.75*   |       |
| 9. Obsessive-compulsive | 0.64*   | 0.64*   | 0.76*   | 0.63*   | 0.69*   | 0.68*   | 0.67*   | 0.48*   | 0.84*   | 0.62*   |       |
| 10. Interpersonal sensitivity | 0.66*   | 0.75*   | 0.76*   | 0.62*   | 0.74*   | 0.63*   | 0.57*   | 0.81*   | 0.48*   |       |
| 11. Depression    | 0.66*   | 0.63*   | 0.55*   | 0.68*   | 0.73*   | 0.65*   | 0.82*   | 0.62*   |       |
| 12. Anxiety       | 0.76*   | 0.78*   | 0.64*   | 0.60*   | 0.60*   | 0.88*   | 0.62*   |       |
| 13. Hostility     | 0.67*   | 0.67*   | 0.67*   | 0.52*   | 0.50*   | 0.79*   | 0.56*   |       |
| 14. Phobic anxiety| 0.60*   | 0.49*   | 0.42*   | 0.75*   | 0.63*   |       |
| 15. Paranoid ideation | 0.68*   | 0.48*   | 0.80*   | 0.53*   |       |
| 16. Psychoticism  | 0.70*   | 0.77*   | 0.63*   |       |
| 17. Other         | 0.71*   | 0.60*   |       |
| 18. Mental health |       |       |       |       |
| 19. QoL           |       |       |       |       |

Abbreviations: CHD-PAH, congenital heart disease-pulmonary arterial hypertension; QoL, quality of life.
*p < 0.01.
menstrual bleeding in patients with anticoagulants negatively affect sexual activity. In addition, the disease altered perceptions of intimacy, sexuality, and attitudes toward pregnancy among women with PAH. As up to 80% of PAH patients were women, Pregnancy increases the risk of disease exacerbation, and patients fear of pregnancy may impact sexual and reproductive health in women of childbearing age and their partners because pregnancy was strongly discouraged, due to the risk of pregnancy-related death.

Anxiety and depression are common in PAH and it is conceivable that this may be driven in part by as yet unquantified effects on sexual relationships and feelings of intimacy. This study confirmed the hypothesis that sexual function was negatively correlated with mental health and QoL in female CHD-PAH patients, while QoL was positively correlated with mental health, and the differences were statistically significant ($p < 0.01$). The scores of each factor of SCL-90 and emPHasis-10 in the sexual dysfunction group were significantly higher than those in the nonsexual dysfunction group. Marian Petersen's study on patients with epilepsy and multiple sclerosis concluded that female sexual function was related to physical and mental health. The poorer the patient's mental health, the lower the desire, and the decrease in sexual satisfaction. Patients expressed guilt about the impact of their illness on their sexual partners and their relationships. Sexual function was significantly affected by stress, anxiety, and depression. Women with positive and satisfactory functions have higher emotional satisfaction and mental health. Vaginal intercourse can improve people's mental health, reduce depression and suicide attempts, and reduce psychosis and neuroticism. Sexual health is an important part of QoL. Female sexual dysfunction (decreased sexual desire, inability to reach orgasm, and difficulty in sexual intercourse) is an independent predictor of adverse cardiovascular events and poor QoL. Studies have reported that sexual function and QoL of female CHD-PAH patients were significantly correlated, and sexual health will affect patients' overall QoL. The better the QoL in sexual health, the higher the overall QoL. In this study, the QoL assessment adopts emPHasis-10. The higher the score, the worse the QoL of patients. The study found that QoL was significantly positively correlated with mental health. It was reported that 50.6% of PAH patients had different degrees of depression, including 19.2% major depressive disorder, 14.8% panic disorder, and 7.1% phobia. The QoL of patients with severe mental disorders was significantly impaired. The scores of SF-36 of PAH patients complicated with severe mental diseases decreased significantly, and there was a significant negative correlation between depression and anxiety ($p < 0.05$) and QoL. The results showed that the better the sexual health status, the higher the mental health level and the better the QoL.

**SUMMARY**

Female patients with PAH had a high level of sexual dysfunction. The sexual function was significantly correlated with poor mental health and QoL. PAH is a negative life event and has a serious impact on physical and mental health. It is suggested that sexual activity suggestions and guidance suitable for patients with PAH should be formulated as soon as possible to improve their sexual function.

**LIMITATION**

The subjects selected in this study were all female patients with CHD-PAH. The sample size of the study was small, and it was a cross-sectional study. This study only analyzed the correlation between sexual function, mental health, and QoL. Future studies can expand the sample size, compare patients with different types of PAH, and carry out corresponding interventions. The relationship between sexual function, mental health, and QoL of patients can be further explored.

**AUTHOR CONTRIBUTIONS**

Conceptualization: Ting Luo and Jun Luo. Data curation: Sisi Chen and Wen Zhou. Formal analysis: Sisi Chen and Jun Luo. Investigation: Ting Luo and Wen Zhou. Methodology: Lingzhi Huang and Ting Luo. Supervision: Lingzhi Huang. Software: Sisi Chen and Ting Luo. Writing – original draft: Sisi Chen. Writing – review and editing: Lingzhi Huang and Ting Luo.

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**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

**DATA AVAILABILITY STATEMENT**

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.
ETHICS STATEMENT
All participants fulfilled the informed consent. The study was approved by the Ethics Committee of the Second Xiangya Hospital of Central South University. Ethics Approval No. 2021 and Lunshen No. Yan 157.

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