BMC Women's Health

RESEARCH

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The relationship between stress perception and anxiety among patients with polycystic ovary syndrome: the mediating role of negative coping strategies

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Abstract

Objective Polycystic ovary syndrome (PCOS) is a highly prevalent disorder that not only induces physical alterations and discomfort, but also exerts an impact on mental health. This study aimed to examine the mediating effects of negative coping strategies on the relationship between perceived stress and anxiety.

Methods In total, 219 women diagnosed with PCOS were recruited from the reproductive clinic of a grade 3 class A hospital in Harbin. A questionnaire-based survey was conducted using the Self-Rating Anxiety Scale, Perceived Stress Scale, and Simplified Coping Strategies Questionnaire. Data were analyzed using descriptive statistics, Pearson's correlation analysis, and mediation effect analysis.

Results The results revealed that 35% of the participants experienced anxiety, including 8% with moderate anxiety and 3% with severe anxiety. A significant positive correlation was observed between perceived stress and anxiety. Moreover, negative coping strategies were found to significantly mediate the relationship between perceived stress and anxiety ($p < 0.05$).

Conclusions These results indicated that anxiety was a common psychological issue among PCOS patients. The numerous pressures associated with disease and daily life activities were important related factors that were linked to anxiety. Meanwhile, higher levels of perceived stress were associated with increased use of negative coping strategies, which in turn were correlated with elevated anxiety levels. Therefore, interventions aimed at improving coping strategies may help reduce stress and alleviate anxiety in women with PCOS.

Keywords Polycystic ovary syndrome, Negative coping strategies, Anxiety, Perceived stress, Mediation

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Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine and metabolic disorder that affects approximately 10% of reproductive-aged women, according to the Androgen Excess and Polycystic Ovary Syndrome Society [1]. The external symptoms of PCOS, which include menstrual disorders, obesity, hirsutism, acne, and androgenic alopecia [2], can further lead to complications, especially cardiovascular diseases [3]. As compared to healthy controls, women with PCOS exhibit significantly higher levels of anxiety, with a reported prevalence of 39.2% [4]. Anxiety imposes a considerable psychological burden characterized by a prolonged state of tension and unease, thereby increasing perceived stress, which may exacerbate the physical symptoms of PCOS and result in severe sleep disorders, depression, and other psychological disorders [5]. Moreover, anxiety can impair attention, memory, and decision-making abilities, which reduce work efficiency and learning ability [6]. Anxiety can also lead to emotional instability, negatively affecting interpersonal relationships [7]. Therefore, identifying the underlying mechanism of PCOS can facilitate healthcare providers to more accurately detect and address psychological issues of PCOS patients, enable better disease management, improve treatment adherence, and enhance subjective well-being and confidence. Moreover, such research offers new perspectives for the study of PCOS, thereby contributing to a more comprehensive understanding of the mental health challenges associated with this disorder.

Notably, PCOS patients experience higher levels of perceived stress [8], which may arise from physical discomfort directly caused by this disorder or from social and familial conflicts or dissatisfaction. Severe perceived stress levels of PCOS patients are often accompanied by increased anxiety levels [9]. For example, unfounded fear of disease complications can lead to anxiety about medical diagnoses [10], especially for women with infertility disorders, who often endure profound emotional distress while simultaneously confronting familial conflicts and stress [11], which can trigger negative emotions. Moreover, external symptoms, such as obesity, hirsutism, acne, and androgenetic alopecia, can lead to diminished self-esteem and impair performance in social, occupational, and academic settings, thereby further exacerbating anxiety levels [12]. Thus, perceived stress is an important factor in the development of anxiety. However, the specific psychological mechanisms linking stress perception to anxiety remain unclear, thus warranting further in-depth investigations.

Negative coping strategies are maladaptive behaviors often employed when confronted with stress, such as avoidance and emotional suppression [13]. Individuals diagnosed with an illness often resort to negative emotional coping strategies, which may intensify both stress and anxiety [14]. This phenomenon has been demonstrated in pregnant women with human immunodeficiency virus infection, who typically experience elevated anxiety levels and more heavily employ emotion-focused coping mechanisms [15]. A large body of research evidence indicates that there is a prevalent tendency among patients with PCOS to adopt negative coping strategies. While such strategies may help individuals avoid distress in the short term, they will exacerbate psychological distress in the long run, thereby forming a vicious cycle [16, 17]. Notably, patients with PCOS are more inclined than healthy women to adopt negative coping strategies such as avoidance and emotional suppression, and these strategies have been consistently associated with significantly higher levels of anxiety and depressive symptoms in this population [18]. When an individual repeatedly relies on negative coping strategies, such as avoidance and denial, the problem remains unresolved, and the resulting guilt and powerlessness can amplify catastrophic assessment of the severity of symptoms, thereby further elevating anxiety and distress [19]. Negative coping strategies can also affect the health-related quality of life [20], amplifying the subsequent impacts by enhancing the perception of physical symptoms and pain [21], which further affects mental health status. Reliance on negative coping strategies among PCOS patients in response to stress is closely linked to psychological disorders such as anxiety and depression. Moreover, negative coping has been established as a key psychological indicator for understanding, predicting, and identifying anxiety risk in this population [18]. However, it remains unclear whether negative coping strategies can mediate the association of stress perception with the anxiety of PCOS patients Therefore, further research is warranted to enrich the existing literature.

In addition to physical discomfort, PCOS patients can also experience psychological issues, such as anxiety, that deserve attention. However, most existing studies have focused on the influence of a single factor, such as body image or the impact of obesity, on the extent of anxiety of PCOS patients, while ignoring the impacts of perceived stress and coping strategies. A comprehensive understanding of the psychological mechanisms underlying anxiety in PCOS is essential to develop more effective and targeted interventions. Therefore, continued research is necessary to clarify the interplay among perceived stress, negative coping strategies, and anxiety of PCOS patients.

Building upon previous research and relevant theoretical frameworks, this study aimed to investigate the relationship of perceived stress with anxiety, and to determine whether negative coping strategies served as a mediating factor. The goal was to contribute to

theoretical development and provide practical recommendations to improve the mental health of PCOS patients Based on this rationale, we hypothesized that negative coping strategies mediated the relationship of perceived stress with anxiety.

Materials and methods

Participants

In total, 219 women diagnosed with PCOS were enrolled by using a random number table from the reproductive clinic of a Grade 3 Class A hospital in Harbin, China, from April 2023 to May 2024, to participate in the survey. The study protocol was approved by the Institutional Review Committee of Harbin Medical University and conducted in accordance with the ethical principles for medical research involving human subjects described in the Declaration of Helsinki. Prior to inclusion in this study, informed consent was obtained from all participants.

The sample size was estimated using G*Power software. Based on a linear regression R^2 deviation from a zero model, with an effect size $f^2 = 0.10$, $\alpha = 0.05$, power = 0.95, and controlling for six covariates, a minimum of 158 subjects was required. Considering the presence of invalid samples and missing data, 219 women with PCOS were ultimately included. This sample size fulfilled the empirical requirement for a bias-corrected bootstrap mediation test with greater than 80% power.

All participants completed the required questionnaires. In the data collection stage, there is no incomplete questionnaires or missing values, because investigators checked each patient's completed questionnaire to ensure that all sections were properly filled out. The only inclusion criterion was meeting the 2003 Rotterdam criteria for PCOS, while the only exclusion criterion was any condition that could potentially elevate androgen levels, such as Cushing's syndrome or adrenal cortical hyperplasia.

A diagnosis of PCOS was confirmed if two of the following three diagnostic criteria were met.

(1) Transvaginal ultrasound, conducted by an experienced sonographer, confirming that one or both ovaries contained more than 12 follicles, each with a diameter of 2–9 mm, and/or the ovarian volume exceeded 10 mL.
(2) Hyperandrogenemia and/or clinical manifestations indicative of high androgen levels. Hyperandrogenemia is primarily characterized by excessive androgen secretion, hirsutism, and acne, and is diagnosed by a physician through physical examination of the patient).
(3) Sparse ovulation or anovulation. A progesterone level < 3 ng/mL from blood drawn 7 days before expected menstruation.

Measures

The Self-Rating Anxiety Scale (SAS), developed by Professor W.K. Zung in 1971 [22], was employed to assess anxiety levels. The SAS comprised 20 items, each rated on a 4-point Likert scale, with higher scores indicating greater severity of anxiety symptoms. Notably, items 5, 9, 13, 17, and 19 were reverse-scored, from 4 to 1. The raw score was calculated as the sum of all 20 items, which was then multiplied by 1.25 and rounded to the nearest whole number to derive the standard score. A standard score > 50 indicated anxiety, where 50–59 represented mild anxiety, 60–69 moderate anxiety, and ≥ 70 severe anxiety. The SAS had strong reliability and validity (Cronbach's α coefficient = 0.88).

The Perceived Stress Scale (PSS), originally developed by Cohen et al. in 1983 and translated into a Chinese version by Yang and Huang in 2003 [23], consisted of 14 items, covering two dimensions: tension and a sense of loss of control. Responses were rated on a 5-point Likert scale, ranging from 0 ("never") to 4 ("always"). The total score ranged from 0 to 56, with higher scores suggesting higher levels of perceived stress. The overall Cronbach's α coefficient of the PSS was 0.78, indicating good reliability and validity.

The Simplified Coping Strategies Questionnaire (SCSQ) [24], developed by Xie et al. in 1995, was tailored to the Chinese population and designed to assess typical coping strategies in response to stress or adversity. The SCSQ included two subscales: positive and negative coping strategies. Applicable to both adolescents and adults, the SCSQ is frequently utilized in mental health research, clinical evaluations, and as a tool for self-reflection. The SCSQ contained 20 items in total, including eight items addressing negative coping strategies, which were further divided into three dimensions: avoidance, self-blame, and emotional repression. With a Cronbach's α of 0.75 for the negative coping subscale, the SCSQ demonstrated robust reliability and validity.

Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics for Windows (version 26.0; IBM Corporation, Armonk, N.Y., USA). Measured data are presented as the mean ± standard deviation (SD). Pearson's correlation analysis was conducted to identify relationships among three variables: perceived stress, anxiety, and negative coping strategies. The PROCESS regression-based modeling tool (model 4; https://www.processmacro.org/index.html) was utilized to assess the mediating effect of negati ve coping strategies.

Table 1 Patient demographics ($n = 219$)

	Mean ± SD	*n*	%
Age	30.11 ± 4.08		
BMI	25.36 ± 4.39		
Height/cm	160.08 ± 19.40		
Education level			
Junior high school		46	21.00
High school		55	25.12
Undergraduate and above		118	53.88
Fertility status			
Yes		16	7.31
No		203	92.69

BMI Body mass index

Table 2 Anxiety status of women with PCOS

Anxiety status	*n*	%
None	142	65
Mild	53	24
Moderate	17	8
Severe	7	3

Table 3 Correlations of variables

	Mean ± SD	Perceived stress	Negative coping strategies	Anxiety
Perceived stress	42.89 ± 8.49	1		
Negative coping strategies	10.64 ± 4.90	0.277**	1	
Anxiety	47.65 ± 10.02	0.272**	0.250**	1

**Significant correlation at the 0.01 level (two-tailed)

Results

Common method bias test

All responses to the self-reported questionnaires were by the participants. Common method bias was examined using Harman's single-factor test. An exploratory factor analysis including all items of the study variables was conducted. Eleven factors emerged with eigenvalues greater than 1, and the first unrotated factor explained 18.18% of the total variance, which was well below the 40% threshold. Thus, common method bias was unlikely to substantially distort the reported findings.

Patient demographics

The patient demographics are summarized in Table 1. The mean age (± SD), Body Mass Index (BMI) and average height of the 219 participants were 30.11 ± 4.08 years, 25.36 ± 4.39, and 160.08 ± 19.40 cm, respectively. 53.88% had a bachelor's degree, and 92.69% had not given birth.

Current anxiety status among PCOS patients

The results in Table 2 indicated that anxiety was a prevalent psychological concern among women with PCOS. Specifically, 35% of the participants exhibited symptoms of anxiety, with 24% classified as having mild anxiety, 8% as moderate, and 3% as severe.

Correlations of variables

The results in Table 3 indicated that, overall, women with PCOS exhibited moderate levels of perceived stress, reliance on negative coping mechanisms, and anxiety symptoms. Pearson's correlation analysis was conducted to examine the relationships among perceived stress, negative coping mechanisms, and anxiety. The findings revealed a significant positive correlation between perceived stress and negative coping mechanisms among women with PCOS ($r = 0.277$, $p < 0.01$). Similarly, a positive correlation was observed between negative coping mechanisms and anxiety ($r = 0.250$, $p < 0.01$), as well as between perceived stress and anxiety ($r = 0.272$, $p < 0.01$).

Mediation model validation

Based on the findings of the correlation analysis, we further investigated the mediating role of negative coping strategies in the relationship between perceived stress and anxiety. In the first step, linear regression analysis was conducted, with perceived stress as the independent variable and anxiety as the dependent variable. The results revealed a significant predictive effect of perceived stress on anxiety ($\beta = 0.3213$, $p < 0.01$).

In the second step, negative coping strategies were introduced into the regression model. The results demonstrated that perceived stress remained a significant

Table 4 Mediating effect analysis of negative coping strategies

Independent variable	Dependent variable	β	SE	t	*p*	R^2	MSE	95% CI
Perceived stress	Anxiety	0.3213	0.0771	4.1684	< 0.001	0.0741	93.3659	[0.169, 0.473]
Perceived stress	Negative coping strategies	0.1598	0.0376	4.2485	< 0.001	0.0768	22.2346	[0.086, 0.234]
Perceived stress	Anxiety	0.2594	0.0790	3.2855	< 0.005	0.1072	90.4483	[0.104, 0.415]
Negative coping strategies	Anxiety	0.3873	0.1369	2.8284	< 0.01	0.1072	90.4483	[0.104, 0.415]

Note. β = Standardized regression coefficient

Table 5 Bootstrap results of mediation analysis

Variable	Effect	SE	t	*p*	Lower limit CI	Upper limit CI
Perceived stress on anxiety (total effect)	0.3407	0.0783	4.3495	0.000	0.1863	0.4951
Perceived stress on anxiety (direct effect)	0.2802	0.0799	3.5057	0.006	0.1226	0.4377
Negative coping strategies on anxiety (indirect effect)	0.0606	0.0356			0.0084	0.1442

predictor of anxiety (β = 0.2594, $p < 0.001$), although with a slightly diminished predictive power compared to the first step. Notably, negative coping strategies also emerged as a significant predictor of anxiety (β = 0.3873, $p < 0.05$).

In the third step, perceived stress was designated as the predictor variable and negative coping strategies as the outcome variable. The results indicated a significant predictive effect of perceived stress on negative coping strategies (β = 0.1598, $p < 0.001$). The specific results of the mediating effect are shown in Table 4.

These findings indicated that negative coping strategies played a mediating role in the relationship between perceived stress and anxiety.

Bootstrap resampling [5,000 replicates, bias-corrected 95% confidence interval (CI)] was employed to estimate the regression coefficients. All bootstrap analyses were conducted with R 4.3.0 software using the package "boot" with simple random sampling (replacement = TRUE). The random seed was set at 42,069 to ensure reproducibility. The results presented in Table 5 showed that the total effect of perceived stress on anxiety was 0.3407 (95% CI: 0.1863–0.4951), while the direct effect was 0.2802 (95% CI: 0.1226–0.4377), indicating a statistically significant direct relationship. The effect size of the indirect effect was 0.0606 (95% CI = 0.0084–0.1442). The proportion of the indirect effect of negative coping strategies in the relationship between perceived stress and anxiety was 17.79%.

These findings suggested that perceived stress not only directly affected anxiety levels but also exerted an indirect effect through negative coping strategies. In this model, negative coping strategies functioned as a partial mediator in the relationship between perceived stress and anxiety.

Discussion

This cross-sectional study identified factors influencing anxiety in women with PCOS, specifically exploring the impact of perceived stress on anxiety and examining the mediating role of negative coping strategies. The findings revealed that women with PCOS exhibited elevated levels of anxiety. Both perceived stress and negative coping strategies were positively correlated with anxiety, indicating that an increased level of either factor was associated with increased anxiety symptoms. Furthermore, negative coping strategies were shown to mediate the relationship between perceived stress and anxiety.

The results showed that 35% of women with PCOS experienced symptoms of anxiety, where mild anxiety was the most prevalent, accounting for 24%, which is consistent with findings of previous studies conducted in China. For instance, a meta-analysis from China reported an anxiety prevalence of 37% among women with PCOS [25]. However, the results of this study differed from those of investigations conducted in other countries. A survey conducted in Thailand reported a significantly lower prevalence of anxiety at 11.92% among PCOS patients [26], whereas a study from the Philippines, using the Hospital Anxiety and Depression Scale, found that 46.25% of women with PCOS met the criteria for anxiety disorder [27].

The cross-national differences in the prevalence of anxiety may be attributed to a range of factors, including cultural beliefs, regional differences among the study populations, and differences in ethnic backgrounds. For example, in Chinese culture, infertility creates a strong sense of guilt for women and debt to their husbands and in laws, thus negatively affecting relationships among family members [28]. The findings of the majority of related studies indicate that anxiety is a common psychological issue among women with PCOS, which aligned with the hypothesis and findings of the present study.

The results of this study showed that perceived stress was significantly positively correlated with anxiety in women with PCOS. As a general trend, the higher the level of perceived stress, the greater the degree of anxiety. This result is consistent with the findings of many previous studies [4]. From a physiological perspective, perceived stress can activate the stress response system,

manifesting as overexcitation of the sympathetic nervous system, which leads to increased secretion of stress hormones, such as adrenaline and cortisol. Long-term secretion of these hormones can affect the nervous system and may induce anxiety [29]. From a cognitive perspective, individuals with high levels of perceived stress tend to overestimate the severity of stressors and are more likely to interpret stressful events as uncontrollable and threatening, which may also be related to the occurrence of anxiety [30]. In addition, social and cultural factors may contribute to elevated stress levels. With the rise of modern socioeconomic standards and aesthetic expectations, women are increasingly concerned with external appearance. The external symptoms of PCOS will seriously affect the appearance and self-image of women, thereby reducing self-perceived femininity and self-confidence. Such negative self-appraisal has been associated with both depression and anxiety [31]. Moreover, in many cultures, childbearing is regarded as an important social role of women. Infertility caused by PCOS may result in misunderstanding, stigma, or discrimination from others. Lack of emotional support and understanding from family members in the face of illness may cause women with PCOS to feel isolated, further increasing the risk of anxiety [31].

The results of this study showed that negative coping strategies played a mediating role between perceived stress and anxiety. This result is consistent with most of the existing literature. In the present study, the mediating effect of negative coping strategies accounted for 17.79% of the variance in anxiety. This finding suggests that intervening in negative coping strategies can alleviate the impact of perceived stress on anxiety to a certain extent, which holds certain guiding significance for clinical practice. According to the stress and coping theory proposed by Lazarus and Folkman, which emphasizes the cognitive and emotional processes involved in stress and the management strategies employed by individuals, self-perception of stress and coping strategies are critical determinants of psychological health [32]. Previous studies have shown that expectations for positive outcomes often decrease when faced with significant adversity or major life changes [33, 34]. In the context of chronic, uncontrollable conditions, such as PCOS, maintaining a positive emotional outlook becomes especially difficult due to a perceived loss of control. As a result, women with PCOS may adopt a pessimistic explanatory strategy, stemming from the inability to manage the condition and the associated physical and psychological changes. Under the influence of these cognitive strategies, women with PCOS are more likely to adopt negative coping strategies, which are highly correlated with the occurrence of anxiety [35]. Furthermore, negative coping strategies, such as avoidance, denial, excessive worry, and rumination, may exacerbate negative perception of stress and lead to heightened anxiety levels [36, 37].

From a personality and temperament perspective, many women with PCOS tend to exhibit traits of introversion and emotional withdrawn, while attitudes are characterized by immaturity, anger, hostility, and distrust [38]. Previous studies have shown that women with PCOS exhibit obvious D-type personality traits, with higher scores for neuroticism and lower scores for openness and conscientiousness than the control group, as well as higher emotional fear and lower activity levels [39]. Distressed personality is typified by chronic negative emotions and social inhibition. Another study found that women with PCOS scored significantly higher on personality traits associated with avoidance and antisocial behavior, compared to women without PCOS. Women with PCOS also had higher incidences of mania, alcohol dependence, severe depression, and delusional disorders [40]. These findings collectively provide strong evidence that women with PCOS are more prone to adopting negative coping strategies, which might exacerbate anxiety symptoms [41, 42].

The findings of this study are also clinically significant. First, during routine diagnosis and treatment of PCOS patients, screening for psychological stress can be added to promptly identify patients with high levels of stress to timely implement intervention measures. Second, PCOS patients generally face long-term and recurrent metabolic and reproductive symptoms. Through corresponding psychological interventional methods, such as cognitive behavioral therapy, solution-focused brief therapy, and other measures, patients can be helped to establish useful concepts for coping with disease and related stress to actively seek positive ways to solve problems faced in real life [43], and to a certain extent, reduce the probability of being referred for psychiatric treatment or being prescribed antidepressants. Finally, healthcare workers can learn corresponding psychological communication or interventional methods, encourage patients to adopt correct coping strategies, help patients obtain more effective emotional regulation strategies, enhance coping abilities, and enable patients to more effectively cooperate with doctors for treatment of physical symptoms to return to normal life [44].

In summary, these results suggested that in clinical practice, psychological intervention for PCOS patients experiencing high levels of stress and anxiety should be more precisely tailored. Techniques, such as cognitive behavioral therapy, mindfulness-based interventions, and self-esteem enhancement strategies, may help patients to adjust cognition and coping strategies regarding stress and illness, and maintain a positive attitude.

Limitations

This study adopted a cross-sectional design, which could not determine the temporal sequence between variables, and thus was insufficient to infer causal relationships among perceived stress, negative coping, and anxiety. The lack of longitudinal data made it difficult to exclude the reverse causality and bidirectional dynamic effects of related variables. Future research through longitudinal studies or ecological momentary assessment is needed to further clarify the causal relationships among related variables and to test whether the improvement to coping strategies precedes the clinically significant decrease in anxiety and endocrine indicators. Only such data can determine whether intervening in negative coping is a true etiological target rather than a concomitant phenomenon, thus providing evidence for the timing and target selection of psychological intervention for PCOS.

Conclusion

The findings of this study revealed that women with PCOS exhibited elevated levels of anxiety, and that negative coping strategies mediated the relationship between perceived stress and anxiety. By examining the cognitive and behavioral aspects of PCOS patients, this study provided important insights into the psychological mechanisms underlying anxiety in this population, offering a basis for targeted intervention strategies aimed to reduce both stress and anxiety.

Furthermore, this study underscored the critical role of healthcare professionals in addressing the mental health needs of PCOS patients. Encouraging the adoption of more positive coping strategies may not only mitigate psychological distress, but also enhance treatment outcomes, improve overall quality of life, and strengthen the sense of self-efficacy to manage mental health needs.

Abbreviations

PCOS	Polycystic ovary syndrome
PSS	Perceived Stress Scale
SAS	Self-Rating Anxiety Scale
SCSQ	Simplified Coping Strategies Questionnaire

Acknowledgements

We would like to thank all women who participated in this study.

Authors' contributions

X. H., P. S. and R. Z. played a leading role in the design of the methodology and participated in the writing of the manuscript. C. S. and X. L. contributed to conceptualization and formal analysis, while actively participating in coordinating with hospitals participating in the study, and managed the survey. Y. K., X.L., and K. Q. played a leading role in data analysis. X. M. and L.S. conducted a literature review and then categorized relevant articles. Y. Y. and Z. Q. conceived and designed the study and participated in the review and writing of the manuscript. All authors have read and approved the final version of the manuscript.

Funding

No funding was received for this study.

Data availability

The Data involving patient privacy issues cannot be disclosed. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

All methods were carried out in accordance with the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of Harbin Medical University. Informed consent was obtained from all patients prior to participation. All participants were informed of the study purpose and how these data would be used.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 18 September 2025 / Accepted: 29 December 2025
Published online: 29 January 2026

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