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ORIGINAL RESEARCH

The Chain Mediating Effect of Health Literacy and Self-Care Ability on the Relationship Between Dysmenorrhea Symptoms and Negative Emotions Among Chinese Female College Students

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Background: Dysmenorrhea, a common concern among female college students, is closely linked to anxiety and depression, particularly during the early menstrual phase (the first one to two days of menstruation), when cramping pain in the lower abdomen and other discomforts occur. This study aims to assess the current status of dysmenorrhea and negative emotions among female college students and explore the factors influencing the relationship between menstrual pain and negative emotions.

Methods: A total of 1,117 female college students with moderate to severe dysmenorrhea (based on a Visual Analog Scale (VAS) ≥ 4) were recruited from five universities in Guangdong Province through purposive and convenience sampling to complete an online survey between August and October 2024. Data were collected using multiple standardized scales. Pearson correlation coefficients were used to examine the relationships between variables. Multiple linear regression analysis was conducted to analyze the effects of variables with statistically significant differences ($P < 0.05$) identified through one-way ANOVA, independent sample t-tests, and correlation analysis on psychological levels. Structural Equation Modeling (SEM) was used to explore mediating effects.

Results: This study shows that dysmenorrhea symptoms, health literacy, self-care ability, and negative emotions are significantly correlated. Health literacy and self-care ability play a chain mediating role between dysmenorrhea symptoms and negative emotions, with a mediating effect of 0.026, accounting for 4.87% of the total effect.

Conclusion: The findings suggests that health literacy and self-care ability play a chain-mediating role between dysmenorrhea symptoms and negative emotions. It provides new insights for intervening in emotional issues related to dysmenorrhea in female college students. Universities and healthcare institutions should focus on enhancing health literacy and self-care abilities among female college students, offering effective health education and resources to help them better manage menstrual pain and reduce anxiety and depression.

Keywords: dysmenorrhea symptoms, health literacy, self-care ability, negative emotions, female college students

Introduction

Dysmenorrhea refers to a combination of symptoms characterized by cramping pain in the lower abdomen and other discomforts that occur before or during the menstrual phase. This pain is often accompanied by abdominal spasms and may be associated with systemic symptoms such as nausea, headaches, and fatigue.[1] Dysmenorrhea is classified into primary and secondary types. Primary dysmenorrhea refers to lower abdominal pain that occurs specifically during the menstrual phase in the absence of any organic pathology. It is most common among young women aged 15–25 and is the

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more prevalent and extensively studied form of dysmenorrhea.[2] In contrast, secondary dysmenorrhea is caused by organic pelvic conditions, such as endometriosis or uterine fibroids, which lead to pain.[3] The global prevalence of dysmenorrhea ranges from 20% to 90%,[1] with a higher prevalence in young women.[4] A systematic review of 21,573 young female students found that the prevalence of dysmenorrhea (period pain) is as high as 71.1%. Dysmenorrhea and its associated symptoms are very common in young women under 25 years old, and have a significant negative impact on their academic performance, social interactions, and emotional well-being.[5,6] Therefore, college students are an important group that cannot be ignored in dysmenorrhea research, and they also represent a significant public health challenge.

Relationship Between Dysmenorrhea Symptoms and Negative Emotions

Recent studies have shown that dysmenorrhea can affect women's quality of life and mental health. For example, a study conducted at a university in Saudi Arabia reported that women with dysmenorrhea reported higher levels of mental health issues, such as anxiety and depression.[7] A cross-sectional survey also found that 42.5% of adolescents and young adults aged 26 and under with dysmenorrhea exhibited widespread symptoms of anxiety or depression.[8] Additionally, a study conducted in Poland found that women experiencing more severe menstrual pain had a higher prevalence of depression, anxiety, and overall poor mental health.[9] Most studies indicate that anxiety and depression are psychological disorders that are significantly positively correlated with dysmenorrhea symptoms.[10] As a global common health problem, dysmenorrhea is affected by many factors, including demographic characteristics, lifestyle, eating habits, reproductive factors, and psychological and social environment.[11] However, although the physical symptoms of dysmenorrhea have received much attention, mental health, especially negative emotions such as anxiety and depression, often has not received enough attention, especially in the college student population. Therefore, in-depth research on the relationship between dysmenorrhea and anxiety and depression can not only help us understand the multi-dimensional impact of dysmenorrhea more comprehensively, but also provide more scientific mental health intervention and support for female college students, which is of great practical significance for improving the overall health level of college students and promoting their comprehensive psychological and physiological development.

The Potential Mediating Effect of Health Literacy

Health literacy refers to an individual's ability to access, understand, and apply health information, which is crucial for effectively responding to health challenges.[12] It not only affects how individuals manage their physical health but also plays a role in how they cope with emotional distress, stress, and mental health issues. High levels of health literacy enable individuals to better understand and manage physiological symptoms, such as dysmenorrhea, thereby reducing the negative emotional impact of these symptoms.[13] Chen et al found that students with higher levels of health literacy exhibited lower levels of anxiety and depression. When facing daily or chronic stressors, such as exams, class schedules, or illness-related burdens, health literacy helps alleviate negative emotions, such as anxiety and depression, by enhancing their health knowledge and management strategies in response to these stressors.[14] Sarhan et al assessed whether health literacy is associated with health status and health behaviors among Palestinian university students.[15] The results showed a positive correlation between students' self-reported health status and higher levels of health literacy. In addition, Yao et al studied the impact of health literacy on stress, anxiety, and depression among university students, revealing that health literacy helps maintain good mental health.[16] However, there is limited literature on the relationship between dysmenorrhea symptoms, health literacy, and negative emotions (anxiety and depression) among university students. Therefore, this study proposes Hypothesis 1: Health literacy may play a significant mediating role between dysmenorrhea symptoms and negative emotions in female college students.

The Potential Mediating Effect of Self-Care Ability

The China government's "Healthy China 2030" plan emphasizes the concept of universal health and specifically calls for strengthening health education, particularly health literacy and management for adolescents.[17] As a part of personal health management, self-care ability covers many aspects such as prevention and health promotion. Individual health status largely depends on self-care management.[18] Related studies have shown that self-care can significantly improve the physical and mental health of individuals.[19] In the study by Marlene et al self-care ability was identified as a key

factor potentially influencing the relationship between disease symptoms (such as sleep problems, fatigue, and low energy) and anxiety and depression.[20] In a randomized controlled trial, adolescent girls with moderate to severe menstrual pain who participated in self-care interventions reported lower menstrual distress and physical negative psychological scores compared to the control group. This further demonstrates the positive role of self-care in alleviating both the physical and psychological symptoms associated with menstrual pain.[21] According to the Health Belief Model, an individual's health behavior is influenced by their perception of health threats (such as the severity and susceptibility to illness) and the expected benefits and barriers of taking action. When female college students perceive their dysmenorrhea symptoms as a significant health threat and evaluate self-care behaviors as effective in alleviating pain and regulating emotions, they are more likely to engage in self-care measures, thereby reducing negative emotions such as anxiety and depression.[22] Therefore, this study proposes Hypothesis 2: Self-care ability may play a crucial mediating role between dysmenorrhea symptoms and negative emotions in female college students.

The Chain Mediating Effect of Health Literacy and Self-Care Ability

Studies have found that health literacy is closely related to self-care ability.[23] Self-care ability is an important means for individuals to cope with health problems. By improving health literacy, it is beneficial to understand the physiological mechanism and management methods of the disease, and to take more active self-care measures, so as to alleviate the symptoms of the disease and reduce the generation of negative emotions.[24] According to the Health Belief Model (HBM), an individual's perception, belief and emotional state of health problems affect their health behavior. Based on this model theory, it can be considered that health literacy promotes female college students to take effective self-care measures by enhancing the cognition and coping ability of dysmenorrhea symptoms, thereby reducing dysmenorrhea symptoms and relieving negative emotions (such as anxiety and depression).[22] Therefore, this study proposes Hypothesis 3: Health literacy and self-care ability may play a chain mediating role between dysmenorrhea symptoms and negative emotions. Based on the above three assumptions, this study established the conceptual framework as shown in Figure 1.

Methods

Study Design and Participants

The study employed a cross-sectional research design. A purposive convenience sampling method was used to recruit female college students experiencing dysmenorrhea from five universities in Guangdong Province, China. Inclusion criteria: (1) female college students with clinical symptoms of dysmenorrhea, pain score (≥4 points) based on visual analogue scale (VAS); (2) aged 18–24 years; (3) body mass index (BMI) 18–30, regular menstruation, and interval of 21–35 days between two consecutive menses; (4) the duration of each bleeding episode was 3–7 days; (5) willing to participate in the study voluntarily. Exclusion criteria: Students who had not experienced dysmenorrhea or were taking medications that could affect menstrual pain. The sample size for this study was calculated by multiplying the total number of scale items by 10 ([N = 1+36+9+23+7+9] × 10 = 850),[25] with an additional 15% non-response rate considered

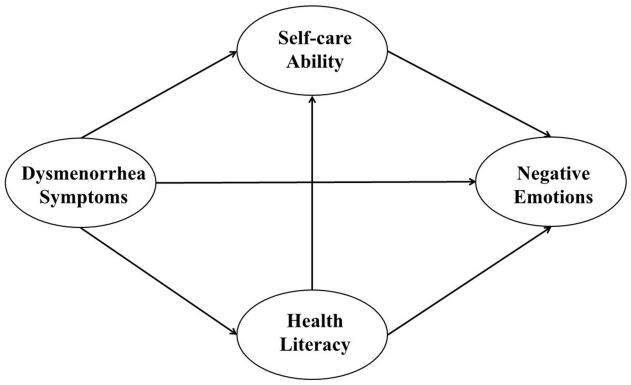

Figure 1 Conceptual Framework.

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to ensure adequate representation. After obtaining informed consent from the interviewed students, data were collected through an anonymous online questionnaire. A total of 3,325 female college students participated in the study. Among them, 33.6% (1,117 out of 3,325) reported significant dysmenorrhea with a VAS score ≥4, of which 89.3% and 10.7% experienced moderate and severe dysmenorrhea, respectively. Ultimately, 1,117 female college students with dysmenorrhea were included in the final analysis.

Data Collection

This study conducted an online survey from August to October 2024. The questionnaire was collected through the online survey platform "Questionnaire Star", with counselors and teachers directly sending the link to students. All participating university students were required to submit their responses via "Questionnaire Star", and each IP address could only submit once. Prior to distributing the questionnaire, electronic informed consent was obtained from all participants. Students were informed that their participation was completely voluntary, their responses would remain confidential, and they could withdraw from the study at any time without reason. The average time required to complete the questionnaire was approximately 15 to 25 minutes.

Measurements

Socio-Demographic and Menstrual Information Questionnaire

The sociodemographic information in this study includes age, body mass index (BMI) (underweight group: BMI < 18.5 kg/m²; normal weight group: 18.5 kg/m² ≤ BMI < 24.0 kg/m²; overweight/obese group: BMI ≥ 24.0 kg/m²), and lifestyle habits (presence of a habit of staying up late, engaging in high-intensity exercise, alcohol consumption, and smoking).

Menstrual-related information includes whether the participant has experienced menarche, the age at first menstruation, average duration of the menstrual period (in days), menstrual cycle length (in days).

Visual Analogue Score (VAS)

The Visual Analogue Scale (VAS) for pain is a subjective tool used to quantify pain intensity and was employed in this study to assess individuals' perception of menstrual pain.[26] The scale consists of a line marked from 0 to 10, where "0" represents "No pain" and "10" represents "Worst pain imaginable." VAS scores are categorized as mild (1–3), moderate (4–7), and severe (8–10). Higher scores indicate greater pain intensity. In this study, a VAS score of ≥4 is generally considered moderate or higher pain, which is clinically significant and effective for identifying participants with more pronounced dysmenorrhea symptoms. This criterion has been widely used in numerous dysmenorrhea studies globally.[27] The test-retest reliability of VAS was 0.89.

Cox Menstrual Symptom Scale (CMSS)

The Cox Menstrual Symptom Scale (CMSS) is a menstrual distress scale developed by Cox in 1978 and translated into Chinese in 2015.[28] CMSS have two subscales, CMSS severity and CMSS frequency. Each subscale contains 18 items, covered the severity and frequency of menstrual symptoms, including pain, emotional disturbances and other physical symptoms such as nausea during the menstrual period. The scale uses a five-point scoring method. Among them, the duration of "0 ~ 4" corresponding to the "no", "continuous" 3 h "and" for 3 ~ 7 h, "continuous 7 ~ 24 h", "continuous" > 24 h; The severity of "0–4 level" indicated "no discomfort", "mild discomfort, pain can be felt", "moderate discomfort, pain symptoms but do not affect daily life", "severe discomfort, pain symptoms have affected daily life", "very serious, pain symptoms have seriously affected daily life". The duration and severity of dysmenorrhea symptoms were scored separately, and the scores of each item were added to the total score. The total score ranged from 0 to 144, with higher scores indicating more severe pain in PD patients. The scale has high reliability and validity in Chinese female population (Cronbach's $\alpha = 0.833$). In this study, the Cronbach's alpha coefficient for the CMSS was 0.90.

Health Literacy Scale - Short Form 9 (HLS-SF9)

This study utilized the simplified Health Literacy Scale, HLS-SF9 (Health Literacy Scale - Short Form 9).[29] This scale is a reliable and valid tool for the rapid assessment of health literacy in the Chinese population, demonstrating good

reliability and validity. The HLS-SF9 consists of 9 items, covering three core dimensions of health literacy: the ability to access health information, the ability to understand health information, and the ability to apply health information. Each item is rated on a 4-point Likert scale. In this study, the Cronbach's alpha coefficient for the HLS-SF9 was 0.95.

Self-Care Ability Scale (SCA)

The self-care ability scale for Adolescent women with Primary dysmenorrhea was developed by CAI Yue, a Chinese scholar.[30] It included 5 dimensions (acquiring knowledge, venting emotions, seeking help, using resources, psychological hints) and 23 items. The study employed a 5-point Likert scale (1 = completely disagree to 5 = completely agree). The Cronbach's α coefficients for the five dimensions ranged from 0.797 to 0.883, demonstrating good internal consistency. The model fit indices indicated an acceptable fit: χ^2/df was 2.10 (less than the recommended threshold of 3), while GFI, CFI, and IFI were all above 0.90. Additionally, PNFI and PGFI exceeded 0.50, and both SRMR and RMSEA were below 0.08, confirming the scale's strong internal consistency and construct validity. In this study, the Cronbach's alpha coefficient for the SCA was 0.88.

Patient Health Questionnaire (PHQ)

The Patient Health Questionnaire Anxiety Module (GAD-7) consists of 7 items, while the Depression Module (PHQ-9) consists of 9 items. In this study, we used the Generalized Anxiety Disorder 7-item scale (GAD-7) and the Patient Health Questionnaire 9-item scale (PHQ-9) to measure negative emotional indicators.

The Generalized Anxiety Disorder-7 (GAD-7) scale is a concise self-report tool developed by Spitzer et al in 2006 for screening and assessing the severity of generalized anxiety disorder (GAD).[31] The GAD-7 consists of seven items rated on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly always), with a total score ranging from 0 to 21. Higher scores indicate greater severity of anxiety symptoms. Scores of 0–4 indicate minimal or no anxiety, 5–9 indicate mild anxiety, 10–14 indicate moderate anxiety, and 15–21 indicate severe anxiety. A total score of ≥10 is commonly used as a cut-off point for identifying cases of generalized anxiety disorder. In this study, the Cronbach's alpha coefficient for the GAD-7 was 0.75.

The Patient Health Questionnaire-9 (PHQ-9) is a self-report questionnaire developed by Kroenke et al in 2001,[32] widely used for screening, diagnosing, and assessing the severity of depressive symptoms. The questionnaire consists of 9 items rated on a 4-point Likert scale ranging from "not at all" (0) to "nearly every day" (3), with a total score ranging from 0 to 27. Higher scores indicate more severe depressive symptoms. Scores of 0–4 indicate no or minimal depression, 5–9 indicate mild depression, 10–14 indicate moderate depression, 15–19 indicate moderately severe depression, and 20–27 indicate severe depression. In this study, the Cronbach's alpha coefficient for the PHQ-9 was 0.89.

Data Analysis

In this study, the data were directly exported from "Questionnaire Star" into Microsoft Excel format and then imported into SPSS 25.0 software for statistical analysis. The measurement data were expressed as mean ± standard deviation, and the counting data were expressed as frequency and percentage. Pearson correlation coefficient (r) was used to examine the correlation between continuous variables. Multiple linear regression analysis was conducted to identify the influencing factors of dysmenorrhea in female college students. Mediation analysis was conducted using Amos 26.0, and the Bootstrap method was used with 5000 resamples to calculate the 95% confidence interval (CI). If the CI did not include 0, the mediation effect was considered significant. A P-value of < 0.05 was regarded as statistically significant.

Ethical Considerations

This study complies with the Declaration of Helsinki. Before completing the questionnaire, all eligible participants signed an electronic informed consent form. Participation was voluntary and anonymous, and participants had the right to withdraw from the study at any time. The study was approved by the hospital's institutional review board (IRB) before data collection (Approval Number: KY-2022-010-11).

Results

Common Method Bias Test

Given that all variables were measured using a self-report scale, it was necessary to examine the potential for common method bias. The results of Harman's single-factor test revealed 19 factors with eigenvalues greater than one. The first factor explained 14.31% of the total variance, which is below the 40% threshold commonly used as a criterion.[33] Thus, common method bias was not present in this study.

Socio-Demographic Characteristics of the Participants and Univariate Analysis of Negative Emotions in Chinese Female College Students with Different Characteristics

A total of 1,117 Chinese female college students aged between 18 and 24 years (mean age: 20.02 ± 1.84) were included in this study. The majority of participants had a BMI between 18.5 and 24 kg/m² (84.4%), experienced menarche between the ages of 12 and 14 (80.5%), had an average menstrual duration of 4 to 7 days (97.2%), and a menstrual cycle between 26 and 30 days (87.6%). The vast majority of participants had no family history of dysmenorrhea (92.9%). Additionally, 73.9% of the participants reported staying up late, 85.4% did not engage in high-intensity physical exercise, 94.4% did not have drinking habits, and 97.9% did not smoke. Furthermore, there were statistically significant differences in the scores of staying up late and negative emotions of female college students (see Table 1 for details).

Correlation Analysis and Significance Test

The scores for dysmenorrhea symptoms, health literacy, self-care ability, and negative emotions in female college students were 59.84±12.69, 19.14±6.60, 76.06 ± 11.91, and 18.75 ± 7.72, respectively. Additionally, Pearson correlation

Table 1 Socio-Demographic Characteristics of the Study Participants and Univariate Analysis of Negative Emotions in Chinese Female College Students with Different Characteristics (N = 1,117)

Classification		Number of people (%)	Statistic[α]	p-value
Age(year)	18–21	927(83.0)	−1.921	0.056
	22–24	190(17.0)		
BMI (weight (kg)/ height(m)^2	<18.5	99(8.9)	0.316	0.729
	18.5–24	943(84.4)		
	>24	75(6.7)		
Age at menarche(year)	<12	151(13.5)	0.472	0.624
	12–14	899(80.5)		
	>14	67(6.0)		
Average menstrual duration(day)	≤3	31(2.8)	−0.430	0.667
	4–7	1086(97.2)		
Menstrual cycle(day)	21–25	63(5.6)	0.047	0.954
	26–30	978(87.6)		
	31–35	76(6.8)		
Family history of dysmenorrhea	Yes	79(7.1)	1.298	0.194
	No	1038(92.9)		
Stay up late	Yes	826(73.9)	2.041	0.042
	No	291(26.1)		
High-intensity exercise	Yes	163(14.6)	−0.781	0.435
	No	954(85.4)		
Alcohol consumption habit	Yes	62(5.6)	0.720	0.471
	No	1055(94.4)		
Smoking habit	Yes	23(2.1)	1.593	0.125
	No	1094(97.9)		

Notes: [α], a two-sample *t*-test was used for comparisons between two groups, while one-way ANOVA was employed for comparisons among three or more groups.

analysis was conducted to determine the potential relationships among the four variables. Dysmenorrhea symptoms were significantly negatively correlated with health literacy ($r = -0.25$, $P < 0.01$) and self-care ability ($r = -0.40$, $P < 0.01$), and significantly positively correlated with negative emotions ($r = 0.41$, $P < 0.01$). Table 2 presents the results of the Pearson correlation coefficients and descriptive analysis.

Multiple Linear Regression Analysis of Factors Affecting Negative Emotions in Chinese Female College Students with Dysmenorrhea

To explore the relationship between dysmenorrhea symptoms and negative emotions, a regression analysis was conducted with dysmenorrhea symptoms as the independent variable and negative emotions as the dependent variable (Table 3). Given differences in the dependent variable, demographic factors (late-night habits) were included in the regression model. The results indicated that factors such as dysmenorrhea symptoms, health literacy, and self-care ability significantly predicted negative emotions ($p < 0.001$), explaining 0.671% of the variance in negative emotions.

Mediating Effect Analysis

Based on the hypothesized framework, we constructed a structural equation model (SEM) comprising four latent variables and twelve measurement variables (Figure 2). The fit indices for the SEM fully met the model fit criteria: $\chi^2/df = 2.44$ (<3.00), RMSEA = 0.04 (≤0.08), GFI = 0.98 (≥0.90), NFI = 0.99 (≥0.90), RFI = 0.98 (≥0.90), CFI = 0.99 (≥0.90), PGFI = 0.57 (≥0.50), TLI = 0.99 (≥0.90), and RMR = 0.01 (≤0.05).

According to Preacher and Hayes,[34] bootstrap is considered the most effective method for assessing indirect effects, as it makes no assumptions about the sample distribution of indirect effects and offers better control over Type I errors. A bootstrapping procedure with 5,000 samples and a 95% confidence interval (CI) was employed to examine the direct and indirect effects of dysmenorrhea symptoms on negative emotions.

Using the Bootstrap method with 5,000 resamples and a 95% confidence interval (excluding 0), the mediating roles of health literacy and self-care ability in the relationship between dysmenorrhea symptoms and negative emotions were tested. The results are as follows: dysmenorrhea symptoms positively predicted negative emotions ($\beta = 0.179$, $p < 0.001$) and negatively predicted health literacy ($\beta = -0.277$, $p < 0.001$) and self-care ability ($\beta = -0.410$, $p < 0.001$). In other words, the indirect effects were mediated by health literacy ($\beta = 0.097$, 95% CI [0.073, 0.125], $p < 0.001$) and self-care ability ($\beta = 0.233$, 95% CI [0.193, 0.279], $p < 0.001$), indicating that health literacy and self-care ability partially mediated the relationship between dysmenorrhea symptoms and negative emotions. The mediation effect was 0.356, accounting for 66.67% of the total effect (total effect = 0.534), as shown in Table 4. Therefore, all three hypotheses of this study were supported.

Discussion

Analysis of the Current Status of Dysmenorrhea Symptoms, Health Literacy, Self-Care Ability and Negative Emotions in Chinese Female College Students

The results show that the menstrual pain symptom score of female college students is 59.84 ± 12.69, which is slightly higher than that of adolescents,[35] indicating that the menstrual pain symptoms among female college students are concerning. This may be related to the more severe menstrual symptoms observed in the college student population included in this study compared to younger adolescents, as influenced by lifestyle factors such as academic pressure, irregular sleep patterns, or poor diet. For instance, some studies have shown that stress, sleep disorders, and psychological issues can significantly predict menstrual pain symptoms.[36,37] Meanwhile, the health literacy score of female college students was 19.14±6.60, which is at a lower-middle level, and lower than the score (23.59±5.09) reported by Yu et al in their survey of health literacy among elderly individuals in China using the same measurement tool.[38] The differences may be attributed to factors such as age, educational background, life experiences, health awareness, health behaviors, and lifestyle differences. In addition, the self-care ability level of female college students is at a moderate level, which is similar to the self-care scores for primary dysmenorrhea in Chinese female college students reported by Chen et al[39] This result may be attributed to the limited knowledge and practices among college students in managing dysmenorrhea. While students generally possess some health knowledge, factors such as academic pressure, irregular

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Table 2 Correlation Coefficient Analysis Between the Study Measures (N = 1,117)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Mean±SD
1.DS1	1.00																29.96±6.80
2.DS2	0.74**	1.00															29.88±6.81
3.DS	0.93**	0.93**	1.00														59.84±12.69
4.HL1	−0.21**	−0.20**	−0.22**	1.00													6.29±2.31
5.HL2	−0.24**	−0.21**	−0.24**	0.83**	1.00												6.43±2.38
6.HL3	−0.24**	−0.21**	−0.24**	0.80**	0.85**	1.00											6.42±2.33
7.HL	−0.24**	−0.22**	−0.25**	0.93**	0.95**	0.94**	1.00										19.14±6.60
8.SA1	−0.28**	−0.33**	−0.33**	0.19**	0.20**	0.21**	0.21**	1.00									13.28±2.63
9.SA2	−0.28**	−0.31**	−0.32**	0.18**	0.17**	0.18**	0.19**	0.54**	1.00								12.46±2.49
10.SA3	−0.29**	−0.33**	−0.33**	0.19**	0.18**	0.20**	0.20**	0.62**	0.47**	1.00							14.23±2.57
11.SA4	−0.33**	−0.34**	−0.36**	0.24**	0.23**	0.25**	0.25**	0.65**	0.67**	0.59**	1.00						25.45±4.54
12.SA5	−0.26**	−0.28**	−0.29**	0.13**	0.16**	0.15**	0.16**	0.58**	0.36**	0.71**	0.58**	1.00					10.65±2.22
13.SA	−0.36**	−0.39**	−0.40**	0.25**	0.25**	0.27**	0.27**	0.82**	0.75**	0.81**	0.90**	0.77**	1.00				76.06±11.91
14.NE1	0.32**	0.32**	0.34**	−0.39**	−0.40**	−0.39**	−0.42**	−0.45**	−0.42**	−0.43**	−0.50**	−0.39**	−0.54**	1.00			9.59±4.78
15.NE2	0.38**	0.33**	0.38**	−0.33**	−0.34**	−0.33**	−0.36**	−0.34**	−0.39**	−0.33**	−0.44**	−0.33**	−0.46**	0.51**	1.00		9.16±4.08
16.NE	0.40**	0.37**	0.41**	−0.41**	−0.42**	−0.42**	−0.45**	−0.46**	−0.47**	−0.44**	−0.54**	−0.42**	−0.58**	0.89**	0.85**	1.00	18.75±7.72

Notes: ** $p < 0.01$, statistically significant.

Abbreviations: DS1, duration of dysmenorrhea symptoms; DS2, severity of dysmenorrhea symptoms; DS, dysmenorrhea symptoms; HL1, access to health information; HL2, understanding health information; HL3, applying health information; HL, health literacy; SA1, acquiring knowledge; SA2, venting emotions; SA3, seeking help; SA4, using resources; SA5, psychological hints; SA, self-care ability; NE1, anxiety; NE2, depression; NE, negative emotions. SD, Standard Deviation.

Table 3 Multiple Linear Regression Analysis of Factors Affecting Negative Emotions in Chinese Female College Students with Dysmenorrhea

Variables (Predictors)	B	Beta	t	P	95% CI	
					LL	UL
Stay up late	−0.059	−0.003	−0.150	0.881	−0.830	0.712
Dysmenorrhea symptoms	0.100	0.165	6.698	< 0.001	0.071	0.129
Health literacy	−0.342	−0.293	−12.550	< 0.001	−0.396	−0.289
Self-care ability	−0.282	−0.436	−17.645	< 0.001	−0.314	−0.251
$R^2 = 0.671$, $F = 227.225$, $p < 0.001$						

Abbreviations: R^2, Coefficient of determination; B, Unstandardized Coefficients; Beta, Standardized Coefficients; *t*, *t*-test of significance; CI Confidence interval, LL Lower limit, UL Upper Limit.

lifestyles, and inadequate access to health education resources can hinder their ability to approach dysmenorrhea management in a systematic and evidence-based manner. Furthermore, some students may rely on painkillers or endure the symptoms, rather than implementing a variety of self-care strategies, such as dietary adjustments, regular exercise, and emotional regulation.

Previous studies have shown that Chinese female college students commonly experience negative emotions related to dysmenorrhea, as well as issues with anxiety and depression,[40] which is consistent with the finding in this study that anxiety and depression scores are at a moderate level. Existing studies have shown that the physiological discomfort caused by dysmenorrhea often triggers emotional fluctuations, which in turn exacerbate anxiety and depression.[41] Another experimental study found that dysmenorrhea leads to higher levels of anxiety and depression, with a lower perception of quality of life. In cases with higher levels of depression, the likelihood of dysmenorrhea is greater.[42] In addition, studies have also shown that college students lack systematic support and guidance in managing dysmenorrhea and related emotional issues.[40] Therefore, it is of practical significance to understand the level of anxiety and depression of female college students with dysmenorrhea and its influence to adopt targeted coping strategies.

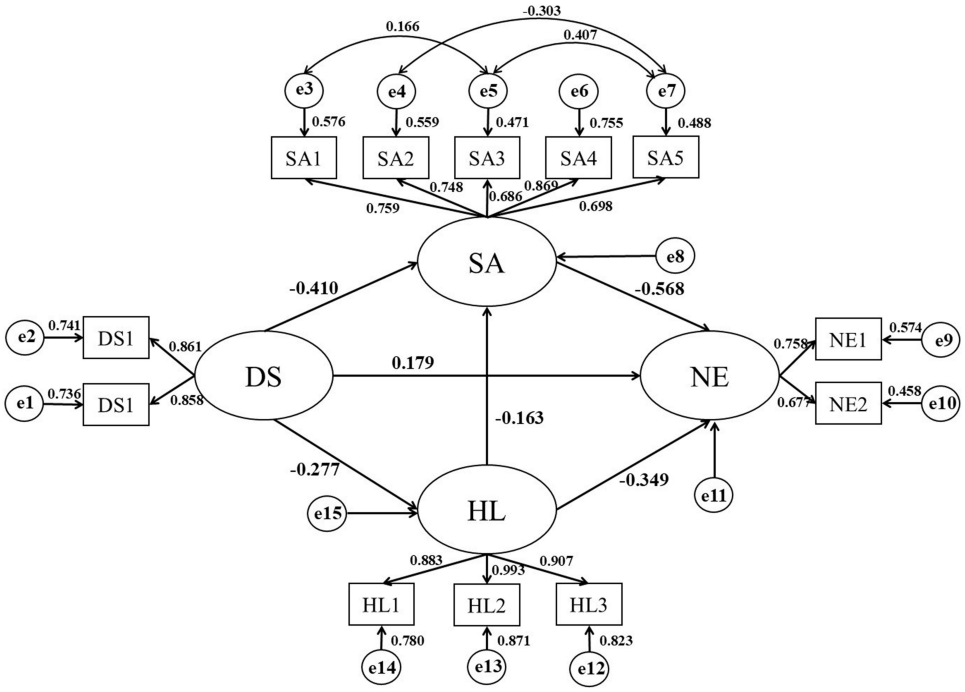

Figure 2 SEM of dysmenorrhea symptoms, health literacy, self-care ability, and negative emotions.
Abbreviations: DS1, duration of dysmenorrhea symptoms; DS2, severity of dysmenorrhea symptoms; DS, dysmenorrhea symptoms; HL1, access to health information; HL2, understanding health information; HL3, applying health information; HL, health literacy; SA1, acquiring knowledge; SA2, venting emotions; SA3, seeking help; SA4, using resources; SA5, psychological hints; SA, self-care ability; NE1, anxiety; NE2, depression; NE, negative emotions.

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Table 4 Standardized Direct, Indirect and Total Effect of the Structural Equation Model

Path	Estimate	SE	95% CI	
			Lower	Upper
Standardized direct effect				
Dysmenorrhea symptoms→ Negative emotions	0.178	0.037	0.102	0.248
Standardized indirect effect				
Dysmenorrhea symptoms → Health literacy → Negative emotions	0.097	0.013	0.073	0.125
Dysmenorrhea symptoms → Self-care ability → Negative emotions	0.233	0.022	0.193	0.279
Dysmenorrhea symptoms → Health literacy → Self-care ability → Negative emotions	0.026	0.005	0.016	0.037
Standardized total effect				
Dysmenorrhea symptoms → Negative emotions	0.534	0.033	0.466	0.596

Abbreviations: SE, standard error; CI, confidence interval.

The Mediating Effect of Health Literacy on Dysmenorrhea Symptoms and Negative Emotions in Chinese Female College Students

The results indicate that health literacy plays a partial mediating role between dysmenorrhea symptoms and negative emotions, confirming Hypothesis 1, which is consistent with previous research findings.[14] As Jeong et al found, high levels of health literacy help alleviate the psychological burden individuals experience when facing physical discomfort, while low health literacy may exacerbate the generation of negative emotions.[43] In addition, a study by Durand et al suggests that individuals with higher health literacy are better equipped to cope with and manage dysmenorrhea symptoms, which in turn helps reduce negative emotions such as anxiety.[44] These results suggest that health literacy not only plays a crucial role in coping with physical symptoms but also plays a key role in emotional regulation, especially in the context of physiological discomforts such as dysmenorrhea. Individuals with higher health literacy are more likely to adopt proactive health behaviors, access necessary health information, and effectively manage dysmenorrhea, reducing its negative impact on mental health. Therefore, strengthening health literacy education for female college students, particularly in terms of knowledge and skills for managing dysmenorrhea, may help alleviate negative emotions and improve overall mental well-being.

The Mediating Effect of Self-Care Ability on Dysmenorrhea Symptoms and Negative Emotions in Chinese Female College Students

Mediation analysis indicates that self-care partially mediates the relationship between dysmenorrhea symptoms and negative emotions, further confirming Hypothesis 2 of this study. Research has shown that high levels of self-care behaviors can effectively alleviate the negative impact of dysmenorrhea symptoms and reduce the negative emotions triggered by them.[14] Self-care includes health management, emotional regulation, and stress-coping strategies, all of which help individuals better cope with the physical and psychological distress caused by dysmenorrhea.[45] According to the Health Belief Model, when individuals perceive a significant threat to their health, they are more likely to engage in proactive health behaviors to alleviate the problem.[46] In the context of dysmenorrhea, women may adopt self-care behaviors to alleviate pain and discomfort, based on their perception of the severity of the dysmenorrhea symptoms and the impact these symptoms have on their daily lives. These self-care behaviors, such as regular rest, heat application, appropriate exercise, and dietary adjustments, help improve physical health and reduce the severity of dysmenorrhea.[47] In addition, related studies suggest that good self-care behaviors help individuals adopt more positive coping strategies, preventing emotions from spiraling into anxiety and depression. In contrast, those lacking self-care awareness and skills may exacerbate negative emotions due to their inability to effectively manage physical discomfort, thus creating a vicious cycle.[48] Therefore, this study suggests strengthening self-care education for female college students to help them improve their self-care ability and master effective coping strategies, which can not only reduce dysmenorrhea symptoms, but also effectively relieve the resulting negative emotions such as anxiety and depression.

The Chain Mediating Effect of Health Literacy and Self-Care Ability Between Dysmenorrhea Symptoms and Negative Emotions

The study also found that health literacy and self-care had a chain mediating effect on the relationship between dysmenorrhea symptoms and negative emotions, confirming Hypothesis 3. A high level of health literacy is closely related to individuals taking more effective self-care measures in the face of dysmenorrhea symptoms, which in turn helps individuals relieve dysmenorrhea symptoms, thereby reducing the occurrence of anxiety and depression. Health literacy provides individuals with the necessary knowledge and skills to better manage their physical health and understand and cope with negative emotions brought about by physiological changes,[49] while good self-care ability further regulates emotional states through practical actions such as drug use, exercise, and relaxation techniques.[50] According to the health behavior theory, an individual's health literacy level affects their intention and ability to adopt healthy behaviors, which can significantly improve their mental health.[51] In addition, health literacy and self-care are seen as key factors to cope with physical discomfort and emotional distress, especially in recurrent health problems such as dysmenorrhea.[14] Therefore, improving the health literacy and self-care ability of female college students can not only help them relieve dysmenorrhea symptoms, but also effectively improve their emotional health, especially in the face of stress and distress, and enhance their psychological adaptability.

Limitations

There were several limitations in this study. First, since this study employed a cross-sectional design, the causal relationships between the variables cannot be determined. Future research could adopt a longitudinal design to track participants over time, providing a clearer understanding of the causal relationships between these variables. Second, the study relied on self-reported data, introducing the possibility of social desirability and recall biases. Future research might incorporate objective measurement tools to validate the accuracy of self-reported data. Third, the sample in this study was primarily drawn from five universities in Guangdong Province, China, which may limit the generalizability of our findings to other regions, cultures, and educational backgrounds. To enhance the external validity of future studies, researchers could consider expanding the sample to include participants from diverse geographical and cultural backgrounds.

Conclusion

In summary, the study found that health literacy and self-care ability play a chain-mediated role between dysmenorrhea symptoms and negative emotions in female college students. This means that female college students with more severe dysmenorrhea symptoms may, due to insufficient health literacy, fail to properly understand or cope with the symptoms, leading to poor self-care ability and, in turn, the development of negative emotions. These findings contribute to a deeper theoretical understanding of these associations and provide practical implications for educational institutions and healthcare providers. Educational institutions and healthcare providers are encouraged to implement targeted interventions that focus on enhancing health literacy and self-care, ultimately improving the well-being and mental health of female college students during menstruation. Furthermore, future research could explore the long-term effects of these interventions on overall emotional and physical health.

Abbreviations

HBM, Health Belief Model; VAS, Visual Analogue Score; CMSS, Cox Menstrual Symptom Scale; HLS-SF, Health Literacy Scale–Short Form; SCA, Self-Care Ability Scale; PHQ, Patient Health Questionnaire.

Data Sharing Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethics Approval and Consent to Participate

All participants provided written informed consent prior to the study, authorizing researchers to collect and use their personal data for scientific research purposes. The data in this study have been anonymized and do not contain any information that could directly identify the participants, ensuring their privacy is protected. Furthermore, this study adhered to relevant ethical guidelines and was approved by the Medical Ethics Committee of Zhongshan Boai Hospital (Approval Number: KY-2022-010-11).

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Author Contributions

All authors made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas. All authors took part in drafting, revising, or critically reviewing the article, gave final approval of the version to be published, agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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