

Factors Associated with Severe Primary Dysmenorrhea in Adolescent Girls: A Retrospective Single-Center Study

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Objective: To identify the risk factors for severe primary dysmenorrhea in adolescent girls and provide evidence for clinical prevention and intervention.

Methods: This retrospective study enrolled adolescent girls with primary dysmenorrhea from Jingzhou Central Hospital between January 2022 and December 2023. Participants were divided into severe group and mild-to-moderate group grouped by VAS score (VAS 0–10, 0=no pain, 1–3=mild, 4–6=moderate, 7–10=severe). Demographic, lifestyle, menstrual and laboratory parameters were collected via questionnaires and medical records. Bivariate analysis and multivariate Logistic regression were used to screen independent risk factors, and ROC curve was applied to assess model performance.

Results: 426 participants were included (158 in severe group, 268 in mild-to-moderate group). Early menarche (≤ 12 years old), frequent cold food intake (≥ 3 times/week), high serum PGF2 α level and low physical activity level were independent risk factors (all $P < 0.05$). The predictive model yielded an AUC of 0.826 (95% CI: 0.783–0.869), showing good predictive efficiency.

Conclusion: Early menarche, frequent cold food intake, high serum PGF2 α and low physical activity are independent risk factors for severe primary dysmenorrhea in adolescent girls. Targeted interventions on these factors can help reduce the occurrence of severe dysmenorrhea.

Keywords: adolescent girls, primary dysmenorrhea, severe dysmenorrhea, risk factors, retrospective study

Introduction

Primary dysmenorrhea, as a painful dysmenorrhea without obvious organic lesions in the pelvic cavity, is one of the most common gynecological symptoms in adolescent girls.^{1,2} In the global youth population, it is reported that its incidence rate varies from 30% to 80%, and the severity of symptoms varies significantly between individuals.^{3–5} Severe dysmenorrhea can cause severe abdominal pain, usually accompanied by symptoms such as nausea, vomiting, dizziness, and fatigue. This not only affects the normal learning and life of young girls, causes school absence and impaired daily function, but may also have a negative impact on their physical and mental health and long-term quality of life.^{6,7}

So far, many studies have focused on the risk factors of primary dysmenorrhea. It has been reported that factors such as age of menarche, menstrual cycle characteristics, lifestyle habits, and hormone levels are associated with the occurrence and development of primary dysmenorrhea.^{8–10} However, most of these studies focus on adult women with primary dysmenorrhea, and there are few studies specifically targeting the risk factors for severe dysmenorrhea in adolescent girls. Adolescent girls are in a special period of physical and mental development, and their physiological and metabolic characteristics are significantly different from those of adult women. Therefore, the risk factors for severe dysmenorrhea in this population may have unique characteristics.

Prostaglandin F2 α (PGF2 α) has always been considered an important mediator in the pathogenesis of primary dysmenorrhea.^{11,12} It can cause uterine smooth muscle spasm, reduce uterine blood flow, and cause ischemic and hypoxic pain. Some studies have shown that the serum PGF2 α levels in patients with primary dysmenorrhea are significantly higher than those in adolescent girls without primary dysmenorrhea, but the relationship between PGF2 α and the severity of dysmenorrhea in adolescent girls needs further confirmation.^{13,14} In addition, lifestyle factors such as diet and physical activity are closely related to the occurrence of dysmenorrhea. With the changes in modern lifestyle, heavy academic pressure, more electronic product use and less outdoor activities, it is becoming increasingly common for adolescent girls to consume cold foods and have low levels of physical activity. Cold food intake can induce pelvic vasoconstriction and promote prostaglandin release, thus aggravating dysmenorrhea. Known risk factors also include family history and psychological stress. However, the specific role of these factors in the progression of primary dysmenorrhea to severe dysmenorrhea is still unclear.

Therefore, exploring the risk factors for severe primary dysmenorrhea in adolescent girls is of great significance for early identification of high-risk populations and implementation of effective preventive measures.

Methods

Study Population

We included women diagnosed with primary dysmenorrhea who visited the Obstetrics and Gynecology Department of Jingzhou Central Hospital from January 2022 to December 2023 as the research subjects. Among them, the inclusion criteria were as follows: (1) Age between 12 and 18 years old; (2) Meets the diagnostic criteria for primary dysmenorrhea, which refers to dysmenorrhea occurring within 1–2 days before or during menstruation, and no organic lesions detected by pelvic color Doppler ultrasound or other examinations;^{1,4} (3) Having complete clinical data and questionnaire survey results; (4) Voluntarily participate in this study and sign an informed consent form (signed by a guardian for minors under 16 years old). The exclusion criteria: (1) organic diseases such as endometriosis, adenomyosis, pelvic inflammatory disease, and uterine malformation; (2) Suffering from diabetes, hypertension, autoimmune diseases and other systemic diseases; (3) Regular use of medications that may affect menstrual symptoms, such as hormones and analgesics, taken within the first 3 months of enrollment; occasional use was allowed; (4) Incomplete clinical data or refusal to cooperate with the investigation.

Ethical Exemption Statement

This retrospective study was conducted in accordance with the Helsinki Declaration (revised 2024); <https://www.wma.net/policies-post/wma-declaration-of-helsinki>). This research protocol has been reviewed and approved by the Ethics Committee of Jingzhou Central Hospital (Ethics Approval Number: 2025-100-01). All questionnaires were completed during clinical visits from January 2022 to December 2023 as routine clinical data. Due to the retrospective analysis of existing medical records and questionnaire data, no direct intervention was conducted on patients, and all personal identification information of the subjects was completely anonymous to protect privacy and confidentiality, the ethics committee granted an exemption to individual informed consent. Exemptions are approved based on the guidelines for retrospective studies using existing data identified by the committee, which pose the least risk to participants. The patient screening and screening process was shown in [Figure 1](#).

Grouping Criteria

According to the Visual Analog Scale (VAS) for dysmenorrhea,⁴ we divided the subjects into a severe group and a mild-to-moderate dysmenorrhea group. The VAS score range is from 0 to 10 points, with 0 indicating no pain, 1–3 indicating mild pain, 4–6 indicating moderate pain, and 7–10 indicating severe pain. The severe group includes patients with VAS scores ≥ 7 , while the mild-to-moderate group includes patients with visual scores 1–6.

Data Collection

We collected data through questionnaire surveys and medical record reviews. The questionnaire was designed by the research team based on relevant literature and clinical practice and completed by participants during visits, including

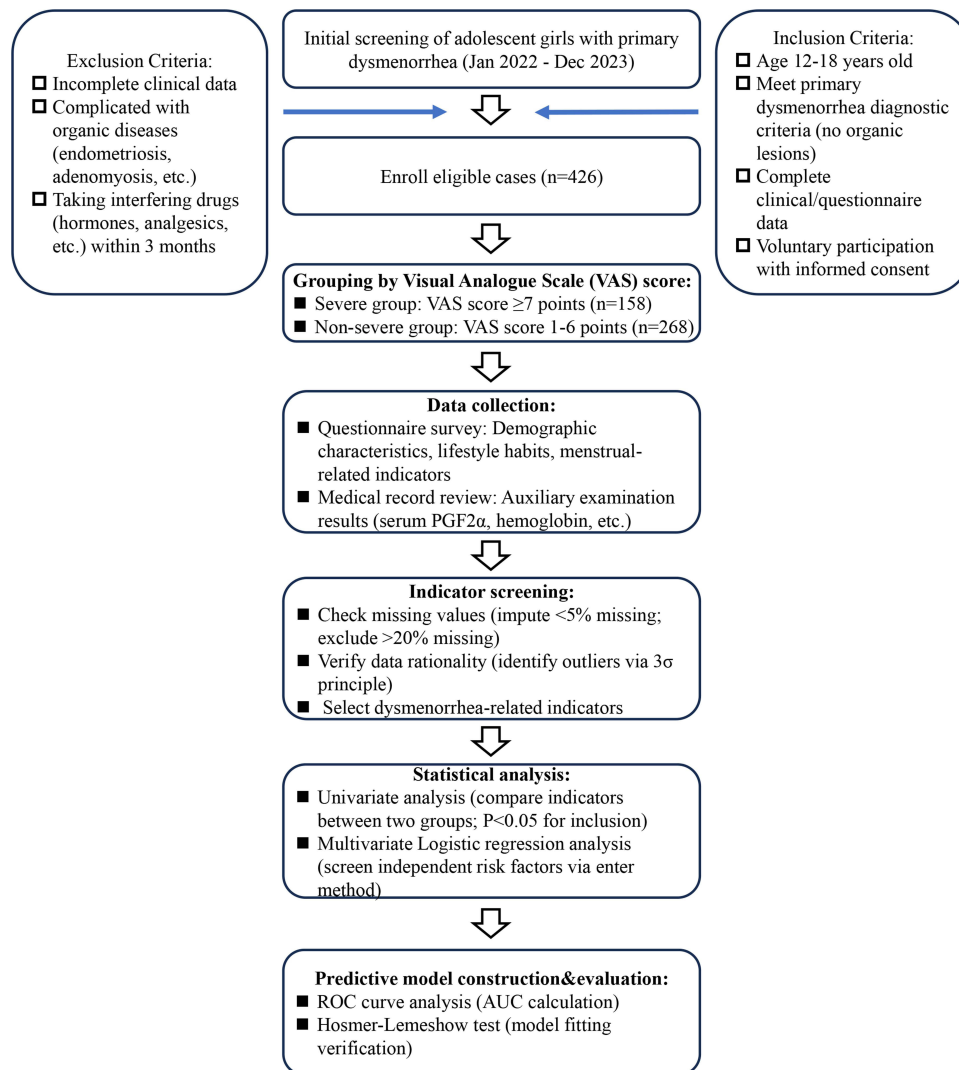


Figure 1 Flow Chart of Patient Enrollment and Risk Factor Identification for Severe Primary Dysmenorrhea in Adolescent Girls.

demographic characteristics (age, age of menarche, body mass index (BMI)), lifestyle habits (sleep status, frequency of cold food intake, physical activity level, smoking and drinking history), and menstrual related indicators (menstrual cycle duration, menstrual duration, menstrual blood volume, presence of dysmenorrhea and radiating pain). Menstrual blood volume was assessed by routine clinical method. Laboratory parameters were extracted from medical records, including serum PGF2 α levels, hemoglobin levels, serum estrogen and progesterone levels, which were single test results detected by the clinical laboratory of Jingzhou Central Hospital using standard testing methods. The cutoff of ≥ 3 times/week for cold food intake was set based on literature and clinical experience.

Inclusion Indicator Screening

Before conducting formal statistical analysis, we organized and screened the collected indicators. Firstly, check the missing values of the indicators and eliminate situations where key indicators (accounting for more than 20% of the total indicators) have missing values. For indicators with fewer missing values (less than 5%), use the mean (for continuous variables) or the most common value (for categorical variables) for imputation. Then, the rationality of the indicator data was verified, and outliers were identified through the 3 σ principle (values outside mean ± 3 standard deviations). After confirming that the outliers are not caused by measurement errors, retain them for subsequent analysis. Finally, based on

clinical experience and relevant literature reports, select risk factors closely related to dysmenorrhea for bivariate and multivariate analysis.

Predictive Model Construction

Firstly, we employed bivariate analysis to compare the differences in various risk factors between the severe and mild-to-moderate groups. Among them, risk factors with statistical differences ($P < 0.05$) were included in the multiple logistic regression analysis. Using input method to screen independent risk factors for severe dysmenorrhea, and constructing a predictive model with independent risk factors as variables. The expression of the model is: $\text{Logit}(P) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$. Among them, P is the probability of severe dysmenorrhea, β_0 is the intercept term, $\beta_1 - \beta_n$ is the regression coefficient of each independent variable, and $X_1 - X_n$ is an independent risk factor. The model was validated internally with the same dataset.

Statistical Methods

We conducted all statistical analyses using SPSS 26.0 software and R 4.2.1 software. Measurement data that conforms to a normal distribution were represented as mean $\pm$ standard deviation ($\bar{x} \pm s$), and independent sample t -test was used for inter group comparison. Measurement data that do not conform to a normal distribution were represented as median (interquartile range) [M (Q1, Q3)] and compared between groups using Mann Whitney U -test. The categorical variable was expressed as frequency (percentage) [n (%)], and the comparison between groups was conducted using the chi square test. We used multiple logistic regression analysis to screen for independent risk factors, adjusted for age, BMI and menstrual duration. The ROC curve was used to evaluate the predicted values of the model and calculate the area under the curve (AUC). $P < 0.05$ was considered statistically significant.

Results

Baseline Characteristics of the Study Population

A total of 452 women with primary dysmenorrhea were preliminarily screened, and 26 cases were excluded based on inclusion and exclusion criteria (12 cases with incomplete data, 8 cases with organic diseases, and 6 cases taking drugs that may affect the results). Finally, 426 patients were included in the study, with 158 in the severe group (37.09%) and 268 in the mild-to-moderate group (62.91%). As shown in Table 1, there were no significant differences between the two groups in terms of age, BMI, menstrual time, smoking history, and alcohol consumption history (all $P > 0.05$). However, the age of menarche in the severe group was significantly earlier than that in the mild-to-moderate group, with a higher proportion of irregular sleep, a higher frequency of cold food intake, lower levels of physical activity, a higher proportion of prolonged menstrual cycles (≥ 35 days), and a higher proportion of excessive menstrual bleeding (all $P < 0.05$). The above results indicate that the differences in baseline characteristics between the two groups are mainly concentrated in menstrual related indicators and lifestyle habits.

Bivariate Analysis of Risk Factors for Severe Dysmenorrhea

On the basis of baseline feature analysis, we conducted bivariate analysis on dysmenorrhea related risk factors. The results showed percentage distribution differences between two groups. As shown in Table 2, in terms of menstrual related indicators, the age of menarche ≤ 12 years old accounted for 42.41% in the severe group, significantly higher than the 23.51% in the mild-to-moderate group ($\chi^2 = 15.682$, $P < 0.001$). The proportion of severe menstrual cycle elongation was 28.48%, significantly higher than the mild-to-moderate group's 16.42% ($\chi^2 = 7.895$, $P = 0.005$). The proportion of heavy menstrual blood in the severe group was 35.44%, significantly higher than the mild-to-moderate group's 20.52% ($\chi^2 = 10.326$, $P = 0.001$). In terms of lifestyle habits, the proportion of severe group with irregular sleep was 68.36%, significantly higher than the mild-to-moderate group's 49.25% ($\chi^2 = 14.563$, $P < 0.001$). The proportion of frequent cold food intake (≥ 3 times/week) in the severe group was 56.96%, significantly higher than the 34.33% in the mild-to-moderate group ($\chi^2 = 22.345$, $P < 0.001$). The proportion of low physical activity levels in the severe group was 62.03%, significantly higher than the 40.29% in the mild-to-moderate group ($\chi^2 = 19.876$, $P < 0.001$). The laboratory parameters

Table 1 Baseline Characteristics of the Study Population [n (%) or $\bar{x} \pm s$ or M (Q1, Q3)]

Indicators	Severe Group (n=158)	Non-Severe Group (n=268)	Statistic Value	P value
Age (years)	15.23 $\pm$ 1.56	15.45 $\pm$ 1.62	t=-1.235	0.218
Age at menarche (years)	11.85 $\pm$ 0.92	12.56 $\pm$ 1.05	t=-7.892	<0.001
BMI (kg/m ²)	19.87 $\pm$ 2.34	20.12 $\pm$ 2.45	t=-0.987	0.326
Menstrual duration (days)	5.23 $\pm$ 1.12	5.35 $\pm$ 1.23	t=-0.876	0.382
Menstrual cycle duration			$\chi^2=7.895$	0.005
≤28 days	85 (53.79%)	168 (62.69%)	—	—
29–34 days	38 (24.05%)	72 (26.87%)	—	—
≥35 days	35 (22.15%)	28 (10.45%)	—	—
Menstrual blood volume			$\chi^2=10.326$	0.001
Normal	102 (64.56%)	213 (79.48%)	—	—
Heavy	56 (35.44%)	55 (20.52%)	—	—
Irregular sleep	108 (68.36%)	132 (49.25%)	$\chi^2=14.563$	<0.001
Cold food intake frequency			$\chi^2=22.345$	<0.001
<3 times/week	68 (43.04%)	176 (65.67%)	—	—
≥3 times/week	90 (56.96%)	92 (34.33%)	—	—
Physical activity level			$\chi^2=19.876$	<0.001
High	28 (17.72%)	75 (27.98%)	—	—
Medium	37 (23.42%)	83 (30.97%)	—	—
Low	93 (62.03%)	110 (40.29%)	—	—
Smoking history	5 (3.16%)	8 (3.00%)	$\chi^2=0.012$	0.912
Drinking history	7 (4.43%)	12 (4.48%)	$\chi^2=0.001$	0.974

Notes: The classification of physical activity level is based on the International Physical Activity Questionnaire (IPAQ): high physical activity level refers to ≥150 minutes of moderate intensity physical activity or ≥75 minutes of high intensity physical activity per week; medium physical activity level refers to 60–149 minutes of moderate intensity physical activity or 30–74 minutes of high intensity physical activity per week; low physical activity level refers to <60 minutes of moderate intensity physical activity or <30 minutes of high intensity physical activity per week.

Abbreviation: BMI, body mass index.

Table 2 Univariate Analysis of Risk Factors for Severe Dysmenorrhea

Indicators	Severe Group (n=158) n (%) or $\bar{x} \pm s$	Non-Severe Group (n=268) n (%) or $\bar{x} \pm s$	Statistic Value	P value
Age at menarche ≤12 years old	67 (42.41%)	63 (23.51%)	$\chi^2=15.682$	<0.001
Prolonged menstrual cycle (≥35 days)	35 (28.48%)	28 (16.42%)	$\chi^2=7.895$	0.005
Heavy menstrual blood	56 (35.44%)	55 (20.52%)	$\chi^2=10.326$	0.001
Irregular sleep	108 (68.36%)	132 (49.25%)	$\chi^2=14.563$	<0.001
Frequent cold food intake (≥3 times/week)	90 (56.96%)	92 (34.33%)	$\chi^2=22.345$	<0.001
Low physical activity level	93 (62.03%)	110 (40.29%)	$\chi^2=19.876$	<0.001
Serum PGF2 α (pg/mL)	89.65 $\pm$ 15.32	65.32 $\pm$ 12.45	t=16.892	<0.001
Hemoglobin (g/L)	115.68 $\pm$ 10.25	123.45 $\pm$ 11.36	t=-7.235	<0.001
Serum estrogen (pg/mL)	45.32 $\pm$ 10.25	46.56 $\pm$ 11.32	t=-1.023	0.306
Serum progesterone (ng/mL)	12.35 $\pm$ 3.45	12.87 $\pm$ 3.62	t=-1.235	0.218

Abbreviation: PGF2 α , prostaglandin F2 α .

showed that the serum PGF2 α level in the severe group was (89.65 $\pm$ 15.32) pg/mL, significantly higher than that in the mild-to-moderate group (65.32 $\pm$ 12.45) pg/mL (t=16.892, P<0.001). The hemoglobin level in the severe group was (115.68 $\pm$ 10.25) g/L, significantly lower than that in the mild-to-moderate group (123.45 $\pm$ 11.36) g/L (t=7.235, P<0.001). In addition, there was no significant difference in serum estrogen and progesterone levels between the two groups (both P>0.05). These results suggest that multiple risk factors, including age at menarche, duration of menstrual

Table 3 Multivariate Logistic Regression Analysis of Independent Risk Factors for Severe Dysmenorrhea

Variables	β	SE	Wald χ^2	P value	OR	95% CI
Constant term	-1.235	0.345	12.892	<0.001	—	—
Age at menarche ≤ 12 years old	0.857	0.268	10.235	0.001	2.356	1.423–3.897
Frequent cold food intake (≥ 3 times/week)	0.763	0.276	7.892	0.002	2.145	1.312–3.516
High serum PGF2 α level	1.17	0.302	15.236	<0.001	3.218	1.987–5.203
Low physical activity level	0.637	0.278	5.235	0.012	1.892	1.154–3.105

Abbreviations: β , regression coefficient; SE, standard error; OR, odds ratio; CI, confidence interval; PGF2 α , prostaglandin F2 α .

cycle, menstrual blood volume, sleep status, frequency of cold food intake, physical activity level, serum PGF2 α level, and hemoglobin level, may be associated with severe dysmenorrhea.

Multivariate Logistic Regression Analysis of Independent Risk Factors

In bivariate analysis, a total of 8 risk factors with statistical differences were included in a multivariate logistic regression model to screen for independent risk factors for severe dysmenorrhea. As shown in Table 3, after adjusting for other confounding factors, early menarche (≤ 12 years old) (OR=2.356, 95% CI: 1.423–3.897, $P=0.001$), frequent consumption of cold food (≥ 3 times/week) (OR=2.145, 95% CI: 1.312–3.516, $P=0.002$), high serum PGF2 α levels (OR=3.218, 95% CI: 1.987–5.203, $P<0.001$), and low physical activity levels (OR=1.892, 95% CI: 1.154–3.105, $P=0.012$) are independent risk factors for severe dysmenorrhea in girls with primary dysmenorrhea. Other risk factors, such as irregular sleep, prolonged menstrual cycle, high menstrual blood volume, and low hemoglobin levels, were not included in the final model (all $P>0.05$). This result confirms that the above four factors are closely related to the occurrence of severe dysmenorrhea and have independent predictive value.

Evaluation of the Predictive Model Based on Independent Risk Factors

We selected four independent risk factors through multiple logistic regression analysis and constructed a predictive model. As shown in Figure 2, the ROC curve of the model was plotted with an AUC of 0.826 (95% CI: 0.783–0.869). When the optimal critical value is 0.35, the sensitivity and specificity of the model are 78.48% and 76.87%, respectively. The Hosmer Lemeshaw test showed that $\chi^2=5.682$, $P=0.682$, indicating that the model has good fit. This result indicates that the predictive model constructed from four independent risk factors has good predictive performance and can effectively identify high-risk populations for severe dysmenorrhea in adolescent girls with primary dysmenorrhea.

Correlation Analysis Between Key Risk Factors and Severity of Dysmenorrhea

We further analyzed the correlation between four independent risk factors and VAS scores for dysmenorrhea. As shown in Figure 3, the serum PGF2 α level is positively correlated with VAS score ($r=0.623$, $P<0.001$), indicating that the higher the serum PGF2 α level, the higher the VAS score, and the more severe the dysmenorrhea. The level of physical activity is negatively correlated with VAS score ($r=-0.456$, $P<0.001$), meaning that the lower the level of physical activity, the higher the VAS score. In addition, the VAS score of girls in early menarche (≤ 12 years old) was (8.25 ± 1.02) points, significantly higher than that of girls in menarche >12 years old (6.89 ± 1.23) points ($t=10.325$, $P<0.001$); The VAS score of girls who frequently eat cold meals is (8.12 ± 1.15) points, significantly higher than that of girls who do not frequently eat cold meals (6.78 ± 1.32) points ($t=9.876$, $P<0.001$). These results further confirm that these four independent risk factors are closely related to the severity of dysmenorrhea.

Discussion

Primary dysmenorrhea represents a prevalent gynecological issue among adolescent girls, with severe cases significantly impacting their physical and mental well-being.¹⁵ Through a retrospective analysis of single-center data, this study identified independent risk factors for severe dysmenorrhea in adolescent girls suffering from primary dysmenorrhea,

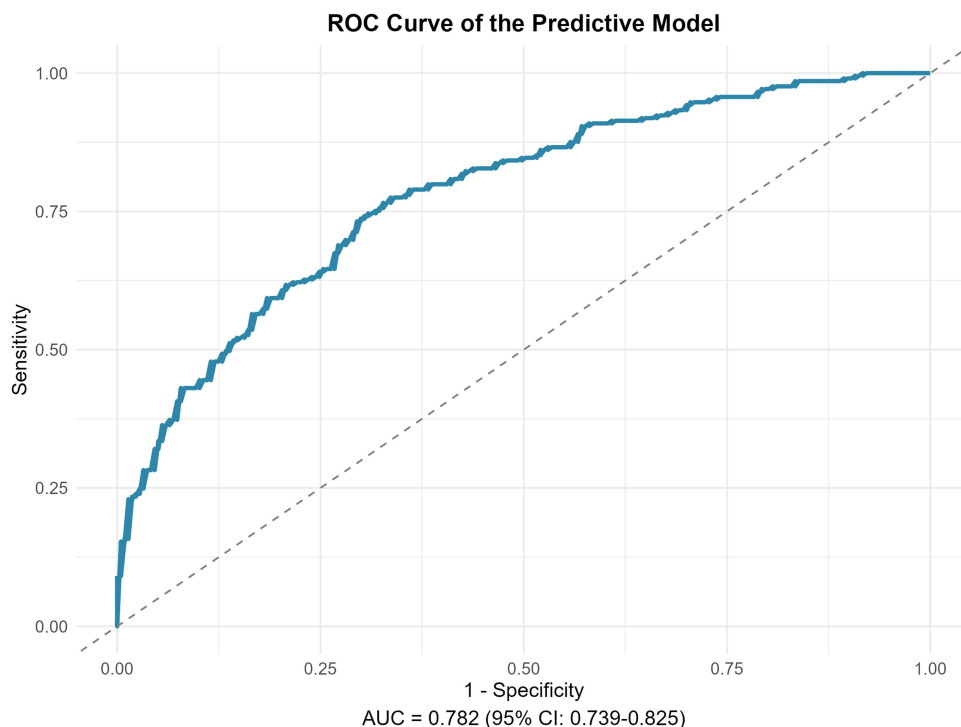


Figure 2 ROC curve of the predictive model for severe dysmenorrhea in adolescent girls with primary dysmenorrhea. The area under the curve (AUC) is 0.826 (95% CI: 0.783–0.869), indicating good predictive performance of the model.

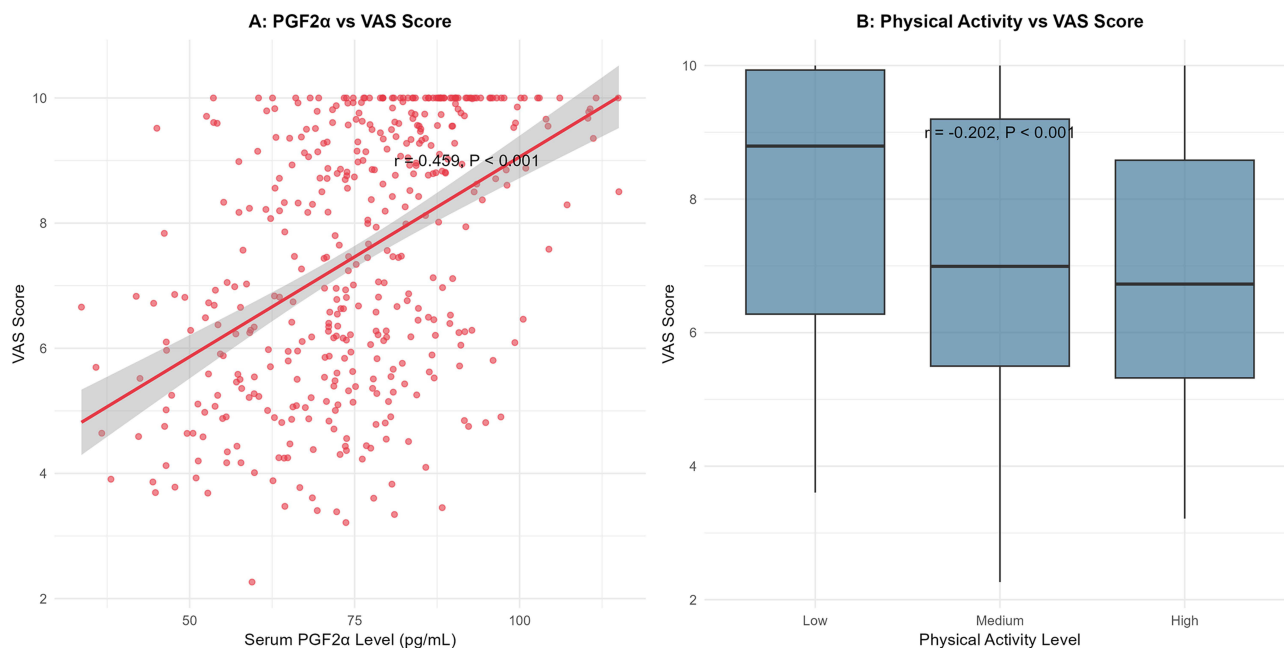


Figure 3 Correlation between key risk factors and VAS score of dysmenorrhea. (A) Positive correlation between serum PGF2α level and VAS score ($r=0.623$, $P<0.001$); (B) Negative correlation between physical activity level and VAS score ($r=-0.456$, $P<0.001$).

thereby offering crucial insights for clinical prevention and intervention strategies. Our findings indicate that early menarche, frequent consumption of cold foods, elevated serum PGF2α levels, and low levels of physical activity constitute independent risk factors for severe dysmenorrhea. Furthermore, the predictive model constructed based on these four factors demonstrates robust predictive performance as a preliminary screening tool.

In this study, early menarche was identified as an independent risk factor for severe dysmenorrhea, a finding consistent with the results of most previous studies.^{16,17} A study conducted by Hoppenbrouwers et al revealed that among 13-year-old Flemish girls, dysmenorrhea (with a prevalence of 41.6%) was more prevalent among those who experienced early menarche. Furthermore, the proportion of girls whose dysmenorrhea negatively impacted their social lives was significantly higher, underscoring the necessity for a systematic evaluation of menstrual cycle characteristics shortly after menarche.¹⁸ Immature hypothalamic-pituitary-ovarian axis leads to unstable estrogen and progesterone levels, which in turn affects the normal contraction of the uterus and increases its sensitivity to prostaglandins.¹⁹ Additionally, early menarche may coincide with an immature myometrium, rendering it more susceptible to spasms under the influence of prostaglandins, thereby resulting in more severe pain. However, some studies have yielded different conclusions. For instance, a study by De Sancis et al found that after adjusting for covariates, there was no independent association between the age at menarche and menstrual abnormalities (including menorrhagia, oligomenorrhea, irregular menstrual cycles, abnormal bleeding duration, and dysmenorrhea) among Italian girls.²⁰ This discrepancy may stem from variations in sample size, ethnic background, and regional characteristics of the study populations. The subjects in our study are all girls from the Jingzhou region, which may introduce certain regional biases.

In this study, frequent consumption of cold food emerged as an independent risk factor for severe dysmenorrhea. Cold food intake can irritate the gastrointestinal tract and pelvic region, leading to uterine vasoconstriction, decreased uterine blood flow, and subsequent ischemia-induced hypoxia pain.^{21,22} Furthermore, cold stimulation can also enhance the release of prostaglandins within the uterus, exacerbating uterine smooth muscle spasms and thereby intensifying the severity of dysmenorrhea. This observation aligns with the traditional Chinese medicine theory of dysmenorrhea caused by “cold coagulation and blood stasis”. A study conducted by Omidvar et al revealed that dill seed exhibits superior efficacy in alleviating dysmenorrhea pain (followed by ginger), whereas cumin, although lacking analgesic properties, can mitigate systemic symptoms (such as cold sweats and back pain), thereby offering an alternative therapeutic approach for dysmenorrhea treatment.²³ However, there is a scarcity of Western medicine research focusing on the impact of diet on primary dysmenorrhea. This study contributes supplementary evidence to this field and provides a foundation for guiding adolescent girls in cultivating healthy dietary habits. Clinical intervention includes reducing cold food intake and strengthening health education.

Elevated serum levels of PGF2 α represent an independent risk factor for severe dysmenorrhea, aligning with the classic pathogenesis of primary dysmenorrhea. PGF2 α is predominantly secreted by the endometrium, with its levels significantly rising during the menstrual period.^{24,25} It binds to receptors on uterine smooth muscle cells, triggering calcium influx and inducing robust contractions of the uterine smooth muscle. Concurrently, PGF2 α diminishes blood flow to the uterus and endometrium, resulting in ischemia and hypoxia-induced pain.²⁶ Prior research has demonstrated that patients with primary dysmenorrhea exhibit markedly higher PGF2 α levels in both the endometrium and blood compared to adolescent girls without primary dysmenorrhea, with a positive correlation observed between PGF2 α levels and the severity of dysmenorrhea.^{27,28} This study further corroborates this association and reveals that serum PGF2 α levels possess substantial predictive value for severe dysmenorrhea. Routine population screening for PGF2 α is not recommended; it is only used for high-risk groups identified by the model. These findings suggest that reducing PGF2 α levels may serve as a crucial therapeutic target for adolescent primary severe dysmenorrhea. For instance, nonsteroidal anti-inflammatory drugs (NSAIDs), which inhibit prostaglandin synthesis and alleviate dysmenorrhea symptoms, are widely employed in clinical practice.

A low level of physical activity also stands as an independent risk factor for severe dysmenorrhea. Appropriate physical activity can enhance blood circulation, optimize pelvic blood supply, mitigate uterine spasms, and thereby alleviate dysmenorrhea.²⁹ Furthermore, physical activity can modulate the levels of endorphins and other neurotransmitters within the body, exerting an analgesic effect. A study conducted by Matthewman et al revealed that physical activity can diminish both the intensity and duration of pain in women with primary dysmenorrhea (with moderate-quality evidence indicating an improvement in pain intensity).³⁰ Nevertheless, with escalating academic pressures, the physical activity levels among adolescent girls are generally low, potentially serving as a significant contributor to the high incidence of severe dysmenorrhea. Consequently, guiding adolescent girls to engage in appropriate physical activities holds substantial importance for the prevention and mitigation of severe dysmenorrhea.

The predictive model developed in this study demonstrates favorable predictive performance (AUC=0.826), enabling effective identification of high-risk individuals among adolescent girls with primary dysmenorrhea who are prone to severe dysmenorrhea. The model comprises four readily accessible indicators, rendering it simple and practical. Clinicians can utilize this model to evaluate the risk of severe dysmenorrhea in girls suffering from primary dysmenorrhea and implement targeted interventions for high-risk populations. For instance, for girls experiencing early menarche, enhanced health education and menstrual monitoring should be provided to guide them in maintaining menstrual health. Girls who frequently consume cold foods should be advised to reduce their intake. Those with low levels of physical activity should be encouraged to engage in appropriate physical exercise. For girls with elevated serum PGF2 α levels, early intervention with nonsteroidal anti-inflammatory drugs may be considered to prevent the onset of severe dysmenorrhea.

Our study inevitably presents the following limitations. Firstly, as a single-center retrospective study, it has a relatively limited sample size, which may introduce selection bias and compromise the generalizability of the findings. Secondly, due to constraints in data collection, certain potential confounding variables, such as psychological factors and family history of dysmenorrhea, were not incorporated into the analysis, potentially affecting the accuracy of the results. Thirdly, this study solely identified risk factors without conducting intervention research to validate the efficacy of targeted interventions. Future research should encompass multi-center, large-scale prospective studies to further corroborate our findings and undertake intervention research to investigate effective preventive and therapeutic strategies for severe dysmenorrhea among adolescent girls.

Conclusion

In summary, early menarche (≤ 12 years of age), frequent consumption of cold food (≥ 3 times per week), elevated serum PGF2 α levels, and low levels of physical activity are independent risk factors for severe dysmenorrhea in adolescent girls with primary dysmenorrhea. The predictive model constructed based on these four factors demonstrates favorable predictive performance. Clinical interventions targeting these risk factors, including health education, lifestyle modification and timely symptomatic treatment, can contribute to reducing the incidence of severe dysmenorrhea and enhancing the quality of life among adolescent girls.

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Disclosure

The authors report no conflicts of interest in this work.

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