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Prevalence of Menstrual Disorders among School and College-Going Adolescents in an Urban Metropolitan Setting of Chennai: A Cross-Sectional Study

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Abstract

Aims: To determine the prevalence and pattern of menstrual disorders and identify associated socio-demographic and anthropometric factors among school and college-going adolescents in an urban metropolitan setting.

Methods: Study Design: Cross-sectional survey.

Place and Duration of Study: The study was conducted among school and college students in Chennai, Tamil Nadu, India, between June and September 2025.

Methods:

A total of 15,120 post-menarche school and college-going girls aged 15-21 years participated in the study. Data were collected using a structured, pre-tested, self-administered questionnaire covering socio-demographic characteristics, menstrual history, and associated symptoms. Descriptive statistics were used to summarize baseline characteristics. Associations between menstrual disorders and categorical variables were assessed using the chi-square test. Differences in age and body mass index (BMI) were evaluated using non-parametric tests. Variables with statistical significance were further examined using multivariable binary logistic regression to identify independent predictors.

Results: Dysmenorrhea was the most commonly reported menstrual disorder. Significant associations were observed between menstrual disorders and age category, socio-economic status, type of institution, and educational level ($p < 0.001$). Age and BMI were independently associated with several menstrual disorders in multivariable analysis. Increasing age was associated with higher odds of dysmenorrhea and metrorrhagia, whereas younger age showed greater association with menorrhagia and oligomenorrhea. Higher BMI demonstrated significant associations with dysmenorrhea and oligomenorrhea. However, the overall predictive contribution of age and BMI remained modest.

Scientific Novelty: Large-sample analysis identifying key socio-demographic and BMI-related predictors of menstrual disorders in adolescents.

Keywords: Menstrual Disorder, Dysmenorrhea, Oligomenorrhea, Menorrhagia, Metrorrhagia, Menstrual Health, Logistic Regression.

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Conclusion: Menstrual disorders are highly prevalent among adolescents and young women and are influenced by multiple socio-demographic and biological factors. Strengthening early screening, menstrual health education, and targeted interventions within educational settings may improve menstrual health and overall well-being among adolescents.

Introduction

According to the World Health Organization, adolescents are individuals aged 10-19 years, a developmental period marked by the onset of secondary sexual characteristics, reproductive maturation, and establishment of menstrual function [1,2]. Although menstruation is a normal physiological process, the early post-menarche years are frequently accompanied by menstrual disorders and related morbidities [3]. If left unrecognized or untreated, these conditions may adversely affect future reproductive health and overall well-being, highlighting the importance of achieving optimal menstrual health during adolescence 4

Menstrual disorders are the most common of around 75% gynecological complaints globally, accounting for a substantial proportion of clinical consultations [5]. These disorders are multifactorial in origin and are influenced by biological, socioeconomic, and lifestyle determinants, including nutritional status, age at menarche, urbanization, and reproductive health conditions [6]. Evidence also indicates that body mass index, early menarche, and unhealthy lifestyle behaviors such as smoking, alcohol consumption, processed food intake, and prolonged screen exposure are significantly associated with menstrual morbidity, particularly dysmenorrhea and menstrual cycle irregularities [7].

Menstrual disorders encompass a broad spectrum of conditions characterized by disturbances in the normal cyclic pattern of menstruation, or associated physical symptoms include abnormal uterine bleeding (AUB), Dysmenorrhea, and premenstrual symptoms (8). Previous studies in developing countries reported that the prevalence of abnormal uterine bleeding is 5% to 15% among young women in their reproductive age (9). The frequency of amenorrhea ranges from about 5% to 9%, whereas irregular cycle was by 5% to 17%. Around 16% to 78% of women experience Dysmenorrhea, which is the most prevalent menstrual disorder [10]. Despite their high prevalence and potential long-term consequences, healthcare-seeking for menstrual and other reproductive health problems remains low in many low- and middle-income countries, where menstrual concerns are often normalized or considered private matters [11]. For example, a current review of Harlow & Campbell reported that only about two-fifths of women sought medical care for menstrual complaints, while the majority did not perceive these symptoms as requiring clinical attention [12].

Research Problem

The available evidence of menstrual disorders in India is limited and region-specific, with inadequate data from rapidly urbanizing metropolitan populations where lifestyle transitions and socioeconomic diversity may influence menstrual health patterns.

Research Focus

Generating context-specific evidence on the prevalence and determinants of menstrual disorders among school- and college-going adolescents is therefore essential for informing early screening, health education, and targeted reproductive health interventions.

Research Aim and Research Questions

This study was undertaken to address this gap by assessing the burden and pattern of menstrual disorders among adolescents in an urban metropolitan setting.

Research Methodology

Study Design and Setting (2.1)

A cross-sectional survey was conducted from June to September 2025 among school and college going adolescent girls in Chennai, Tamil Nadu, India. Chennai was selected as it represents an urban metropolitan area with both government and private educational institutions with diverse socioeconomic backgrounds.

Study Population (2.2)

Inclusion criteria:

The study population comprised post-menarche school- and college-going girls aged 15-21 years who had attained menarche at least 3 years prior to enrolment.

Exclusion criteria:

The students with the following criteria were excluded:

Girls who had not yet attained menarche, those with a known history of chronic systemic diseases (such as thyroid disorders, diabetes, or bleeding disorders), or those on long-term hormonal therapy were excluded (13)

Girls absent from school due to any other reason other than menstruation.

Pregnancy.

Sample Size Determination (2.3)

The sample size was calculated using the formula for estimating a single population proportion:

$$n = (Z^2 \times p(1-p)) / d^2$$

where Z is the standard normal deviate at 95% confidence level (1.96), p is the anticipated prevalence of menstrual disorders, and d is the allowable error (precision).

Assuming a prevalence (p) of 72%, based on prior studies among Indian adolescents (14-16) (3,4), and a precision (d) of 5%, the required sample size was calculated as:

$$n = [1.96]^2 \times 0.72 \times (1-0.72) / [0.05]^2 = 310$$

Allowing for a 10% non-response rate, the final sample size was rounded to 340 participants.

Sampling Technique (2.4)

A multistage stratified random sampling technique was employed. In the first stage, schools in Chennai were stratified into government and private institutions. From each stratum, schools were selected by simple random sampling. In the second stage, classes containing eligible students were randomly chosen, and all consenting post-menarche girls in those classes were invited to participate. Permissions were obtained from the respective school authorities prior to data collection.

Data Collection Tool and Procedure (2.5)

Data were collected using a structured, pre-tested, self-administered questionnaire prepared in English and Tamil. The tool was developed after reviewing previous studies conducted among Indian adolescents and validated by experts. The questionnaire comprised sections on:

Sociodemographic details: age, class, Marital Status and socioeconomic status

Menstrual characteristics: age at menarche, cycle length, duration of flow, regularity, number of sanitary pads used per day

Menstrual disorders: presence and severity of dysmenorrhea, menorrhagia, oligomenorrhea and metrorrhagia.

The questionnaire was pilot-tested before the data collection. Data collection was facilitated by trained female investigators to ensure privacy and comfort.

Operational Definitions (2.6)

Operational definitions were based on previous literature and standardized guidelines [11,15]:

Dysmenorrhea: Menstrual pain requiring medication or causing restriction of routine activities.

Menorrhagia: Self-reported excessive menstrual bleeding lasting more than seven days or requiring frequent pad changes.

Oligomenorrhea: Menstrual cycles occurring at intervals longer than 35 days.

Metrorrhagia: Self-reported intermenstrual bleeding occurring between two consecutive menstrual cycles, irrespective of flow volume, during the preceding

Ethical Considerations(2.7)

Ethical clearance was obtained from the Institutional Ethics Committee (IEC.NO:EC MGR0309243 dated 18.11.2023) and also from the Tamil Nadu Directorate of Public Health (Approval No.: R.No.011575/HEB/A2/2025). Permission was obtained from school authorities prior to data collection. Parental consent and participant assent were obtained from all participants. Confidentiality and anonymity were maintained, and participants were informed that their participation was voluntary with the option to withdraw at any time (13).

Data Management and Statistical Analysis (2.8)

Data were entered into Microsoft Excel 2021 and analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics were used to summarize sociodemographic characteristics and menstrual patterns. The prevalence of each

menstrual disorder was calculated with 95% confidence intervals (CIs). Associations between menstrual disorders and potential predictors (such as age, age at menarche, BMI, and type of institution and class) were assessed using Chi-square tests. Variables showing $p < 0.05$ were further examined using binary logistic regression to identify independent predictors.

Research Results

A total of 15,120 school and college-going girls from Chennai were included in the analysis.

Tables 1.1 and 1.2 state that the mean age of participants was 16.8 ± 2.1 years. Most participants were aged 13–15 years (42.3%), followed by 16–18 years (35.5%), with smaller proportions aged 19–21 years and above 21 years. The majority were enrolled in government institutions (67.7%) and belonged to the Hindu religion (80.9%). More than half of the participants were from below the poverty line (BPL) households (57.1%).

Table 1.1 Baseline characteristics of study participants (N =15,120)

Variable	Category	Frequency and Percentage (n=15,120)
Age group (years)	13-15	6395 (42.3%)
	16-18	5373 (35.5%)
	19-21	2824(18.7%)
	>21 yrs	528(3.5%)
Type of institution	Govt	10,241 (67.7%)
	Private	4879 (32.3%)
Religion	Hindu	12232 (80.9%)
	Muslim	1435 (9.5%)
	Christian	1406 (9.3%)
	Others	47 (0.3%)
Class / Course	9-10 th Std	5974 (39.5%)
	11-12 th Std	1952 (12.9%)
	UG	1972 (13%)
	PG	5214 (34.5%)
	Diploma	8 (0.15%)
Socio Economic Status	Above Poverty Line	6,493 (42.9%)
	Below Poverty Line	8,627(57.1%)

UG-Under graduation, PG-Post graduation

Table 1.2. History of menstrual cycle pattern

Variable	Category	Frequency & Percentage (n=15,120)
Age at menarche	<11 Yrs	5134 (34%)
	12-13 Yrs	8026 (53.1%)
	14-15 Yrs	1587 (10.5%)
	>15 Yrs	373 (2.5%)
Regularity of menstrual flow	Regular	10,231 (67.7%)
	Irregular	4889 (32.3%)
Duration of menstrual bleeding	1-2 Days	4634 (30.6%)
	3-7 days	9277 (61.4%)
	>7 days	1209 (8%)

Period of Menstrual cycle	25-30 days	10,739 (71%)
	30-35 days	3316 (21.9%)
	>45 days	1065 (7%)
Change of pads/day (Average)	03	

Anthropometric characteristics

Sup. Table 1.1 reports the mean height, weight, and BMI of participants were 155.2 ± 8.7 cm, 46.3 ± 12.4 kg, and 19.3 ± 5.3 kg/m², respectively.

Menstrual characteristics

Most participants attained menarche between 12 and 13 years (53.1%), followed by early menarche (<11 years) in 34%. Nearly 67.7% reported regular menstrual cycles, while 32.3% reported irregular cycles. The majority experienced menstrual bleeding lasting 3-7 days (61.4%), and 71% reported cycle lengths of 25-30 days. On average, participants used three sanitary pads per day.(Table 1.2 & 1.3)

Table 1.3. Demographic and anthropometric characteristics by menstrual disorder status

Variable	Oligomenorrhea n=1727	Dysmenorrhea n=3501	Menorrhagia n=1140	Metrorrhagia n=730	p-value*
Age (years)	16.3 $\pm$ 1.7	16.9 $\pm$ 2.2	15.9 $\pm$ 1.4	17.3 $\pm$ 2.2	<0.001
Height (cm)	155.1 $\pm$ 9.1	155.4 $\pm$ 8.4	155.3 $\pm$ 9.1	155.5 $\pm$ 8.2	<0.001
Weight (kg)	47.1 $\pm$ 12.6	47.5 $\pm$ 12.1	46.3 $\pm$ 12.1	45.5 $\pm$ 13.4	<0.001
BMI (kg/m ²)	19.6 $\pm$ 5.4	19.7 $\pm$ 5.1	19.3 $\pm$ 5.3	18.9 $\pm$ 5.9	<0.001

P value <0.05 is statistically significant

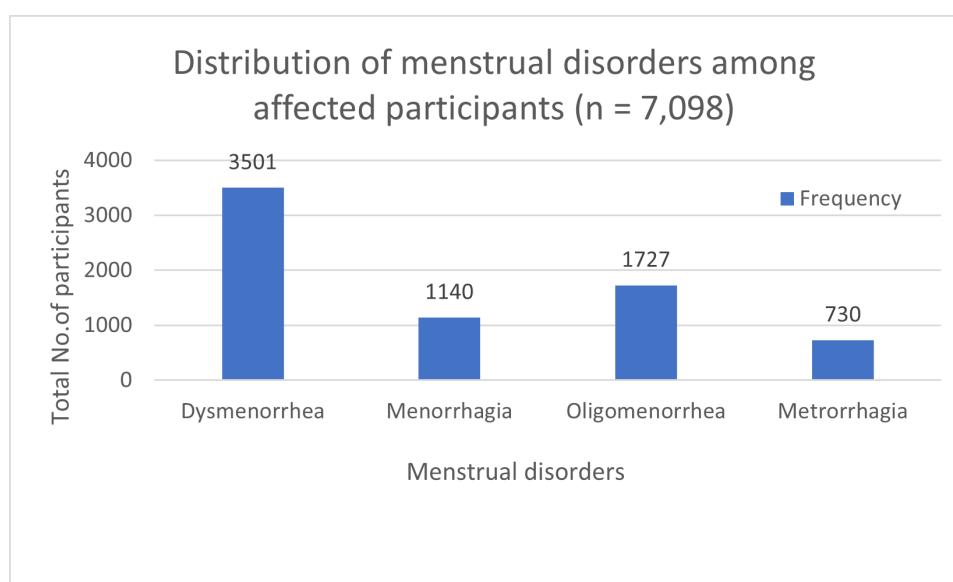


Figure 1. Distribution of menstrual disorders.

Figure 1 shows the distribution of menstrual disorders among affected participants (n = 7,098). Overall, findings indicate that dysmenorrhea (23.2%) accounts for the highest proportion of menstrual disorder cases among affected participants, whereas metrorrhagia (4.8%) constitutes the lowest proportion.

Associated menstrual and systemic symptoms

Common symptoms reported during menstruation (Sup. Table 2 & 3) included back pain (50.2%), fatigue (39.2%), excessive hair loss (38.5%), and headache (22.7%). Table 1.5 indicates that the symptoms suggestive of hormonal imbalance among those with oligomenorrhea included acne or oily skin (33.8%), irregular menstruation (32.3%), skin darkening around the neck (18%), and abnormal weight gain (15.4%).

Urinary and genital tract symptoms

Supplementary Table 4 reports that a considerable proportion of participants reported genitourinary complaints, including increased white discharge (25.7%), urinary urgency (12.3%), and burning micturition (8.5%).

Differences in anthropometric characteristics by menstrual disorder

Supplementary Table 1. shows that significant differences in age, weight, and BMI were observed across menstrual disorder categories. Participants with metrorrhagia tended to be older, while those with oligomenorrhea and dysmenorrhea showed variations in BMI and weight. Height showed minimal variation across groups.

Inferential analysis

Age and menstrual disorders (Table 2: Inferential Statistics):

Age category (Table 2.1) showed a significant association with all four menstrual disorders ($p < 0.001$). Dysmenorrhea prevalence increased with age, while menorrhagia was more common in younger adolescents. Metrorrhagia was more frequent among older age groups, whereas oligomenorrhea was more prevalent among mid-adolescents.

Table 2.1. Association between Age Category and Menstrual Disorders (Chi-square Analysis)

Menstrual Disorders	13-15 yrs	16-18 yrs	19-21 yrs	Above 21 yrs	p-value
Dysmenorrhea n (%)	1316 (20.6)	1331 (24.8)	715 (25.3)	139 (26.3)	<0.001
Menorrhagia n (%)	631 (9.9)	431 (8.0)	70 (2.5)	8 (1.5)	<0.001
Metrorrhagia n (%)	235 (3.7)	284 (5.3)	178 (6.3)	33 (6.3)	<0.001
Oligomenorrhea n (%)	789 (12.3)	713 (13.3)	198 (7.0)	27 (5.1)	<0.001

P value <0.05 is statistically significant

Socio-economic status

Socio-economic status (Table 2.2) was significantly associated with all menstrual disorders ($p < 0.001$). Participants from BPL households had higher prevalence of oligomenorrhea, menorrhagia, and dysmenorrhea, while metrorrhagia was more common among APL participants.

Table 2.2. Association between socio-economic status and menstrual disorders (n = 15,120)

Menstrual disorder	Above Poverty line n (%)	Below poverty line n (%)	p-value
Oligomenorrhea	486 (7.5)	1241 (14.4)	<0.001
Metrorrhagia	443 (6.8)	287 (3.3)	<0.001
Menorrhagia	239 (3.7)	901 (10.4)	<0.001
Dysmenorrhea	1222 (18.8)	2279 (26.4)	<0.001

P value <0.05 is statistically significant

Menstrual regularity

Cycle regularity (Sup. table 5) was significantly associated with dysmenorrhea and metrorrhagia. Along with this, metrorrhagia occurred exclusively among those reporting irregular cycles.

Type of institution

Supplementary table (6) shows that the menstrual disorder distribution differed significantly between government and private institutions. Dysmenorrhea, menorrhagia, and oligomenorrhea were more prevalent in government institutions, whereas metrorrhagia was more common among private institution students.

Educational level

Supplementary table (7) shows significant differences in menstrual disorder prevalence were observed across educational categories ($p < 0.001$). Dysmenorrhea and oligomenorrhea were more common among undergraduate and higher secondary students, while metrorrhagia was more frequent among postgraduate students which aligns same as reported in the older age group.

Anthropometric measures and menstrual disorders

Mann-Whitney U tests (Table 3) demonstrated significant associations between menstrual disorders and few anthropometric variables. Age was significantly associated with all disorders. Weight and BMI were significantly associated with dysmenorrhea, oligomenorrhea, and metrorrhagia, but not with menorrhagia.

Table 3. Comparison of Age, height, weight and BMI across Menstrual Disorders (Mann-Whitney U Test)

Menstrual Disorder	Variable	Z value	p value
Dysmenorrhea	Age	−4.288	<0.001
	Height	−2.001	0.045
	Weight	−7.900	<0.001
	BMI	−5.879	<0.001
Menorrhagia	Age	−13.961	<0.001
	Height	−0.780	0.436
	Weight	−0.579	0.562
	BMI	−0.082	0.934
Metrorrhagia	Age	−7.375	<0.001
	Height	−1.063	0.288
	Weight	−2.895	0.004
	BMI	−2.608	0.009
Oligomenorrhea	Age	−8.241	<0.001
	Height	−0.187	0.852
	Weight	−2.571	0.010
	BMI	−2.054	0.040

P value <0.05 is statistically significant

Binary logistic regression analysis

Binary logistic regression (Table 4) showed that age and BMI had statistically significant but small effects on the occurrence of menstrual disorders.

Table 4. Association between Age Category and Menstrual Symptoms (Binary Logistic Regression)

Outcome	Predictor	B	SE	Adjusted OR (Exp B)	p value	Model fit (Nagelkerke R ²)
Dysmenorrhea	Age	0.025	0.009	1.026	0.004	0.003
	BMI	0.016	0.004	1.016	<0.001	
Menorrhagia	Age	−0.291	0.021	0.748	<0.001	0.041
	BMI	0.008	0.006	1.008	0.183	
Metrorrhagia	Age	0.110	0.016	1.116	<0.001	0.010
	BMI	−0.019	0.007	0.981	0.009	
Oligomenorrhea	Age	−0.141	0.014	0.868	<0.001	0.016
	BMI	0.016	0.005	1.016	0.001	

For dysmenorrhea, both increasing age and higher BMI were associated with a slightly greater likelihood of experiencing the condition. However, the effect size was very small, indicating that age and BMI contribute only minimally to predicting dysmenorrhea.

For menorrhagia, increasing age was associated with a lower likelihood of the condition, suggesting that younger participants were more likely to report menorrhagia. BMI did not have a meaningful influence.

For metrorrhagia, older age increased the likelihood of occurrence, while higher BMI slightly reduced the risk. Nevertheless, these effects were small in magnitude.

For oligomenorrhea, increasing age was associated with reduced likelihood, whereas higher BMI increased the probability of occurrence, although the strength of these associations was modest.

Overall, despite statistical significance, age and BMI explained only a small proportion of variation in all menstrual disorders, indicating that other biological, hormonal, or lifestyle factors likely play a more important role.

Discussion

This large cross-sectional study provides comprehensive evidence on the burden and determinants of menstrual disorders among school and college-going girls. Nearly half of the participants experienced at least one menstrual disorder, highlighting the substantial reproductive health burden among adolescents and young adults.

A study conducted in Malaysia reported that adolescent girls from urban settings and higher socioeconomic backgrounds exhibit a greater prevalence of menstrual disorders, particularly premenstrual syndrome and dysmenorrhea (11). The findings further indicated that in the Peninsula region of Malaysia, the prevalence of premenstrual syndrome and dysmenorrhea exceeded 60% and 70%, respectively (17). Our study demonstrated comparable findings, with dysmenorrhea emerging as the most prevalent menstrual disorder. Adolescents experiencing menstrual disorders also frequently report associated somatic symptoms, including headache, fatigue, and vomiting (18), which were similarly documented in our study. These symptoms can contribute to increased over-the-counter medication use, higher rates of school absenteeism, and a reduced quality of life (11).

Previous studies have reported comparable patterns in the age at menarche among adolescent girls. A study (Bagga. A et al) conducted among 366 schoolgirls aged 9–16 years found that the majority (68%) attained menarche between 12 and 14 years of age, with nearly all participants (94.97%) having achieved menarche by 16 years (19). Similarly, another study from Ghosh.D states that among 557 schoolgirls reported a mean age at menarche of 13.2 $\pm$ 0.66 years, with 95.2% attaining menarche between 11 and 16 years and only 1.8% after 16 years (20).

The findings of the present study are largely consistent with these observations. More than half of the participants (53.1%) attained menarche between 12 and 13 years of age, followed by 34% before 11 years, 10.5% between 14 and 15 years, and only 2.5% after 15 years. Overall, these results indicate that the majority of girls in our study experienced menarche within the typical early-to-mid adolescent age range, aligning with previously reported population trends.

Menstrual disorders varied significantly across age groups. Oligomenorrhea and menorrhagia were more frequent among mid-adolescents, while metrorrhagia was more common among older participants. These patterns may reflect maturation of the hypothalamic-pituitary-ovarian axis, with early post-menarche years characterized by anovulatory cycles and hormonal fluctuations (21). Logistic regression findings further support age as a statistically significant but relatively weak predictor, suggesting that biological maturation alone does not fully explain menstrual irregularities. Clinical guidelines also recognize adolescence as a period of menstrual variability before cycle stabilization (22).

In the present study, socio-economic variation was evident among participants, with 42.9% belonging to the above-poverty-line group and 57.1% to the below-poverty-line group. Consistent with existing evidence, a hospital-based study shows that earlier attainment of menarche was more commonly observed among girls from higher socio-economic backgrounds(13). This pattern may be attributed to better nutritional status and overall growth, enabling girls from higher socio-economic groups to achieve the critical thresholds of body weight, height, and BMI necessary for the initiation of menstruation at an earlier age. Conversely, girls who did not attain these physiological thresholds tended to experience delayed menarche, indicating the influence of nutritional and developmental factors on the timing of menarche.

The high prevalence of menstrual disorders and associated symptoms underscores the need for structured menstrual health education, early screening, and accessible adolescent health services. The strong socio-economic gradient highlights the importance of targeted interventions among vulnerable populations. School-based reproductive health programs and nutritional interventions may play a critical role in reducing menstrual morbidity even recent NFHS survey reveals that The proportion of women using hygienic menstrual protection increased substantially from NFHS-4 to NFHS-5, reflecting improvements in sanitation, awareness, and access (23). Global adolescent health frameworks emphasize menstrual health as an essential component of reproductive wellbeing. WHO recommends improving the quality of health service provision to adolescents by developing an adolescent-friendly national quality standard of care (1).

The major strength of this study is the large sample size and comprehensive assessment of menstrual patterns and related symptoms. However, the cross-sectional design limits cause-and-effect relationships between risk factors and menstrual disorders. Self-reported menstrual characteristics may introduce recall bias, and hormonal or clinical diagnoses were not confirmed.

Conclusions and Implications

Menstrual disorders are highly prevalent among adolescents and young women, with dysmenorrhea being the most common condition. Age, socio-economic status, menstrual regularity, and anthropometric factors significantly influence menstrual health. These findings highlight the need for integrated adolescent reproductive health strategies that focus on early identification, education, and socio-economic equity.

Suggestions for Future Research

Future research should expand upon the findings of the present study to better understand the complex determinants and long-term implications of menstrual disorders among adolescents and young women. Since the current study employed a cross-sectional design, longitudinal studies are recommended to examine temporal relationships between biological, lifestyle, and socio-environmental factors and the development or progression of menstrual disorders over time. Such studies would help clarify causal pathways and provide stronger evidence for preventive strategies.

Intervention-based research is also suggested to evaluate the effectiveness of structured school- and college-based menstrual health education programs. These programs could focus on menstrual hygiene management, early recognition of menstrual abnormalities, nutrition, and lifestyle modification. Evaluating the impact of such interventions on menstrual health awareness, healthcare-seeking behaviour, and reduction of menstrual morbidity would provide valuable evidence for policy and program development.

Qualitative studies exploring adolescents' perceptions, cultural beliefs, and barriers to healthcare-seeking for menstrual problems are equally important. In many settings, menstrual concerns remain underreported due to stigma, lack of awareness, or limited access to adolescent-friendly health services. Understanding these contextual factors would help in designing culturally appropriate health promotion strategies.

Furthermore, comparative studies across different geographic regions, including rural, semi-urban, and metropolitan populations, are needed to identify regional variations in menstrual health patterns and associated determinants. Investigations examining broader determinants such as dietary patterns, physical activity, psychological stress, environmental exposures, and digital screen time may also provide deeper insights into emerging lifestyle-related influences on menstrual health. Together, such research efforts will contribute to the development of comprehensive and evidence-based adolescent reproductive health programs.

Declarations

Author Contributions

The following statements should be used:

KN - Conceptualization, Data curation, original draft.

GS- Manuscript Writing, Formal analysis, Review and editing

AP- Investigation (data collection/field work), Project administration

MM- Methodology and Validation

UK- Methodology and Validation

BK- Methodology and Validation

KS- Formal analysis, Review and editing

NK- Resources and Methodology. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Data available on request due to restrictions (e.g., privacy or ethical): The data presented in this study are available from the corresponding author upon request. The data are not publicly available because the current study is subject to participant privacy and ethical restrictions. However, the data may be made available to the corresponding author upon reasonable request, subject to approval by the Institutional Ethics Committee and adherence to participant confidentiality requirements.

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Institutional Review Board Statement

Ethical clearance was obtained from the Institutional Ethics Committee (IEC.NO:EC MGR0309243 dated 18.11.2023) and also from the Tamil Nadu Directorate of Public Health (Approval No.: R.No.011575/HEB/A2/2025). Permission was obtained from school authorities prior to data collection. Parental consent and participant assent were obtained from all participants. Confidentiality and anonymity were maintained, and participants were informed that their participation was voluntary and that they could withdraw at any time (13).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies, have been completely observed by the authors

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Supplementary Tables**Table 1. Anthropometric characteristics**

Anthropometric measures	Mean and SD
Age in yrs	16.8±2.1
Height in CMs	155.2±8.7
Weight in KGs	46.3±12.4
BMI	19.3±5.3

CMS-centimetres, KGs-Kilograms

Table 2. Symptoms associated during menstruation

Name of the symptom	Frequency & Percentage (n=15,120)
Back pain	7587 (50.2%)
Headache	3434 (22.7%)
Nausea / vomiting	1389 (9.2%)
Fatigue	5920 (39.2%)
Excessive hair loss	5817 (38.5%)
Breathlessness /Frequent numbness in hands & Legs	2949 (19.5%)

Table 3. Clinical features of oligomenorrhea among participants

Symptom	Frequency & Percentage (n=15,120)
Acne / oily skin	5104 (33.8%)
Excess facial or body hair	1537 (10.2%)
Abnormal weight gain	2334 (15.4%)
Darkening of skin around neck	2727 (18 %)
Irregular menstruation	4889 (32.3%)
Milky Nipple Discharge	510 (3.4%)

Table 4. Urinary tract-related symptoms

Symptom	Frequency & Percentage (n=15,120)
Increased white discharge	3885 (25.7)
Strong Urge to urinate even after urinating	1860 (12.3%)
Foul-smelling discharge	1202 (7.9%)
Burning micturition	1286 (8.5%)
Frequent urination or Passing small amount of urine	1138 (7.5%)
Urine that appears red, Bright pink or Cola coloured due to presence of blood	353 (2.3%)

Table 5. Association between regularity of menstrual cycle and menstrual disorders (n= 15,120)

Menstrual disorder	Regular cycle n (%)	Irregular cycle n (%)	p-value
Oligomenorrhea	1174 (11.5)	553 (11.3)	0.767
Dysmenorrhea	2493 (24.4)	1008 (20.6)	<0.001
Menorrhagia	800 (7.8)	340 (7.0)	0.060
Metrorrhagia	0 (0.0)	730 (14.9)	<0.001

P value <0.05 is statistically significant

Table 6. Association between type of institution (Govt/Pvt) and menstrual disorders (n= 15,120)

Menstrual disorder	Govt (n = 10,241) n (%)	Pvt (n = 4,879) n (%)	p-value
Dysmenorrhea	2526 (24.7)	975 (20.0)	<0.001
Menorrhagia	1049 (10.2)	91 (1.9)	<0.001
Metrorrhagia	367 (3.6)	363 (7.4)	<0.001
Oligomenorrhea	1445 (14.1)	282 (5.8)	<0.001

P value <0.05 is statistically significant

Table 7. Association between the Class/course studied by participants and menstrual disorders (n = 15,120)

Menstrual disorder	High School students (n=5974) n (%)	Higher Secondary Students (n=1952) n (%)	Undergraduate students (n=1972) n (%)	Post graduate students (n=5214) n (%)	Diploma students (n=8) n (%)	p-value
Dysmenorrhea	1286 (21.5)	536 (27.5)	698 (35.4)	979 (18.8)	2 (25.0)	<0.001
Menorrhagia	580 (9.7)	209 (10.7)	229 (11.6)	122 (2.3)	0 (0.0)	<0.001
Metrorrhagia	234 (3.9)	51 (2.6)	57 (2.9)	387 (7.4)	1 (12.5)	<0.001
Oligomenorrhea	683(11.4)	342(17.5)	369 (18.7)	331 (6.3)	2 (25.0)	<0.001

P value <0.05 is statistically significant