

Effects of Lifestyle Factors on Menstrual Cycle among College Students - A Cross-Sectional Study

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Abstract

Background: Menstrual cycle, though a natural process, is significantly influenced by lifestyle factors such as stress, diet, exercise, and sleep. College students

experience considerable challenges due to lifestyle changes and academic pressure, which impact their menstrual cycles.

Objective: This study aims to determine how lifestyle factors affect menstruation among college students from a private institution in Tamil Nadu.

Materials and Methods: An institution-based cross-sectional study was conducted over two months at a private university in Perambalur, Tamil Nadu. Undergraduate students in the fields of medical, paramedical, engineering, and arts and sciences were included in the study population. Data were collected using a validated, self-administered questionnaire distributed through Google Forms. Descriptive statistics and the chi-square test were applied, with a significance level of <0.05 .

Results: Of the 2,199 students invited to participate, 1,996 responded, giving a response rate of 90.8%. The participants had a mean age of 19.4 ± 2.1 years, with a mean age at menarche of 13.5 ± 1.5 years. Among them, 33.1% reported irregular cycle lengths, 11.1% experienced variations in period duration, and 25.3% suffered from abnormal blood flow. Obese or overweight students (33.8%), those who consumed fast food daily (53.6%), followed a vegetarian diet (38.1%), or slept less than six hours per night (45.5%) showed a significant association with abnormal menstrual cycles ($p < 0.05$). Shorter sleep duration was strongly correlated with abnormal menstrual frequency and irregular blood flow. Individuals who rarely consumed vegetables and fruits (38.6%) or dairy products (45.5%) were more likely to experience abnormal menstrual flow ($p < 0.05$).

Conclusion: The study highlights that sedentary behaviour, poor diet, and inadequate sleep contribute to menstrual irregularities among college students. It emphasizes the need for lifestyle modifications, counseling, and health education programs in higher education to support better menstrual health.

Keywords: Menstrual Cycle, Lifestyle Factors, College Students, Diet, Physical Activity, Sleep, Stress, Menstrual Irregularities, Dysmenorrhea

Introduction

Menstruation is a normal physiological process that reflects the functional integrity of the hypothalamic–pituitary–ovarian axis and serves as an important indicator of reproductive health in women. A normal menstrual cycle typically occurs every 21–35 days, lasts between 2 and 7 days, and involves an average blood loss of 25–80 mL. Any deviation in cycle length, duration, regularity, or menstrual flow may indicate underlying hormonal, nutritional, metabolic, or psychological disturbances. Menstrual disorders such as oligomenorrhea, poly menorrhea, dysmenorrhea, menorrhagia, and irregular menstrual cycles are increasingly recognized as important public health concerns because they negatively affect physical health, emotional wellbeing, academic performance, work productivity, and overall quality of life among adolescent girls and young women.¹

Globally, menstrual disorders are highly prevalent among adolescents and women of reproductive age. The World Health Organization estimates that approximately 1.9 billion women worldwide menstruate every month, representing nearly one-quarter of the global population.² Studies conducted across different countries report that 20–40% of adolescent girls experience irregular menstrual cycles, while 50–90% suffer from dysmenorrhea, making it one of the leading causes of recurrent school absenteeism and reduced quality of life among young women.³ A recent systematic review further reported that approximately one in every three adolescent girls experiences some form of menstrual

abnormality, highlighting the substantial global burden of menstrual health problems.⁴

India has one of the world's largest adolescent populations, with nearly 253 million adolescents, of whom almost half are girls. Consequently, menstrual health represents a major public health priority.⁵ Systematic reviews from India have reported that menstrual irregularities affect approximately 23–38% of adolescent girls, while dysmenorrhea has been reported in 50 – 87% of adolescents.⁶ Abnormal uterine bleeding among adolescents has also emerged as an important reproductive health concern, with recent meta-analyses demonstrating considerable regional variation in prevalence. Despite increasing awareness regarding menstrual hygiene, menstrual disorders continue to remain underreported because of cultural taboos, poor health-seeking behaviour, lack of awareness, and social stigma surrounding menstruation.

Young adulthood represents a transitional period characterized by major lifestyle changes that can significantly influence menstrual health. College students frequently encounter irregular eating habits, academic stress, sleep deprivation, sedentary behaviour, excessive screen time, altered physical activity, and increased consumption of processed foods. These behavioral changes may disrupt endocrine homeostasis through alterations in hypothalamic–pituitary–adrenal axis activity, cortisol secretion, insulin resistance, inflammatory pathways, and ovarian hormone production, ultimately affecting menstrual cyclicity.

Among modifiable lifestyle determinants, dietary habits have received considerable attention. Diets rich in fruits, vegetables, whole grains, dairy products, and essential micronutrients are associated with improved reproductive hormone regulation and normal ovulatory

function. Conversely, frequent consumption of fast foods, sugar-sweetened beverages, saturated fats, and ultra-processed foods has been linked with obesity, insulin resistance, chronic inflammation, and menstrual irregularities. Micronutrient deficiencies, particularly of iron, calcium, vitamin D, magnesium, zinc, and B-complex vitamins, have also been implicated in dysmenorrhea, prolonged menstrual bleeding, and abnormal cycle length.

Body mass index (BMI) is another important determinant of menstrual health. Both under nutrition and overweight/obesity can impair ovarian function through disturbances in leptin signaling, insulin metabolism, and sex hormone production. Obesity has consistently been associated with an increased risk of oligomenorrhea, an ovulation, polycystic ovary syndrome, and heavy menstrual bleeding, whereas underweight women are more likely to experience hypothalamic amenorrhea due to reduced estrogen production. Maintaining an optimal BMI is therefore essential for preserving normal menstrual function.

Sleep plays a critical role in maintaining hormonal homeostasis. Emerging evidence indicates that inadequate sleep duration, poor sleep quality, and disrupted circadian rhythms alter melatonin secretion, cortisol regulation, and gonadotropin release, thereby influencing menstrual cyclicity. Several studies among adolescents and college students have demonstrated that sleeping fewer than six hours per night is associated with irregular menstrual cycles, prolonged cycle intervals, severe dysmenorrhea, and premenstrual symptoms. Likewise, chronic psychological stress, particularly academic stress among university students, activates the hypothalamic – pituitary – adrenal axis, suppresses gonadotropin-releasing hormone secretion, and

contributes to ovulatory dysfunction and menstrual irregularities.

Regular physical activity has beneficial effects on reproductive health by improving insulin sensitivity, maintaining healthy body weight, reducing inflammation, and regulating endocrine function. However, both physical inactivity and excessive strenuous exercise have been associated with menstrual disturbances. Sedentary lifestyles, prolonged screen exposure, and reduced participation in recreational activities have become increasingly common among college students and may contribute to menstrual abnormalities through metabolic and hormonal mechanisms.

Several international and Indian studies have reported significant associations between unhealthy lifestyle practices and menstrual disorders.⁷ The Korea Nurses' Health Study demonstrated that inadequate sleep, psychological stress, and unhealthy behavioral patterns significantly influenced menstrual regularity and cycle length.⁸ Lifestyle intervention trials among young women have further shown that improvements in diet, exercise, and sleep hygiene can effectively restore menstrual regularity and reduce menstrual symptoms. Similarly, Indian studies conducted among adolescents have identified unhealthy dietary habits, obesity, insufficient physical activity, and academic stress as important predictors of menstrual disorders. However, findings across studies remain inconsistent because of differences in study populations, geographical settings, socio-cultural characteristics, and measurement of lifestyle factors.

Although several studies have investigated menstrual health among adolescents in India, relatively few large-scale studies have comprehensively evaluated the

combined influence of multiple lifestyle factors—including dietary practices, sleep duration, physical activity, BMI, substance use, and behavioral characteristics—on different menstrual parameters among college students in South India. Furthermore, evidence from Tamil Nadu remains limited despite rapid urbanization, changing dietary patterns, increasing sedentary lifestyles, and growing academic pressures experienced by university students. Understanding these modifiable determinants is essential for developing targeted health education programmes, lifestyle interventions, and campus-based reproductive health initiatives.

Therefore, the present institution-based cross-sectional study was undertaken among female undergraduate students in a private university in Tamil Nadu to assess the prevalence of menstrual irregularities and examine the association between lifestyle factors and menstrual characteristics. The findings are expected to provide evidence for designing preventive strategies and health promotion programmes aimed at improving menstrual and reproductive health among young women.

Objectives

1. To assess the prevalence of irregular menstruation among college students at a private university in Tamil Nadu,
2. To determine the effect of lifestyle factors on menstruation among college students at a private university in Tamil Nadu.

Materials and Methods

This institution-based cross-sectional study was conducted among female undergraduate students at a private university in Perambalur, Tamil Nadu, India, over a period of two months from 26 July to 25 September 2025. The study included students enrolled in

medical, paramedical, engineering, and arts and science programmes. Female undergraduate students who were willing to participate and provided informed consent were included in the study.

A convenience sampling technique was employed to recruit participants. Data were collected using a pre - tested, self - administered, semi - structured questionnaire developed to obtain information on sociodemographic characteristics, menstrual history, and lifestyle - related factors. The questionnaire was distributed electronically through Google Forms using institutional WhatsApp groups and email, allowing students to participate voluntarily and anonymously.

The study collected information on sociodemographic variables, including age, year of study, academic branch, religion, parental education, and annual household income. Clinical and reproductive variables included body mass index (BMI), age at menarche, menstrual cycle frequency, duration of menstruation, menstrual blood flow, and dysmenorrhea. Lifestyle-related variables comprised dietary habits, meal frequency, breakfast skipping, fast-food consumption, fruit and vegetable intake, dairy consumption, whole-grain intake, water intake, physical activity, sleep duration, smoking, alcohol consumption, and the presence of any chronic medical condition. The primary outcome variable was menstrual pattern.

Menstrual pattern was defined as the characteristics of the menstrual cycle, including cycle length, duration of menstrual bleeding, menstrual flow, regularity, and associated symptoms. Lifestyle factors were defined as modifiable behavioral practices such as dietary habits, physical activity, sleep pattern, smoking, alcohol consumption, and other health-related behaviours that could potentially influence menstrual health. A normal

menstrual cycle was defined as one occurring at intervals of 21–35 days with a menstrual duration of 2 –7 days and an estimated blood loss of 25 – 80 mL per cycle. Menstrual irregularity was defined as a cycle length of less than 21 days (poly menorrhea) or more than 35 days (oligomenorrhea), menstrual bleeding lasting less than 2 days or more than 7 days, estimated menstrual blood loss exceeding 80 mL (equivalent to more than 16 soaked sanitary pads per cycle) or fewer than five sanitary pads per cycle, or the presence of blood clots during menstruation.

All eligible students were invited to participate in the study, and reminders were circulated before the closure of data collection to improve the response rate. Participation was entirely voluntary, and electronic informed consent was obtained before accessing the questionnaire. Confidentiality and anonymity of all participants were maintained throughout the study, and the information collected was used solely for research purposes.

Following completion of data collection, responses were exported from Google Forms and analysed using IBM SPSS Statistics version 21. Data were checked for completeness and consistency before analysis. Descriptive statistics were used to summarize participant characteristics, with continuous variables expressed as mean $\pm$ standard deviation and categorical variables presented as frequencies and percentages. Associations between lifestyle factors and menstrual characteristics were assessed using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

The study was conducted after obtaining approval from the Institutional Ethics Committee (approval number to be inserted). All procedures were performed in accordance with the ethical principles outlined in the

Declaration of Helsinki. Electronic informed consent was obtained from all participants prior to enrolment, and strict confidentiality of participant information was maintained throughout the study.

Results

Of the 2,199 students invited to participate, 1,996 responded, giving a response rate of 90.8%. The mean age of participants was 19.4 ± 2.1 years, with a mean age at menarche of 13.5 ± 1.5 years. Baseline characteristics of the participants are summarized in Table 1.

Table 1: Baseline characteristics of the participants (N = 1996)

Baseline characteristic	Category	n (%)
Age	<18 years	764 (38.3)
	>18 years	1232 (61.7)
Branch	Medical	536 (26.9)
	Non-medical	1460 (73.1)
Religion	Hinduism	1717 (86.0)
	Islam	210 (10.5)
	Christianity	69 (3.5)
Year of study	1st year	717 (35.9)
	2nd year	647 (32.4)
	3rd year	328 (16.4)
	4th year	304 (15.2)
Age at menarche	≤ 13 years	1115 (55.9)
	>13 years	881 (44.1)
Annual household income (Rs)	<10,000	780 (39.1)
	10,001–18,000	219 (11.0)
	18,001–39,999	453 (22.7)
	$\geq 40,000$	544 (27.3)

Overall, 33.1% of participants reported irregular cycle lengths, 11.1% experienced variations in period duration, and 25.3% suffered from abnormal blood flow. The distribution of the duration of menstruation, the average number of pads used per cycle, and the length of the menstrual cycle are shown in Figures 1–3.

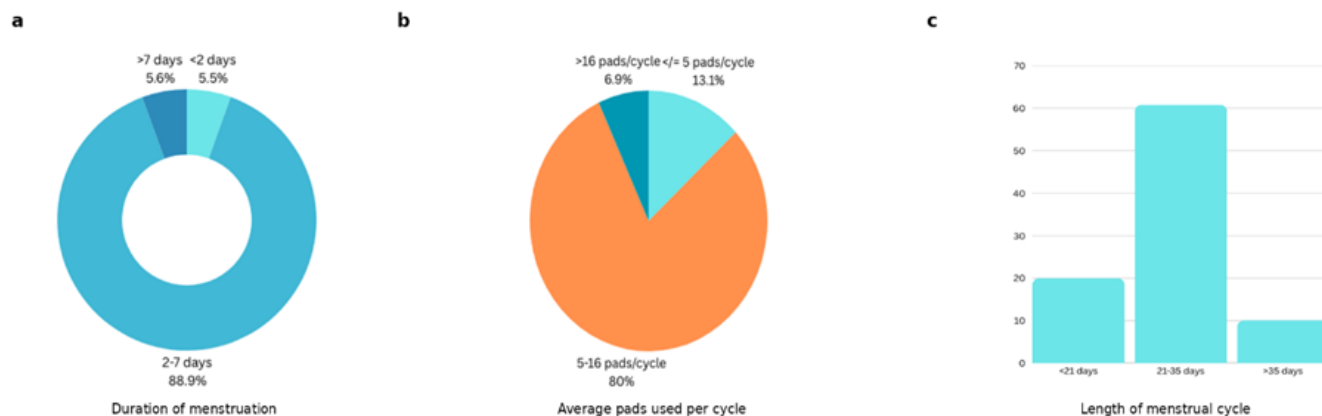
Figure 1. Menstrual characteristics among participants (N = 1996)

Table 2 presents the association between the duration of the menstrual cycle and lifestyle factors. Students who consumed three or more meals per day, ate dairy products regularly, or slept 7–8 hours per night were significantly more likely to report a normal duration of menstruation, whereas smoking and alcohol use were associated with a higher proportion of abnormal duration ($p < 0.05$ for all).

Table 2: Association between duration of menstrual cycle and lifestyle factors (N = 1996)

Participant characteristic	Normal duration (2–7 days) n (%)	Abnormal duration (<2 or >7 days) n (%)	P-value
Branch			0.000
Medical	499 (93.1)	37 (6.9)	
Non-medical	1275 (87.3)	185 (12.7)	
Pain during cycle			0.08
During almost all cycles	753 (89.4)	89 (10.6)	
During some cycles	490 (90.7)	50 (9.3)	
Rarely	332 (87.4)	48 (12.6)	
No pain at all	199 (85.0)	35 (15.0)	
Meals/day			0.00
One	319 (82.9)	66 (17.1)	
Two	418 (86.5)	65 (13.5)	
Three	997 (91.9)	88 (8.1)	
>3	40 (93.0)	3 (7.0)	

Participant characteristic	Normal duration (2–7 days) n (%)	Abnormal duration (<2 or >7 days) n (%)	P-value
Snacks			0.008
Never	321 (85.6)	54 (14.4)	
1–2 times/week	874 (89.8)	99 (10.2)	
3–5 times/week	298 (92.5)	24 (7.5)	
Daily	281 (86.2)	45 (13.8)	
Dairy intake			0.000
Never	277 (85.0)	49 (15.0)	
Rarely	564 (90.7)	58 (9.3)	
1–2 times/week	339 (91.1)	33 (8.9)	
Daily	583 (89.0)	72 (11.0)	
At every meal	11 (52.4)	10 (47.6)	
Average sleep (hours/day)			0.024
<5 hours	121 (83.4)	24 (16.6)	
5–6 hours	732 (88.2)	98 (11.8)	
7–8 hours	813 (90.8)	82 (9.2)	
>8 hours	108 (85.7)	18 (14.2)	
Smoking			0.019
Yes	31 (75.6)	10 (24.4)	
No	1743 (89.2)	212 (10.8)	
Alcohol use			0.008
Yes	36 (75.0)	12 (25.0)	
No	1738 (89.2)	210 (10.8)	
Beverages			0.001
Sugary drinks/soda	215 (87.8)	30 (12.2)	

Participant characteristic	Normal duration (2–7 days) n (%)	Abnormal duration (<2 or >7 days) n (%)	P-value
Tea/coffee	1242 (89.9)	140 (10.1)	0.000
Milk/shakes	254 (84.4)	47 (15.6)	
Alcohol	4 (57.1)	3 (42.9)	
None	59 (96.7)	2 (3.3)	
Whole grains			0.000
None	227 (81.7)	51 (18.3)	
1–2 servings	1367 (90.2)	149 (9.8)	
3–4 servings	148 (90.8)	15 (9.2)	
>4 servings	32 (82.1)	7 (17.9)	
Medical condition			0.002
Yes	180 (82.2)	39 (17.8)	
No	1594 (89.7)	183 (10.3)	

Table 3 shows the association between lifestyle factors and the length of the menstrual cycle. A vegetarian diet (38.1% abnormal), daily fast food consumption (53.6% abnormal), sleeping less than six hours per night (45.5% abnormal), and alcohol use were significantly associated with oligomenorrhea/poly menorrhea ($p < 0.05$).

Table 3: Association between lifestyle factors and the length of the menstrual cycle (N = 1996)

Participant characteristic	Normal cycle n (%)	Oligo/ Poly menorrhea n (%)	P-value
Age			0.08
<18 years	493 (64.5)	271 (35.5)	
>18 years	843 (68.4)	389 (31.6)	
Branch			0.10
Medical	374 (69.8)	162 (30.2)	
Non-medical	962 (65.9)	498 (34.1)	
Age at menarche			0.114
<13 years	763 (68.4)	352 (31.6)	

Participant characteristic	Normal cycle n (%)	Oligo/ Poly menorrhea n (%)	P-value
>13 years	573 (65.0)	308 (35.0)	
Diet			0.006
Vegetarian	172 (61.9)	106 (38.1)	
Non-vegetarian	271 (62.2)	165 (37.8)	
Mixed	856 (69.5)	376 (30.5)	
Eggetarian	37 (74.0)	13 (26.0)	
Meals/day			0.004
One	237 (61.6)	148 (38.4)	
Two	308 (63.8)	175 (36.2)	
Three	764 (70.4)	321 (29.6)	
>3	27 (62.8)	16 (37.2)	
Snacks			0.002
Never	227 (60.5)	148 (39.5)	
1–2 times/week	677 (69.6)	296 (30.4)	
3–5 times/week	228 (70.8)	94 (29.2)	
Daily	204 (62.6)	122 (37.4)	
Skipping breakfast			0.07
Daily	153 (63.5)	88 (36.5)	
Sometimes	547 (64.9)	296 (35.1)	
Rarely	361 (71.1)	147 (28.9)	
Not at all	275 (68.1)	129 (31.9)	
Fast food consumption			0.008
Never	219 (61.9)	135 (38.1)	
1–2 times/month	616 (70.0)	264 (30.0)	

Participant characteristic	Normal cycle n (%)	Oligo/ Poly menorrhea n (%)	P-value
Once a week	357 (67.2)	174 (32.8)	
>2 times/week	131 (64.5)	72 (35.5)	
Daily	13 (46.4)	15 (53.6)	
Dairy intake			0.110
Never	206 (63.2)	120 (36.8)	
Rarely	415 (66.7)	207 (33.3)	
1–2 times/week	243 (65.3)	129 (34.7)	
Daily	454 (69.3)	201 (30.7)	
At every meal	18 (85.7)	3 (14.3)	
Average sleep (hours)			0.004
<5 hours	79 (54.5)	66 (45.5)	
5–6 hours	578 (69.6)	252 (30.4)	
7–8 hours	598 (66.8)	297 (33.2)	
>8 hours	81 (64.3)	45 (35.7)	
Medical condition			0.000
Yes	114 (52.1)	105 (47.9)	
No	1222 (68.8)	555 (31.2)	
Whole grains			0.003
None	165 (59.4)	113 (40.6)	
1–2 servings	1019 (67.2)	497 (32.8)	
3–4 servings	122 (74.8)	41 (25.2)	
>4 servings	30 (76.9)	9 (23.1)	
Smoking			0.09
Yes	22 (53.7)	19 (46.3)	

Participant characteristic	Normal cycle n (%)	Oligo/ Poly menorrhea n (%)	P-value
No	1314 (67.2)	641 (32.8)	
Alcohol use			
Yes	22 (45.8)	26 (54.2)	0.003
No	1314 (67.5)	634 (32.5)	

Table 4 shows the association between lifestyle factors and the average number of pads used per cycle. Household income, BMI, and branch of study were significantly associated with abnormal pad usage per cycle ($p < 0.05$).

Table 4: Association between lifestyle factors and the average number of pads used per cycle (N = 1996)

Participant characteristic	<5 or >16 pads/cycle n (%)	5–16 pads/cycle n (%)	P-value
Household income/annum (Rs)			
≤10,000	175 (22.4)	605 (77.6)	0.03
10,001–18,000	39 (17.8)	180 (82.2)	
18,001–39,999	71 (15.7)	382 (84.3)	
>40,000	114 (21.0)	430 (79.0)	
BMI			
Underweight	133 (24.0)	422 (76.0)	0.05
Normal	137 (18.2)	617 (81.8)	
Overweight	41 (18.4)	182 (81.6)	
Obesity	88 (19.0)	376 (81.0)	
Branch			
Medical	77 (14.4)	459 (85.6)	0.000
Non-medical	322 (22.1)	1138 (77.9)	
Water consumption/day			
<2 litres	59 (23.6)	191 (76.4)	0.13
≥2 litres	340 (19.5)	1406 (80.5)	
Fast food consumption			0.06

Participant characteristic	<5 or >16 pads/cycle n (%)	5–16 pads/cycle n (%)	P-value
Never	82 (23.2)	272 (76.8)	
1–2 times/month	165 (18.8)	715 (81.3)	
Once a week	118 (22.2)	413 (77.8)	
>2 times/week	31 (15.3)	172 (84.7)	
Daily	3 (10.7)	25 (89.3)	
Snacks			0.08
Never	89 (23.7)	286 (76.3)	
1–2 times/week	192 (19.7)	781 (80.3)	
3–5 times/week	51 (15.8)	271 (84.2)	
Daily	67 (20.6)	259 (79.4)	

Discussion

The present institution-based cross-sectional study assessed the influence of lifestyle factors on menstrual characteristics among 1,996 female undergraduate students in Tamil Nadu. Approximately one-third (33.1%) of the participants reported irregular menstrual cycles, while 11.1% experienced abnormal menstrual duration and 25.3% reported abnormal menstrual flow. These findings indicate that menstrual disturbances remain common among young women despite increasing awareness regarding menstrual health. Given the large sample size and high response rate (90.8%), the present study provides valuable evidence regarding the relationship between modifiable lifestyle behaviours and menstrual health among college students.

The prevalence of irregular menstrual cycles observed in the present study (33.1%) is comparable with previous studies conducted among adolescents and young adults in India. Omidvar et al.(2018) reported that approximately one-third of adolescent girls from South

India experienced menstrual irregularities(9), while Dhar et al.(2023) observed a significant burden of menstrual disorders among adolescent and young women in eastern India.(10) Similarly, recent systematic reviews by Majeed J et al.(2022) demonstrated that menstrual irregularities affect nearly one-quarter to one-third of adolescent girls across India, although prevalence varies according to geographical region, age group, and diagnostic criteria.¹¹ The consistency of these findings suggests that menstrual irregularities continue to be an important public health concern among Indian college students.

One of the important observations in the present study was the association between dietary practices and menstrual characteristics. Students consuming three or more meals daily were significantly more likely to have normal menstrual duration and cycle length compared with those consuming fewer meals. Similarly, participants who consumed whole grains and dairy products more frequently demonstrated better menstrual

patterns. These findings are consistent with those reported by Attia G et al. (2023), who demonstrated that dietary modification and improved nutritional practices significantly improved menstrual regularity among young women with irregular menses.¹² Dhar et al.(2023) also reported that healthy dietary habits were associated with fewer menstrual abnormalities among adolescent girls.¹⁰ Adequate nutritional intake is essential for maintaining hypothalamic-pituitary-ovarian axis function, and deficiencies in energy intake or essential micronutrients may alter gonadotropin secretion, ovulation, and endometrial development, resulting in menstrual disturbances.

Fast-food consumption demonstrated a significant relationship with menstrual cycle abnormalities in the present study. More than half (53.6%) of students consuming fast food daily experienced oligomenorrhea or poly menorrhea. Similar findings have been reported by several investigators who observed that diets rich in saturated fats, refined carbohydrates, and ultra-processed foods increase systemic inflammation, insulin resistance, and oxidative stress, thereby disrupting reproductive hormone regulation. Majeed J et al. (2022) emphasized that poor dietary quality and inadequate micronutrient intake adversely affect reproductive health¹¹. The increasing availability of processed foods and changing dietary habits among university students may therefore represent an important modifiable risk factor for menstrual abnormalities.

Sleep duration emerged as one of the strongest lifestyle factors associated with menstrual health in the present study. Participants sleeping fewer than five hours per day exhibited significantly higher proportions of abnormal menstrual duration (16.6%) and irregular menstrual cycles (45.5%) compared with those sleeping

seven to eight hours. These findings corroborate the observations of Jeong et al.(2023), who demonstrated that inadequate sleep duration and poor sleep quality were significantly associated with dysmenorrhea and menstrual irregularities among Korean adolescents.¹² Likewise, Song et al.(2022), in the Korea Nurses' Health Study, reported that sleep disturbances were independently associated with menstrual cycle irregularity and prolonged cycle length.⁸ Physiologically, sleep deprivation alters circadian rhythm, melatonin secretion, cortisol production, and gonadotropin-releasing hormone Pulsatility, ultimately affecting ovarian hormone secretion and menstrual cyclicity. The present findings reinforce the importance of adequate sleep in maintaining reproductive health among young women.

Lifestyle behaviours such as smoking and alcohol consumption were also associated with adverse menstrual outcomes. Participants who reported smoking or alcohol use were significantly more likely to experience abnormal menstrual duration, while alcohol consumption was additionally associated with irregular menstrual cycles. Similar findings have been reported in previous epidemiological studies demonstrating that smoking accelerates estrogen metabolism and impairs ovarian function, whereas alcohol consumption influences hypothalamic – pituitary - ovarian axis regulation and sex hormone metabolism.¹³ Although the prevalence of these behaviours was relatively low in the present study, their significant association with menstrual abnormalities highlights the importance of behavioral counseling within university health programmes.

The present study also demonstrated that students with pre-existing medical conditions were significantly more

likely to experience abnormal menstrual duration and irregular menstrual cycles. Chronic illnesses may alter menstrual function through hormonal disturbances, chronic inflammation, nutritional deficiencies, medication use, or psychological stress. Similar associations have been documented in previous studies evaluating reproductive health among adolescents and young adults.¹⁴ Identification and appropriate management of underlying medical conditions may therefore contribute to improved menstrual health.

Body mass index was significantly associated with abnormal menstrual flow, with underweight and obese participants demonstrating greater abnormalities than students with normal BMI. These findings are consistent with existing literature indicating that both extremes of body weight adversely affect reproductive endocrine function. Obesity contributes to hyper insulinemia, increased aromatization of androgens, and altered estrogen metabolism, whereas under nutrition suppresses hypothalamic gonadotropin - releasing hormone secretion, resulting in menstrual dysfunction. Previous studies have consistently demonstrated that maintaining a healthy BMI is essential for preserving normal ovulatory function and menstrual regularity.¹⁵

Another noteworthy finding was the association between socioeconomic characteristics and menstrual flow. Household income and branch of study showed statistically significant relationships with abnormal pad usage per cycle. Students from different socioeconomic backgrounds may differ in nutritional intake, access to healthcare, menstrual hygiene practices, and health awareness, which could influence menstrual characteristics. Medical students also demonstrated relatively better menstrual outcomes than non-medical students, possibly reflecting greater health literacy and

awareness regarding healthy lifestyle practices. However, further multicentric studies are required to better understand these relationships.

Overall, the findings of the present study support the growing body of evidence that menstrual health is closely linked with modifiable lifestyle factors. Unlike non-modifiable biological determinants, behaviours such as dietary habits, sleep hygiene, maintenance of healthy body weight, and avoidance of smoking and alcohol are amenable to intervention. Universities therefore provide an ideal setting for implementing comprehensive menstrual health promotion programmes, including nutrition education, sleep hygiene counseling, regular physical activity initiatives, and reproductive health awareness campaigns. Such interventions may improve not only menstrual health but also students' academic performance, psychological wellbeing, and overall quality of life.

In summary, the present study contributes robust evidence from a large cohort of female college students in South India, demonstrating that unhealthy dietary practices, inadequate sleep, abnormal BMI, smoking, alcohol use, and underlying medical conditions are significantly associated with menstrual abnormalities. These findings emphasize the importance of promoting healthy lifestyle behaviours as an integral component of adolescent and young women's reproductive health programmes and support the development of institution-based interventions aimed at improving menstrual health outcomes.

Conclusion

This study demonstrates that lifestyle factors, particularly sleep duration, stress levels, and diet, significantly influence menstrual cycle length and flow patterns among college students. With a notable

proportion of participants experiencing irregular cycles and increased pad usage, there is a clear need for structured interventions promoting healthy routines, stress management, adequate sleep, and balanced nutrition. Strengthening menstrual health awareness programs within university settings can play a crucial role in improving reproductive health outcomes among young women.

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