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Psychosocial and stress-related risk factors for abnormal menstrual cycle pattern among adolescent girls: A case-control study

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Abstract:

BACKGROUND: Menstruation is a normal physiological process among reproductive age group females. Although some of them show the abnormal menstrual pattern, which is influenced by several factors, including sociodemographic status, psychosocial stress, improper sleep level, etc. The identification of these risk factors associated with abnormal menstrual patterns may permit risk stratification among adolescent girls. This study was planned to determine various factors which depict menstrual cycle pattern among adolescent girls in urban India.

MATERIALS AND METHODS: A school-based case–control study was carried out in urban India from May to December 2019. Urban locality and schools were randomly selected, and data were collected in two phases. Adolescent girls in the age group of 10–19 years studying in government and private (both Hindi medium and English medium) schools of urban India were screened for the abnormal menstrual pattern. Equal numbers of age-matched controls were also enrolled. Data were collected with the help of self-administered predesigned pretested semi-structured questionnaire. Chi-square test, Fisher's exact test, unpaired *t*-test, and McNemar tests were used to analyze data using SPSS version 23.0.

RESULTS: A total of 100 cases and 100 age-matched controls (mean age 14.8 ± 1.5 years) were included in the study, almost half of the cases and controls have normative menarche. Improper sleep patterns increased stress levels, and low education status of mothers show statistically significant ($P = 0.047$) association with abnormal menstrual patterns.

CONCLUSION: More stress, improper sleep levels, and low education status of mothers among school-going adolescent girls were strongly associated with abnormal menstrual patterns with more symptoms during menstruation.

Keywords:

Adolescent, case–control study, menstrual cycle

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Introduction

Adolescent age group (10–19 years) comprise 16% of world's population, which constitutes 1.2 billion of population worldwide.[1] According to census 2011 and National Family Health Survey-4 (2015–2016), India have >250 million adolescents, who constitute nearly 20% of country's total population.[2,3] Healthy adolescents are assets to economic growth and productivity of any nation. Although they are a relatively healthy group, their developmental stage makes them vulnerable for many health issues. Adolescent age is a difficult phase where many physiological and psychological changes take place. Most of mental health

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disorders remain unnoticed due to negligence and ignorance on part of their parents.[4]

Also, adolescent age is an "age cohort" which provides an opportunity to identify risk factors for upcoming adolescent cohorts and design appropriate promotive and preventive strategies. Adolescent girls experience many stressors, which may be attributed to studies, peer pressures, bad habits, causing the deleterious effect on their physical as well as mental health. Adolescent girls, while going through puberty and meet changing expectations of others and cope with feelings that may be new to them. There are various sexual and reproductive problems faced by girls in this age.[5] Majority of these problems remain unaddressed and unnoticed because of various factors such as inadequate knowledge, familial conditions, hesitancy of revealing problems to family members, and many other environmental and social factors.[5-7]

Female reproductive system is characterized by regular cyclic changes known as menstrual cycle. First menstruation (menarche) commonly occurs at a mean age of 13 years (range 11–15 years).[8] Menstruation is cyclical bleeding from uterus due to shredding of its endometrial wall, which lasts for an average of about 4–7 days and among two-third of women, average cycle observed is of 21–35 days.[9] Amount of blood loss during every menstrual cycle is approximately 15–80 ml, which is considered as normal flow. However, >80 ml is considered as heavy, and <15 ml is considered as light bleeding.[10] Heavy menstrual bleeding (HMB) is a common complaint among all adolescent girls. It is noticed as an abnormal volume of blood loss during menstrual cycle. Abnormal menstrual pattern can manifest as either HMB or irregular menstruation. In many cases, immaturity of hypothalamic-pituitary-ovarian axis or hormonal conditions like polycystic ovarian syndrome leading to anovulatory cycles are underlying cause for HMB.[11] Abnormal menstrual bleeding is defined as any variation from normal menstrual cycle and includes changes in regularity, frequency, duration of flow, or amount of blood loss.[12] Duration and regularity of menstrual cycle are influenced by several factors, including sociodemographic profile, psychosocial stress, disturbed sleep level, strenuous physical exercise, diet, etc.[13-18] Various studies have documented increased stress levelduring menstrual pain and also identified stress as one of key factors responsible for menstrual irregularities.[13-15,19] Unhealthy lifestyle is also a major risk factor for menstrual abnormality. There are limited data available on prevalence of menstrual problems and their association with factors mainly psychological stress and disturbed sleep level. However, most of available studies are either cross-sectional studies or did not utilize a validated questionnaire. Main rationale of this study was to determine association between psychological stress and disturbed sleep level with abnormal menstrual pattern using a validated questionnaire. The study results would be helpful to establish this association and for creating strategies for improving psychological and reproductive health among adolescent girls.

Materials and Methods

A school-based case–control study was conducted in an urban city of India over a period of 6 months from May to December 2019. Study participants were adolescent girls (10–19 years) studying in Government and Private Schools of urban Rishikesh. Girls with a history of abnormal menstrual cycle pattern were included in study as cases after taking written informed consent from participant above 18 years of age and written informed assent from participant with age between 12 and 18 years. Similarly, age-matched controls were selected, having normal menstrual cycle patterns. Anonymity and confidentiality of information obtained from participants were maintained. The study was approved by the Institutional Ethical Committee (Letter No: AIIMS/IEC/19//713.[20]

Case definition for abnormal menstrual patterns

As per the Federation of International Gynaecologist and Obstetricians, abnormal menstrual pattern is defined as any departure from normal menstruation or a normal menstrual cycle pattern. However, considerable variations are documented in regularity, frequency, heaviness, and duration of flow.[21,22] Cases were selected based on the following four criteria's:

1. Irregularity of menses with the variation of >20 days[10]
2. Frequency of menses (<21 days or >35 days)[10]
3. Menstrual flow (heavy flow > 80 ml per cycle or light flow <15 ml per cycle)[10]
4. Duration of the menstrual cycle (prolonged >7 days or shortened <4 days).[9]

Adolescent girls who did not attain menarche, on hormonal contraceptives, hormonal therapy, or treatment for any medical and mental illnesses were excluded.

In the present study, stress scores were compared among adolescent girls with normal and abnormal menstrual patterns. Standard deviation (SD) for stress score with and without painful bleeding was 37 and 32, respectively, with a mean difference as 15.[14] With 95% Confidence interval and 80% power, the sample size was calculated as 84 in each group (cases and controls) using the formula ($n = [Z\alpha/2 + Z\beta]^2 \times 2 \times \sigma^2/d^2$), where σ denotes SD and d denotes mean difference. Adjusting for non-response rate, as high as 20%, 100 individuals were finally enrolled in each group.

Sampling was done utilizing a multistage random sampling technique. There were 40 administrative urban localities in local Municipal Corporation. In first stage, out of 40 urban localities, 8 urban localities were selected using simple random sampling method (online random number generation). In second stage, one middle school, one high school, and one higher secondary school were selected from each urban locality by simple random sampling method. A total of 2–3 classes per school from 5th to 12th standards were selected by simple random sampling method. In third stage, adolescent girls from each selected school fulfilling eligibility criteria were approached. A total of 12–13 cases and age-matched controls were selected from each school.

Study was conducted in two sessions for each selected school. In the first session, an introductory session was taken for each class and a brief description of the study was given to students about questionnaire and its different components and the confidentiality of their responses was assured. Written consent/assent was obtained from students for participation in the study.

Self-administered questionnaires related to sociodemographic information and menstrual histories were distributed first among 30–40 students per school to screen cases and controls. Items from "Women's Health Symptoms Survey"[23] were used for collecting menstrual history. After screening, 12–13 cases and age-matched controls were selected from each school. Those selected 12–13 cases and age-matched controls are then provided with questionnaires related to sleep and psychological stress assessment. Sleep was assessed by the Epworth Sleepiness Scale (ESS). Total score of ESS can range from 0 to 24. Higher the ESS score, the greater will be the possibility of daytime sleepiness. Scores 0–5 indicates lower normal daytime sleepiness, 6–10 is higher normal daytime sleepiness, 11–12 is mild excessive daytime sleepiness, 13–15 is moderate excessive daytime sleepiness, and 16–24 is severe excessive daytime sleepiness.[24] Stress was assessed by Perceived Stress Scale (PSS). PSS-10 scores were obtained by reversing the scores related to 4 positively stated questions (Questions no. 4, 5, 7, and 8) i.e., 1 = 3, 2 = 2, 3 = 1, and 4 = 0. Higher the PSS score, the greater will be stress level. Scores 0–10 represent no stress, 11–20 is mild stress, 21–30 is moderate stress , and 31–40 as severe stress.[25]

Data were entered in MS Excel version 2016, transferred and analyzed using SPSS version 23.0 IBM Company, Armonk, NY, U.S.A. Descriptive statistics were used to describe categorical data as frequency or proportions. Continuous variables were described as mean with SD or median with interquartile range. Chi-square test or Fisher's exact test was used to determine the association between categorical variables and strength of association was estimated by calculating odds ratio (OR) among cases and controls. An Independent *t*-test was used to compare means among cases and controls. As it was matched case–control study; therefore, the McNemar test was used to examine the association between matched pair of subjects for 2 × 2 tables. A $P < 0.05$ was considered as statistically significant.

Results

A total of 200 adolescent girls (100 cases and 100 controls) were included in the study (mean matched age 14.8 ± 1.5 years). A total of 95% of cases and 78% of control included in the study were Hindu by religion. Mother's education was up to intermediate level among 30% cases, while 35% controls reported it up to graduate level and above. However, father's education was up-to graduate and above among 59% of cases and 65% of controls. A statistically significant association was found between the education status of the mother and menstrual abnormality ($P = 0.047$). However, no statistically significant association was found between abnormal menstrual pattern and father's education level. About half of the cases and controls reported father as head of the family. A maximum proportion of cases reported their parent's/head of family occupation level as professional or semi-professional (35%), followed by clerical/shop owner (24%). While among controls, i.e., 39% reported their parent's/head of family occupation as professional or semi-professional and 32% as clerical/shop owner ($P = 0.39$) [Table 1].

The majority of cases (54%) and controls (48%) were in normative menarcheal age group (13–14 years). Mean menarcheal age of cases and controls came out to be 13 and 13.3 years, respectively ($P = 0.35$) [Table 2].

A total of 84% cases and 45% controls complaint of menstrual symptoms. Stomach ache was the most common complaint (73% cases and 38% controls), followed by backache (24% of cases and 6% of controls). Intensity of menstrual symptoms was more among cases than in controls with higher odds of getting menstrual abnormality (OR 6.57; 2.94–17.25), Mc Nemar Test value, $P = 0.001$. Statistically significant association was seen between menstrual discomfort and going out from home (Chi-square test, $P < 0.001$) and with a compulsion to lie down due to discomfort (Fischer's Exact test $P < 0.001$).

Daytime sleepiness was assessed by ESS. Most common responses obtained by ESS regarding the frequency of dozing for different variables of ESS scales were "moderate to high chances of dozing" among cases and "no to slight chances of dozing" among controls. All

Table 1: Association of sociodemographic characteristics with cases (*n*=100) and controls (*n*=100)

Sociodemographic characteristics of study subjects	Cases (%)	Controls (%)
Age-matched distribution (years)		
Preadolescent (<15)	44.0	44.0
Adolescent (16-17)	42.0	42.0
Late adolescent (17-19)	14.0	14.0
Religion		
Hindu	95.0	78.0
Others^	5.0	22.0
Education status of mother*		
Graduate and above	25.0	35.0
Intermediate	30.0	28.0
High school	24.0	24.0
Primary or middle school	9.0	11.0
Illiterates	12.0	2.0
Education status of father		
Graduate and above	59.0	65.0
Intermediate	20.0	17.0
High school	16.0	14.0
Primary and middle school	4.0	3.0
Illiterates	1.0	1.0
Occupation of head of the family#		
Professional or semi professional	35.0	39.0
Clerical/shop owner	24.0	32.0
Skilled worker	21.0	10.0
Semiskilled or unskilled worker	14.0	14.0
Unemployed	9.0	5.0

All values are in percentages. ^Others include Muslim, Buddhism and Jain; **P*=0.047 (Fischers exact test), #*P*=0.39 (Chi-square test)

Table 2: Distribution of cases (*n*=100) and controls (*n*=100) as per age at menarche

Age at menarche (years)	Cases (%) or mean±SD	Controls (%) or mean±SD
Early menarche (10-12)	24.0	19.0
Normative menarche (13-14)	54.0	48.0
Delayed menarche (15-17)	22.0	33.0
Mean±SD*	13±1.2	13.3±1.3

P=0.20 (Chi-square test), **P*=0.35 (unpaired *t*-test). SD=Standard deviation

individual items from ESS was found to be significantly high among cases ($P < 0.001$) [Table 3].

Stress level among study groups was assessed by PSS. Most common responses obtained by PSS regarding the frequency of stress level for different variables of the PSS scale was reported as "some times" by cases. Whereas maximum controls reported frequency of their stress level either "never" or "sometimes." Individual items from PSS were found to be significantly high among cases ($P < 0.001$) [Table 4].

Analysis of composite scores of ESS showed that most of the cases (30%–35%) had moderate or severe excessive daytime sleepiness. Among controls, majority had normal day time sleepiness (52%) ($P < 0.001$). Mean composite score of ESS was higher among cases (13.1 ± 4.3) than in controls (7.3 ± 3.3) (unpaired *t*-test, $P < 0.001$). Analysis of composite scores of PSS showed that, 64% of cases had moderate-to-severe stress levels, whereas 94% of controls had no to mild stress level ($P < 0.001$). The mean composite score of PSS was higher among cases (22.3 ± 4.5) than controls (13.4 ± 4.9) (unpaired *t*-test, $P < 0.001$) [Table 5].

Discussion

Many cross-sectional studies or surveys have been conducted in past documenting prevalence of menstrual problems among adolescent girls. However, limited studies had explained its relationship with psychosocial and stress-related risk factors. Therefore, we conducted an age-matched case–control study to document best evidence for risk factors of abnormal menstrual pattern. In present study, the majority of adolescent girls belonged to preadolescent age group. Also, maximum cases and controls were Hindu by religion. An almost similar result was found in study conducted in Maharashtra, where three fourth of adolescent girls under study were Hindu by religion.[26] Present study showed that among cases, one-fifth of mothers education was up to primary or middle school level including one tenth as illiterate. A community-based cross-sectional study conducted in Varanasi, India, also shows similar results were very few mothers of adolescent girls were illiterate.[18] In our study, fathers of about half of the adolescent girls had completed their education till graduation level, and very few were illiterate. Mean age at menarche reported in present study among both cases and controls was thirteen years, which is similar to many studies conducted in different regions of India.[23,25,26] Lower age at menarche in India may be due to hereditary pattern, nutritional status and can be also related to climatic changes.[27] Present study showed that adolescent girls having menstrual abnormality had higher odds of getting menstrual symptoms than controls, and this association was statistically significant. About three-fourth of cases and less than half of controls complaint about a stomach ache. A similar result was found by cross-sectional study conducted in Nagpur (India) and also reported menstrual problems among three fourth of adolescent girls.[28] In this study, menstrual pain caused hindrance in day-to-day activities, as one-fourth of the study participants reported pain occasionally prevent them from going out, whereas <1 fourth of study participants were not affected by period pain. A significant association was found between these two parameters. In a recent study one fourth study participants reported menstrual pain often caused compulsion to lie down and was also found to be statistically significant. A similar result was documented by a meta-analysis performed among adolescent girls with primary dysmenorrhea showed that one fifth were

Table 3: Association of cases (*n*=100) and controls (*n*=100) with respect to sleeping behaviour as per Epworth Sleepiness Scale

Variables	Study group	Sleep levels			
		Would never doze	Slight chance of dozing	Moderate chance of dozing	High chance of dozing
Sitting and reading*	Cases	12.0	38.0	38.0	12.0
	Controls	30.0	43.0	24.0	3.0
Watching television*	Cases	28.0	24.0	29.0	19.0
	Controls	46.0	24.0	28.0	2.0
Sitting inactive in public place*	Cases	36.0	19.0	22.0	23.0
	Controls	61.0	30.0	5.0	4.0
As a passenger in a car for an hour without a break*	Cases	26.0	15.0	22.0	37.0
	Controls	34.0	32.0	25.0	9.0
Lying down to rest in the afternoon*	Cases	14.0	23.0	30.0	33.0
	Controls	25.0	38.0	24.0	13.0
Sitting and talking to someone*	Cases	20.0	16.0	23.0	41.0
	Controls	57.0	25.0	15.0	3.0
Sitting quietly after lunch*	Cases	19.0	23.0	22.0	36.0
	Controls	47.0	28.0	18.0	7.0
In a car, while stopped in traffic*	Cases	25.0	12.0	22.0	41.0
	Controls	41.0	25.0	27.0	7.0

All values are in percentages; *P<0.001 (Chi-square test)

Table 4: Association of cases (*n*=100) and controls (*n*=100) with respect to stress levels as per perceived stress scale

Variables	Study group	Stress levels				
		Never	Almost never	Sometimes	Fairly often	Very often
Upset because of something that happened unexpectedly*	Cases	20.0	15.0	26.0	17.0	22.0
	Controls	60.0	15.0	19.0	6.0	0
Unable to control the important things in life*	Cases	18.0	16.0	30.0	18.0	18.0
	Controls	42.0	21.0	34.0	2.0	1.0
Felt nervous and "stressed"*	Cases	16.0	12.0	39.0	15.0	18.0
	Controls	37.0	25.0	32.0	3.0	3.0
Felt confident about ability to handle personal problem#	Cases	28.0	14.0	35.0	11.0	12.0
	Controls	18.0	21.0	25.0	10.0	26.0
Felt that things were going in the right way*	Cases	31.0	7.0	44.0	7.0	11.0
	Controls	17.0	15.0	30.0	10.0	28.0
Could not cope with the things*	Cases	20.0	14.0	38.0	5.0	23.0
	Controls	35.0	21.0	37.0	7.0	0
Able to control irritations in the life*	Cases	30.0	13.0	36.0	8.0	12.0
	Controls	10.0	10.0	31.0	18.0	31.0
Felt that on top of things*	Cases	31.0	16.0	42.0	6.0	5.0
	Controls	11.0	9.0	36.0	18.0	26.0
Angered because of things that were out of control*	Cases	19.0	9.0	28.0	15.0	29.0
	Controls	24.0	21.0	41.0	9.0	5.0
Felt difficulties piled up so high and could not overcome them*	Cases	20.0	10.0	32.0	15.0	23.0
	Controls	30.0	17.0	46.0	4.0	3.0

All values are in percentages; *P<0.001 (Chi-square test), #P=0.034 (Fischer's exact test)

absent from school, and nearly half reported that their classroom performance, such as concentration levels or test-taking abilities, were negatively affected during the menstrual cycle.[29] Another study found even greater effects of dysmenorrhea, where more than three fourth adolescent girls reported school abstinence, two-third, loss of concentration, almost half, loss in participation, and few reported a reduction in test taking skills in classes.[30]

In present study, about one-third of cases reported moderate excessive daytime sleepiness, and half of controls reported higher normal daytime sleepiness, and this was found to be statistically significant. A similar result was reported by a study conducted in Iran among adolescent girls documenting a significantly higher daytime sleepiness scores among dysmenorrhea group as compared to normal controls and PMS group.[31] Another study in Japan confirmed that the level of sleep

Table 5: Association of cases (*n*=100) and controls (*n*=100) with sleep and stress level grading

Grading levels	Cases (%)	Controls (%)
Sleep level grading*		
Lower normal daytime sleepiness	7.0	31.0
Higher normal daytime sleepiness	16.0	52.0
Mild excessive daytime sleepiness	12.0	11.0
Moderate excessive daytime sleepiness	35.0	5.0
Severe excessive daytime sleepiness	30.0	1.0
Stress level grading*		
No to mild stress	36.0	94.0
Moderate-to-severe stress	64.0	6.0

All values are in percentages; *P<0.001 (Chi-square test)

altered during the menstrual cycle.[17] Whereas, according to a study in Pennsylvania, sleep disturbances was recognized as one of determinants of women's health and well-being, and is increasing day by day particularly in context of the menstrual cycle and this was found to be associated with infertility.[32]

In the present study, more than half of study participants reported "no" to "mild" stress level and about one-third of study participants reported about "moderate" to "high stress" levels. Although the high-stress level during the menstrual cycle was reported by various studies among young women and showed significant association with menstrual irregularities.[13,14] Whereas a study in Iran showed that stress might not be the sole contributor to the menstruation pain, but it might be one of the factors that lead to dysmenorrhea.[19] Another study in China found that high stress was significantly associated with dysmenorrhea.[15]

Menstruation is an important indicator of reproductive health and development. This study revealed that abnormal menstrual pattern leads to more problems and complications during menstruation, which reflects on girls physical, emotional, and social well-being. Familial education levels, level of stress, and disturbed sleep among adolescent girls also have effects on menstruation leading to abnormal menstrual patterns. A modifiable factor, like lifestyle modification, can prevent abnormal menstrual patterns or help prevents its complications among adolescent girls. A comprehensive health education program on lifestyle modifications such as good sleep, stress management, and healthy eating habits can be initiated. Psychosocial and gynecological counseling, as well as routine screening for menstrual problems by health-care providers, would help in early diagnosis and management of menstrual abnormalities.

We have used a self-administered questionnaire, and data were recorded based on memory, which may introduce recall bias. There may be an underestimation of menstrual health problems because of shy nature, stigma, or under self-reporting by adolescent girls. However, age-matched case-control study was deliberately chosen to minimize the chances of bias; however, factors such as stress and sleep may be affected by other physical and social variables. A school-based study ensures data are collected robustly in a selected representative sample of adolescent age groups.

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Conflicts of interest

There are no conflicts of interest.

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