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ORIGINAL ARTICLE

Prevalence of Menstrual Disorder in Women and Its Correlation to Body Mass Index and Physical Activity

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Abstract

Background Regular menstruation represents reproductive health and quality of life of women. However, many women suffer from menstrual disorders at some point in their life. The occurrence of such abnormalities is affected by two key factors: BMI and physical activity. This study aims to analyse the relationship of these two factors to menstrual disorders.

Materials and Method A cross-sectional study was conducted among 502 women in Uttar Pradesh, India, from July 2021 to January 2023. Samples were selected using purposive sampling technique. The data were analysed using Pearson's Chi-square test on MS Excel 2013 and IBM SPSS 29.0.0.0 (240) software.

Results Mean age of the research subjects was 25.84 + 6.30 years, mean weight was 60.29 + 11.22 kg, mean height was 155.34 + 11.77 cm, and mean BMI was 25.36 + 6.06 kg. 68.92% subjects had regular age at menarche. Most common menstrual disorders were PMS (41.63%) and dysmenorrhea (28.29%). As per BMI categories, most disorders were found in obese (94.87%) and underweight (93.62%) subjects. As per physical activity categories, most disorders were found in low (76.55%) and high (76.40%) category subjects. A significant relationship was found between menstrual disorder and BMI ($\chi^2 = 80.49$, $p < 0.001$) and physical activity ($\chi^2 = 70.09$, $p < 0.001$).

Conclusion The menstrual disorders in women are significantly related to their BMI and physical activity. Women are advised to focus on having a balanced, nutritious diet and indulge in moderate physical activity to improve their reproductive health and quality of life.

Keywords Menstrual disorder · BMI, Menstrual cycle · Physical activity · Menstruation · Premenstrual syndrome

Introduction

Menstruation is a cyclical phenomenon where in monthly discharge of blood and mucosal tissue lining from the uterus through the vagina takes places in women with onset of puberty. The menstrual cycle is marked by the rise and fall of hormones (oestrogen and progesterone) and signifies that pregnancy has not occurred [1]. During a female's reproductive time span, expulsion of ova from the ovary occurs cyclically, with the potential to become fertilized by sperms. This cyclical phenomenon is a part of normal menstrual cycle. Menstrual disorder is any abnormal condition with regard to a normal menstrual cycle. The different types of menstrual disorders include premenstrual syndrome (PMS), amenorrhea, oligomenorrhea, polymenorrhea, abnormally heavy uterine bleeding, hypomenorrhea and dysmenorrhea [2].

Two most significant factors leading to menstrual disorders are body fat content and physical activity. There are other internal factors like uterine fibroids, hormonal

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imbalances, clotting disorders, cancer, sexually-transmitted infections, polycystic ovary syndrome and genetics [2] and external factors like stress and lifestyle factors, which includes weight changes, dieting, caffeine and alcohol consumption, smoking, occupation, socioeconomic status, ethnicity, travel, illness, and changes in exercise [1, 3].

The body fat content can be represented by using the body mass index (BMI) and has an influence in the production of androgens and oestrogens and the variation in their levels may cause menstrual disorders [4, 5]. Previous studies in Delhi and Guwahati (India) revealed that BMI had statistical association with the menstrual cycle disorders [6, 7].

The physical activity affects gonadotropins release and ovulation, which can subsequently influence fertility outcomes. Menstrual dysfunction and subfertility is prevalent among high-performance females [8, 9]. In other studies, in Garhwal [10] and Aligarh [11], north India, dysmenorrhea, PMS, and irregular cycle were observed as common problems among adolescent girls and were directly associated with dietary habits and physical activities. These studies suggest that moderate exercises may have a positive impact on menstrual disorder symptoms reduction.

It is, however, observed that not many studies in India are devoted to mature females who are past adolescence or at an age approaching menopause. Therefore, the present study aims to assess the association of BMI and physical activity to menstrual disorders and create strategies to improve the lifestyle of women who have come out of age.

Materials and Method

A cross-sectional study was conducted among 502 women in Uttar Pradesh, India over a period of 18 months from July 2021 to January 2023. Purposive sampling technique was considered to select a random mix of students, working professionals and housewives. This was done to diversify the profile of women particularly on the two key parameters: BMI and physical activity. Based on the inclusion and exclusion criteria, the samples were found and selected.

Eligibility Criteria

The inclusion criteria are:

- Age above 18.
- Willing to provide informed consent.

The exclusion criteria:

- Are not willing to provide informed consent.
- Have attained menopause.
- Are suffering from gynaecological disorders such primary amenorrhea, fibroid uterus, endometriosis, adenomyosis, PCOS or ovarian cyst, tubo-ovarian mass, tuberculosis etc.
- Are suffering from a chronic disorder or health issues such as diabetes mellitus, hypothyroidism, hyperthyroidism, psychiatric disorder, autoimmune disease etc. for which they were on a treatment.
- Are undergoing or have undergone in past 1 year any kind of hormonal treatment.
- Are pregnant.
- Have history of smoking or alcohol consumption.
- Are on medications including OCPs.

Necessary approval for conducting the study was obtained from the Institutional Ethical committee. The purpose of study was clearly explained to each respondent after which their informed consent was procured. A self-structured questionnaire with predefined questions was handed over to the respondents to be filled and returned within one week's time. Upon submission of questionnaire with responses, personal details such as age, weight, height were measured. Age was recorded in integer years. Weight was captured to the nearest 0.5 kg. Height was measured to the nearest 1 cm. BMI (kg/cm^2) was calculated using WHO classification for BMI 2004 [12].

The questionnaire obtained both quantitative and qualitative data. The physical activity data of subjects in the last week were based on International Physical Activity Questionnaire (iPAQ) [13].

Statistical Analysis

Univariate descriptive data analysis and graph generation were done on MS Excel 2013. Correlation was determined using Pearson's Chi-square tests, performed on both MS Excel 2013 and IBM SPSS Statistics version 29.0.0.0 (240) software. A p-value of < 0.05 was considered for statistical significance. Appropriate validations of the Pearson's Chi-square test assumptions were validated to ensure the validity of the results obtained.

Result

This study was conducted on 502 women with or without menstrual disorders. The characteristics of the respondents in Table 1 showed that none of the variables were normally distributed. Mean age of the research subjects was 25.84 years, mean weight was 60.29 kg, mean height was 1.55 m, and mean BMI was 25.36 kg.

Table 2 shows that the respondents with age 18–24 years constituted the greatest share (55.98%) of sample size. It

Table 1 Characteristics of respondents

Variable	Mean + SD	*p* value or Sig (2-tailed)*
Age (years)	25.8446 + 6.3002	< 0.001
Weight (kg)	60.2890 + 11.2249	0.001
Height (cm)	155.3374 + 11.7698	< 0.001
BMI (kg/m^2)	25.3588 + 6.0579	< 0.001

*Kolmogorov–Smirnov normality test; *p* value > .001 for normal distribution

showed that a 68.92% of the research subjects had attained menarche in the ages between 12 and 15 years. It also showed that subjects with normal weight were in the highest proportion (42.63%) and underweight subjects were significantly low in number (9.36%). Most of the subjects (61.16%) had regular (normal) menstrual interval and only 2 had their menses stopped in the last 6 months. It was also noticed that out of 502 subjects, most (66.93%) had average menstrual period. Moreover, it also showed 44.42% of subjects experienced scanty and 42.63% experienced average menstruation. Table 2 also shows that the majority (39.64%) of participants belonged to socio-economic Class 1 [40] with per capita monthly income of family more than ₹ 8480. It also showed that the greatest share (40.64%) of respondents were graduates. It was noted that a majority (55.98%) of subjects were unmarried. It also showed that a vast majority (75.50%) of participants did not have children.

Figure 1 shows the prevalence of different types of menstrual disorders found in the 502 subjects of this study. The most common menstrual disorder was PMS (41.63%), followed by abnormal uterine bleeding (30.08%—amenorrhea, heavy menstrual bleeding, hypomenorrhea and oligomenorrhea and polymenorrhea) and dysmenorrhea (28.29%).

It is evident from Table 3 that the menstrual disorders are more prevalent in individuals with BMI in underweight, overweight and obese category compared to those with BMI in normal range. Table 4 illustrates the results of the Pearson's Chi-square test at 95% confidence interval ($\alpha < 0.05$), on the association of BMI and physical activity level to menstrual disorders, and depicts that the association of BMI and physical activity level is significant to different menstrual disorders. The presence of different types of menstrual disorders in research subjects across different physical activity categories as a percentage of respective category size is depicted in Table 5. It shows that the individuals with moderate physical activity are found to have low percentage of menstrual disorders (39.29%) compared to low (76.55%) and high (74.40%) levels of physical activity.

In addition to BMI and physical activity level, certain demographic factors were also analysed for their association to occurrence of menstrual disorders and the results are

Table 2 Distribution of respondents based on different variables

Variable	Frequency	% of population
Age		
18–24 years	281	55.98%
25–31 years	117	23.31%
32–38 years	77	15.34%
39–45 years	27	5.38%
*Socio-economic status***		
Class 1	199	39.64%
Class 2	124	24.70%
Class 3	117	23.31%
Class 4	49	9.76%
Class 5	13	5.38%
Education level		
Primary education	47	9.36%
Secondary education	179	35.66%
Graduate	204	40.64%
Post-graduate	72	14.34%
Marital status		
Married	221	44.02%
Unmarried	281	55.98%
Have children		
No	379	75.50%
Yes	123	24.50%
Age at menarche		
Younger than 12 yrs	60	11.95%
12–15 yrs old	378	75.30%
Older than 15 yrs	64	12.75%
BMI		
Underweight (< 18.5)	47	9.36%
Normal weight (18.5–24.9)	214	42.63%
Overweight (25–29.9)	163	32.47%
Obese (> = 30)	78	15.54%
Physical activity		
Low	145	28.88%
Moderate	196	39.04%
High	161	32.07%
Menstrual interval		
Less than 21 days	86	17.13%
21—35 days	307	61.16%
More than 35 days	107	21.31%
Menses have stopped	2	0.40%
Menstrual period		
Scanty (< 2 days)	94	18.73%
Average (2–7 days)	336	66.93%
Heavy (> 7 days)	72	14.34%
Menstrual amount		
Scanty (< 3 pads)	223	44.42%
Average (3–4 pads)	214	42.63%
Heavy (> 4 pads)	65	12.95%

**Basis per capita monthly income of family, Class 5: < ₹ 1272, Class 4: ₹ 1272–2456, Class 3: ₹ 2460–4155, Class 2: ₹ 4156–8396, Class 1: > ₹ 8396 (Modified BG Prasad socioeconomic scale May 2022)

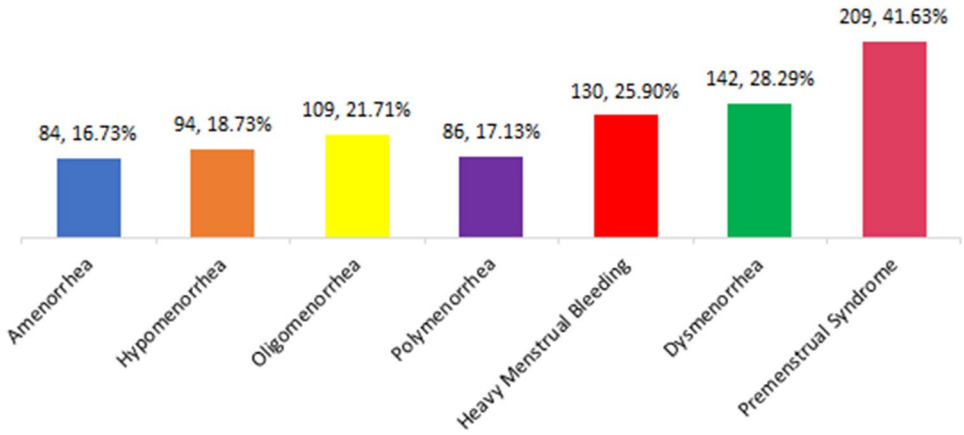

Fig. 1 Prevalence of menstrual disorders

Table 3 BMI categorywise percentage presence of different menstrual disorders

Menstrual disorders	Underweight (n = 47) (%)	Normal weight (n = 214) (%)	Overweight (n = 163) (%)	Obese (n = 78) (%)
Amenorrhea	40.43	5.14	18.40	30.77
Hypomenorrhea	38.30	10.75	9.82	47.44
Oligomenorrhea	53.19	18.69	11.66	32.05
Polymenorrhea	21.28	13.08	14.72	30.77
Heavy menstrual bleeding	44.68	14.95	24.54	47.44
Dysmenorrhea	51.06	17.29	25.15	51.28
Premenstrual syndrome	82.98	26.17	45.40	51.28
Menstrual disorder	93.62	45.79	58.28	94.87

Table 4 Association of BMI and physical activity level with different types of menstrual disorders

Menstrual disorders	Pearson's coefficient χ^2	Symmetric measures (Cramer's V)	*p* value (statistical significance)
Correlation of BMI to occurrence of menstrual disorder			
Amenorrhea	50.933	0.319	5.06E−11 (<<0.05)
Hypomenorrhea	71.529	0.377	2.01E−15 (<<0.05)
Oligomenorrhea	43.149	0.293	2.29E−09 (<<0.05)
Polymenorrhea	13.922	0.167	0.00301 (<0.05)
Heavy menstrual bleeding	41.010	0.286	6.51E−09 (<<0.05)
Dysmenorrhea	45.899	0.302	5.96E−10 (<<0.05)
Premenstrual syndrome	58.065	0.340	1.52E−12 (<<0.05)
Menstrual disorder	80.487	0.400	2.41E−17 (<<0.05)
Correlation of physical activity level to occurrence of menstrual disorder			
Amenorrhea	38.729	0.278	3.89E−09 (<<0.05)
Hypomenorrhea	43.128	0.293	4.31E−10 (<<0.05)
Oligomenorrhea	23.468	0.216	8.02E−06 (<<0.05)
Polymenorrhea	5.931	0.109	0.05154 (>0.05)
Heavy menstrual bleeding	28.847	0.240	5.45E−07 (<<0.05)
Dysmenorrhea	23.774	0.218	6.88E−06 (<<0.05)
Premenstrual syndrome	89.576	0.422	3.54E−20 (<<0.05)
Menstrual disorder	70.085	0.374	6.04E−16 (<<0.05)

Table 5 Physical activity categorywise percentage presence of different menstrual disorders

Menstrual disorders	Low (n = 145) (%)	Moderate (n = 196) (%)	High (n = 161) (%)
Amenorrhea	30.34	5.10	18.63
Hypomenorrhea	25.52	4.59	29.81
Oligomenorrhea	22.76	11.73	32.92
Polymenorrhea	18.62	12.24	21.74
Heavy menstrual bleeding	13.10	23.98	39.75
Dysmenorrhea	33.10	16.33	38.51
Premenstrual syndrome	68.28	17.86	46.58
Menstrual disorder	76.55	39.29	76.40

Table 6 Association of demographic factors with menstrual disorders

Demographic factors	% suffering from menstrual disorder	Pearson's coefficient χ^2	*p* value
Age		9.604	0.02
18–24 years	61.21%		
25–31 years	61.54%		
32–38 years	55.84%		
39–45 years	88.89%		
*Socio-economic status***		8.368	0.08
Class 1	58.29%		
Class 2	58.87%		
Class 3	63.25%		
Class 4	75.51%		
Class 5	84.62%		
Education level		5.151	0.16
Primary education	76.60%		
Secondary education	61.45%		
Graduate	58.82%		
Post-graduate	62.50%		
Marital status		0.887	0.35
Married	64.25%		
Unmarried	60.14%		
Have children		0.358	0.55
No	61.21%		
Yes	64.23%		

summarized in Table 6. It was found that occurrence of menstrual disorder also varies with age group. However, other factors were not associated with any statistical significance.

Discussion

Menstruation is a key indicator of a woman's reproductive physiology and well-being. Abnormalities from normal menstruation are quite common now. Given a significant change, in their lifestyle and eating habits women face deviations in their menstrual cycles.

Our findings showed the prevalence of menstrual disorders to be 61.95%. The prevalence has been recorded as high as 85.00–93.40% in other studies [15–18] in India.

Among the women studied, 42.63% had normal BMI, 9.36% were underweight, 32.47% were overweight, and 15.54% were obese. The subjects in the obese BMI category with a percentage of 94.87% people dominated the subjects with menstrual disorders, followed by the subjects from the underweight BMI category with 93.62% people.

Further, it was also observed that among the respondents, 28.88% had low physical activity, 39.05% had moderate physical activity, and 32.07% had high physical activity. The subjects with menstrual disorders were dominated by the subjects in low physical activity category with percentage of 76.55% people, followed by the subjects in high physical activity category of 76.40% people.

It was found in our study that most subjects suffered from PMS (41.63%) which was lower than rates from the studies in Lucknow (65%) [19], West Bengal (61.5%) [20] and Punjab (85.24%) [34]. It was higher than rates reported in Ujjain (39.60%) [21] and Gujarat (18.40%) [22]. It was also higher than rates reported in some of the studies globally, such as in China (21.10%), [23] Thailand (29.80%) [24] and Iran (24.90%) [37]. However, it is lower than the rates reported in studies in Malaysia (74.60%) [35] and Saudi Arabia (93.00%) [38]. Dysmenorrhea (28.29%) was found to be the next common menstrual disorder. This rate was lower than rates from Andhra Pradesh (65.00%), Maharashtra (72.00%), Gwalior (79.67%), Lucknow (74.30%), Punjab (60.66%) and Delhi (62.00%) [25–29]. However, it was lower than studies reported in Iran (41.00%) [37], Saudi Arabia (70.90%) [38] and Malaysia (67.70%) [35].

Our study found that heavy menstrual bleeding was prevalent in 25.90% of subjects which was higher than the studies in Aligarh (15.90%) [11] and Tamil Nadu (10.90%) [30] but lower than that reported in Saudi Arabia (41.90%) [38]. Oligomenorrhea was found in our study to be suffered by 21.71% of respondents which was more than the rates reported by Vanitha et al. (12.10%) [31] and Indu et al. (14.75%) [34] in their studies. However, it was lower than rate reported in Indonesia (58.3%) [36]. The prevalence of hypomenorrhea in our study was observed in 18.73% of subjects which was more than that found in other studies where it was reported to prevail in smaller proportions [32, 33]. Polymenorrhea was found to be present in 17.13% subjects which was greater than the rates found in the studies in Manipal (6.80%) [32] and Thiruvallur (1.20%), [31] but was less than the rates found in studies in Aligarh (22.20%) [11] and another study in Tamil Nadu (46.20%), [33] as well as globally in a study in Indonesia (38.9%) [36]. Amenorrhea was the least common menstrual disorder with a prevalence

of only 16.73% in our study which was found to be more than rates in other studies [30, 35] but less than studies in Aligarh (21.30%) [11] and Guwahati (40.5%) [7].

The study found that there was a statistically significant relationship between BMI and menstrual disorder ($\chi^2 = 80.49$, $p < 0.001$). All the menstrual disorders were found to have statistically significant association with BMI. The symmetric measures showed the Cramer's V coefficient of 0.400 which also suggested very strong relationship [14]. Subjects with menstrual disorders were dominated by 94.87% of the subjects in the obese BMI category, followed by 93.62% of subjects from the underweight BMI category and then 58.28% of subjects in the overweight category. This was in agreement with a previous study [6] conducted in Delhi where it was found that there was statistically significant difference in problems and symptoms of menstruation among underweight and overweight adolescent girls as compared with adolescent girls who had normal BMI. Our study also found in partial agreement to findings of another study [7] based in Guwahati where significant correlation ($p < 0.001$) was observed between BMI with menstrual cycle length, oligomenorrhea, secondary amenorrhea, menstrual flow duration, perception of flow and dysmenorrhoea. However, our findings differed from this study in the results where unlike the Guwahati based study, we found PMS and menstrual regularity significantly ($p < 0.001$) associated to BMI. Our study also finds support globally where similar results were reported in a study in Indonesia [36] and Iran [37] where based on Chi-square statistical test ($p < 0.05$), it is concluded that there is a significant correlation between body mass index and menstrual cycle disorders. However, a study in Netherlands [39] found that the association of BMI to menstrual disorders was not strong.

This study also found out that there existed a statistically significant relationship between physical activity and menstrual disorder ($\chi^2 = 70.09$, $p < 0.001$). The symmetric measures showed the Cramer's V coefficient of 0.374 which suggested very strong relationship [14]. It was observed that low and high physical activity people were more likely than moderate physical activity people to exhibit menstrual disorder. This result was like another study [10] in Garhwal where dysmenorrhea (66.10%), PMS (78.94%), and were directly associated with physical activities. However, other menstrual abnormalities were not significantly associated with physical activity which contrasted with our findings. Our study also matched with another study [11] in Aligarh where it was found that strong correlation existed between physical activity and menstrual disorders. Dysmenorrhoea and PMS had high correlation ($p < 0.01$) while amenorrhoea and menorrhagia had mild correlation ($p < 0.05$). Our study also found strong correlation ($p < 0.001$) with PMS. Additionally, hypomenorrhea, amenorrhea, heavy menstrual bleeding, dysmenorrhea, and oligomenorrhea were also highly correlated ($p < 0.001$) to physical activity, unlike the findings in the Aligarh study. However, in the study done by Lee et al. [35] association between physical activity and menstrual problems was not found.

Limitations

BMI as an indicator does not account for body structure or frame size, muscularity, bone, cartilage, and water weight and therefore might not accurately account for body fat content. BMI is chosen as a parameter in most studies more so because it is easier to calculate. Hence, a better parameter, more closely related to body fat content, might be far superior in its association with menstrual disorders. The accuracy of the self-reported information about menstrual cycles which were subject to bias related to memory and recall of events by the respondents could not be validated.

It was also found that some of the underweight, overweight, and obese respondents reported very high physical activity data which were hard to believe since such METs/week are achieved by professional athletes only. However, these answers were not omitted from the study since it was very difficult to determine which of them were invalid.

Although we had sufficient subjects that exceeded the size estimated necessary to obtain valid and reliable results, we feel that there may be other factors related to menstrual disorders and for including those in the analysis will require far greater size of sample.

Conclusion

The study concluded that menstrual disorders are quite prevalent in women. Both BMI and physical activity are essential indicators of menstrual disorders among women who are past their adolescence. It was found that underweight and obese women were more prone to menstrual disorders. Also, women with low or high physical activity can become more vulnerable to menstrual complications. Hence, through health education programs, women must be familiarized from an early age to the significance of healthy and balanced nutrition and they should be encouraged to take up regular moderate exercises to maintain an active and health-conscious lifestyle. These habits will help them to regulate their menstrual cycle. Regular counselling for emotional support should be conducted which may lead to timely diagnosis and early management of menstrual problems. That, in turn, may help women to improve their self-healthcare and minimize medicalization. Many other internal and external factors may also be significant indicators. Further studies must be done by creating a profile of subjects which may include parameters such as age, age at menarche,

social support system (access to and level of education, status, and nature of employment), eating habits, consumption of alcohol, smoking and stress level. These studies must be conducted on a much larger scale (number of subjects and geographical areas) to assess the effects of more parameters on menstrual cycles and what more practices and preventive measures can women adopt to improve their reproductive and overall health and life quality.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Committee Clearance and Informed Consent Institutional ethical committee clearance was obtained before conducting the study, and informed consent was taken from individual subjects for participation.

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