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Study of Body Mass Index and its Association with Menstrual Irregularities among Adolescent Girls

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Abstract

Menstrual irregularities such as irregular cycles including length of cycle, heavy or scanty menstruation blood loss are more common among adolescents during the initial year of menarche. When menstrual irregularities affect their day-to-day activities and quality of life it is to be addressed. A survey was taken with a questionnaire from 250 willing adolescent girls from 12-17 years of age. Data was collected regarding age, height, weight, age of menarche, duration of menstrual cycle, menstrual flow, pain, History of Anaemia, PCOS, Thyroid disorders, and necessary family history. Data collected were analysed through tables using proportions and percentages. In our study mean BMI is 22+4.8. Girls with high BMI had more hypomenorrhoea oligomenorrhoea and cycle irregularities when compared to normal and low BMI girls while menorrhagia is seen more among underweight girls and the mean age of menarche is 13+1.4. Menstrual health, menstrual hygiene awareness and early detection and treatment of any irregularities along with lifestyle modification play a key role in well well-being of their community and that of their county for decades.

Keywords: *Body Mass Index, Dysmenorrhea, Menstrual Disorders.*

Introduction

World Health Organization (WHO) defines "Adolescence" as the period between 10 and 19 years of life characterized by critical physical and psychological changes leading to adulthood [1]. This age group requires adequate nutrition, education, counselling, and guidance to ensure their development into healthy adults [2]. Menstruation is one of the most important changes during the adolescent years. It occurs once a month as a regular rhythmic period and remains a normal physiological phenomenon from menarche to menopause [3]. Menstrual disorders are frequent among adolescent girls as they are closely coupled with the processes involved in the pubertal development of females. The menstrual cycle is an essential indicator of a woman's reproductive health and her endocrine functions [4]. Menstruation is characterized by variability in regularity, volume, and pattern. A survey reported about 64% of girls have at least one problem related to menstruation [5]. The prevalence of menstrual disorders in India has been recorded as high as 87% [6]. Various types of menstrual disorders are prevalent, viz. menstrual irregularity, menorrhagia, polymenorrhagia, oligomenorrhea, dysmenorrhoea, etc., It has been observed that most of the girls face some or the other problems, that are individual specific. Dysmenorrhea is the most common menstrual disorder among women, with a prevalence of 60%–93% [7].

Several medical conditions can cause irregular menstruation, which can be diagnosed and treated at an early stage. However, this part of women's health is mostly neglected. More than 90% of menstrual problems are preventable just by early detection and appropriate treatment [8]. Factors that frequently play a role in the regularity, and flow

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of a woman's menstrual cycle include hormonal changes, genetics, serious medical conditions, and body mass index (BMI) [9,10].

FIGO classifies a normal menstrual cycle as 24 to 38 days in frequency, normal (shortest to longest cycle variation < 7-9 days), menstrual duration <8 days along with flow volume determined by the patient with no intermenstrual bleeding.

Any variation in the above can be determined as menstrual irregularities or abnormal uterine bleeding. Multiple factors play a role in puberty and menstruation such as genetics, nutritional status, hormones, BMI (body mass index) and some medical conditions such as anaemia, thyroid disorders, etc. Though Parents may be concerned that menstrual irregularities might impact their daughter's future fertility or ability to lead a sexually satisfying adult life, only a few seek early medical attention and get evaluated.

Body fatness plays a vital role in the age of menarche and menstruation. A study shows girls have a significantly higher prevalence of obesity and overweight than boys and this is seen markedly in adolescence [4]. While obesity is in increasing trend, underweight or nutritional deficiency remains a major health concern among girls and young women. Both extremes affect young girls' menstrual and reproductive health.

Numerous studies addressing menstrual abnormalities in young women have already been addressed. However menstrual irregularities among adolescent girls in a low-resource setting along with treatment-seeking behaviour have received lesser attention. This study aims to look for the association of BMI with menstrual irregularities in adolescent girls aged 10-17 years and look for any associated medical conditions being evaluated and their treatment-seeking behaviour. The study hypothesised that there is a positive association between extreme (both underweight and overweight) BMI and menstrual disorders.

Methods and Materials

Study Design and Setting

A questionnaire study from 250 school-going girls aged 10-17 years was conducted in Palani district in Tamil Nadu.

Inclusion criteria:

1. Adolescent school-going girls of age 10-17 years.
2. Attained menarche.
3. Unmarried.
4. Girls whose parents have given consent.

Exclusion criteria:

1. Age less than 10 and more than 17
2. Married
3. Not attained menarche.
4. Whose parents did not give consent?

Study Tool

Predesigned self-administered questionnaire.

Methods of Collection of Data

The aim of the present study was explained before the collection of data and informed consent was obtained from the adolescent girls. Predesigned self-administered questionnaire containing variables such as age, height in cm, weight in kgs, age of menarche, menstrual pattern, such as length of cycle, regularity, duration and amount of bleeding, any associated medical conditions have been evaluated, whether medical attention was required for menstrual complaints and significant family history was distributed among willing 250 school going girls with their parent's consent and data were collected on the same day to maintain confidentially and to reduce information contamination.

For anthropometric examination, weight was recorded using a standardized weighing scale that was kept on a firm horizontal surface. Weight was recorded to the nearest 500 g. Before the start of measurement day, zero error was eliminated. The weight of girls was

measured barefoot with minimal clothes and warm clothing; shoes and socks were removed [11][12].

It is considered an indicator of women's health, so adolescent girls need to understand menstruation patterns and the factors that may contribute to menstrual disorders or changes such as age, activities, and BMI. It is essential to increase their understanding of menstruation, and appropriate management for it, and clarify their ignorance of menstruation issues [13]. Studies conducted in India have observed the average age at menarche to be 12.4, 13.4, 13.5, and 13.6 years, which are similar to this study [14-18]. The age of onset of menarche is generally between 11 and 15 years. Slight variations in the age of menarche may occur depending on their hereditary pattern and nutritional status [19]. Another study reported that the delay of menarche was present in girls with poor nutrition and earlier in girls with high-energy intake [20].

Body mass index (BMI) calculation was done by using the following formula WEIGHT IN KGS/HEIGHT IN METRE SQUARE. According to BMI CLASSIFICATION BY WHO 2004 <18.5 kg/m^2 – underweight, 18.5-14.9kg/m^2 - normal range, 25-29.9kg/m^2 – pre-obese, and >30kg/m^2 – obese.

Statistical Methods

Data collected were entered in Excel and analysed using SPSS version 26. Variables were analysed as number of adolescent girls and percentage of adolescent girls. A chi-square test was performed for statistical significance association among variables. If any value of $p < 0.05$, the statistical association has been considered significant.

Results

Table 1 and Figure 1 show, that out of 250 participants, 118 girls (47.2%) had normal range BMI whereas 62 girls (24.8%) were underweight and 70 girls (28.0%) were overweight. Maximum girls were under the normal range of BMI whereas when underweight and overweight both together had 52.8% of girls.

Table 1. Participants Based on BMI

BMI	Number	%
<18.5	62	24.8
18.5 - 24.9	118	47.2
>25	70	28.0
Total	**250**	100

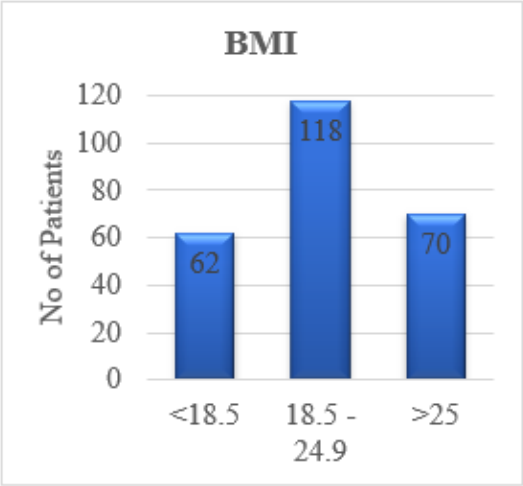

Figure 1. Participants Based On BMI

Table 2. Association with Body Mass Index

Variable	<18.5n(%)	18.5-24.9n(%)	>25n(%)	P-Value
Age of Menarche				
11	21(33.9)	13(11.0)	4(5.7)	0.001
12	20(323)	28(21.2)	8(11.4)	
13	17(27.4)	36(30.5)	21(30)	
14	0(0)	26(22.0)	23(32.9)	
15	4(6.4)	11(9.3)	10(14.3)	
16	0(0)	4(3.4)	4(5.7)	

As shown in Table 2, a maximum number of girls 74(29.6%) had attained menarche at 13 years of age. 56(22.4%) girls had attained menarche at 12 years of age. 49(19.6%) girls had attained menarche at 14 years of age. 38(15.2%) of girls had attained menarche at 11 years of age. 25(10%) of girls attained menarche at 15 years of age and 8(3.2%) of girls attained age at 16 years of age.

Table 3 shows the menstrual patterns and problems in association with BMI. Out of 62 Girls with BMI < 18.5, it was observed that 16(25.8%) had heavy bleeding and 24 (38.7%) had prolonged bleeding. Out of 70 girls with BMI > 25, it was observed that 22(31.4%) had irregular cycles and 31(44.3%) had oligomenorrhea. Dysmenorrhea is equally prevalent across all BMI.

Table 3. Menstrual Patterns and Problem

Variable	<18.5n(%)	18.5-24.9n (%)	>25n(%)	P-value
Irregular Cycles				
Yes	4(6.4)	18(13.3)	22(31.4)	0.001
No	58(93.6)	100(84.8)	48(68.6)	
Bleeding				
Normal	38(61.3)	80(67.8)	61(87.1)	0.001
Light	8(12.9)	13(11.0)	4(5.7)	
Heavy	16(25.8)	25(21.2)	5(7.1)	
Cycle Length				
<24days	0(0)	4(3.4)	4(5.7)	0.001
24–38 days	62(100)	104(8.1)	48(68.5)	
>38 days	0(0)	10(8.5)	18(17.6)	
Day of Flow				
<3 days	1(1.6)	13(11.0)	31(44.3)	0.001
3–7 days	37(59.6)	94(79.7)	34(48.6)	
>8 days	24(38.7)	11(9.3)	5(7.1)	
Dysmenorrhea				
Yes	32(51.6)	74(62.7)	44(62.9)	0.299
No	30(48.4)	44(37.3)	26(31.1)	

Table 3 shows the association of BMI with common medical conditions associated with menstrual irregularities. 8(12.9%) out of 62 girls with BMI <18.5, 1(0.9%) out of 118girls with normal BMI and 15(21.4%) out of 70 girls with BMI>25 have anaemia. 4(6.5%) out of 62 girls with BMI <18.5, 12(10.2%) out of 118 girls with normal range of BMI and 20(28.6%) out of 70 girls with BMI >25 have history of PCOS.0 girls BMI <18.5, 12(10.2%) out of 118 girls with normal range of BMI and 14(20%) out of 70 girls with BMI >25 have history of thyroid disorders.

Table 4. Medical Conditions

Variable	**<18.5**	**18.5-24.9**	**>25**	**P-Value**
History of Anemia				
Yes	8(12.9)	1(0.9)	15(21.4)	0.001
No	8(12.9)	13(11.0)	0(0)	
NotEvaluated	46(74.2)	104(88.1)	55(78.6)	
History of PCOS				
Yes	4(6.5)	12(10.2)	20(28.6)	0.001
No	9(14.5)	18(15.5)	4(5.7)	
NotEvaluated	49(79.0)	88(74.6)	46(65.7)	
History of thyroid disorders				
Yes	0(0)	12(10.2)	14(20)	0.001
No	21(33.9)	9(7.6)	4(5.7)	
NotEvaluated	41(66.1)	97(82.2)	52(74.3)	

Table 4 shows 0 girls out of 62 girls have nil significant maternal history which is statistically significant. In this study of 250 girls, 45(18%) of the girls were evaluated for anaemia and 24(9.6) out of 250 girls were diagnosed with anaemia. 67(26.8%) girls have been evaluated for PCOS and 36(14.4%) out of 250 girls have been diagnosed to have PCOS. 60(24%) girls have been evaluated for thyroid disorders and 26(10.4%) out of 250 girls have been diagnosed to have thyroid disorders.

Table 5 shows, 40(16%) of girls' mothers had significant family history associated with menstrual irregularities.

Table 5. Significant Maternal History

Variable	**<18.5**	**18.5 -24.9**	**>25**	**P-Value**
Significant Family History of Mother				
Yes	0(0)	21(17.8)	19(27.1)	0.00
No	62(10.0)	97(82.2)	51(72.9)	1

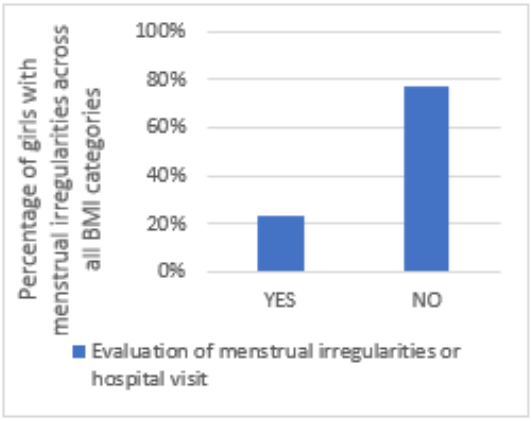

Figure 2. Treatment Behavior Among Girls

As shown in Figure 2 only 26.8% of girls with menstrual irregularities got medical attention or treatment.

Discussion

Adolescence is a critical stage between childhood and adulthood. It is a period of life with specific health and development needs. Attainment of puberty and having normal menstruation is an important part and any issues regarding this is major stress to both the girl and their parents. A girl needs to have good menstrual knowledge, and hygiene to have a better reproductive and sexual life. This in turn results in better future generations. Hence identifying its prevalence and knowing the challenges in early diagnosis and treatment of menstrual irregularities is need of the hour [1,2].

Adolescents should be encouraged to have regular physical exercise to have proper nutritional-rich food and avoid junk foods. Having a sound mind and body is important as it helps the girls to have any nutritional disorders and medical disorders later in life. Regular physical activity and exercise boost confidence and self-esteem and reduce stress and anxiety [1,2].

In this study, out of 250 participants, 118 girls (47.2%) had normal range BMI whereas 62 girls (24.8%) were underweight and 70 girls (28.0%) were overweight with a mean BMI of 22+4.8kg/$m^{2.}$ Maximum girls are under the normal weight range. Maximum BMI was 15.8kg/m^2 and minimum BMI was 32. A cross-sectional study in adolescent girls by Agarwal et al showed a mean BMI of 21.6+3.64. 119(19.8%) girls were underweight, 357(59.5%) girls had normal range BMI, and 124 (20.7%) girls had overweighed with a maximum number of girls under the normal range BMI category [5]. Both studies have similar findings.

An important milestone in an adolescent girl's life is the attainment of menarche. Menarche signifies that the girl is in the process of maturing into a woman in all aspects of life such as physical, hormonal, and psychological and becomes capable of reproduction. In this study, the mean age of menarche among 250 girls is 13+1.4. Mean age at menarche for girls with BMI< 18.5 is 12+ 1.3, for girls with a BMI of 18.5 – 24.9 is 13+1.5, and for girls with BMI >25 the mean age of menarche is 13+1.2 with a p-value of 0.001 which is statistically significant. A descriptive statistical analysis done across birth cohort by Meher et al shows that the majority of the women attained menarche at ages between 13 to 14 (66.2%), with a mean of 13.49+1.21 and that there is a decline in the age of menarche of women in India with the birth year of 1942 to 2006 from 13.78+1.40 to 13.34+1.06(6). The study also stated that the mean age of menarche among women in the south region of India (14.7% of women in the study) is found to be 13.76+ 1.34. Few authors suggest that children with higher

weight gain have an earlier onset of menarche. But this study contradicts that [7,8,9].

Menstrual irregularities observed in 250 adolescent girls who participated in the study are as follows, 44 (17.6%) girls had irregular cycles, 8(3.2%) girls had cycles less than 24 days, and 38(15.2%) girls had cycles more than 38 days. 45(18%) girls had bleeding for less than 3 days while 40(16%) of girls had bleeding for more than 8 days. 46(18.4% of girls had heavy bleeding). 150(60%) of girls had dysmenorrhea.

In this study, 44(17.6%) girls had irregular cycles. Out of which 4 (6.4%) girls had BMI< 18.5, 18(13.3%) girls had normal BMI, and 22(31.4%) girls had BMI >25. Girls with higher BMI had irregular menstruation more common than girls with normal BMI and underweight girls. The values are statistically significant as p-value < 0.001. Agarwal et al observed that 75 girls (12.5%) out of 600 had menstrual irregularities, out of which, 10(8.4%) girls were underweight,37(10.4%) girls were normal range BMI, and 28(22.5%) girls were overweight. The results were statistically significant with p-value <0.05(5). A study by Deshpande et al showed 90.4% of girls with BMI >25 had irregular menstruation, and the association was highly statistically significant with p value <0.0001 [10].

In this study, out of 62 girls with BMI<18.5 majority had normal flow bleeding 38(61.3%) while 16(25.8%) had heavy bleeding. 62(100%) girls had normal cycle length. 37(59.6%) girls had 3-7 days of bleeding while 24(38.7%) girls had prolonged bleeding. 32(51.6%) girls had dysmenorrhea.

Out of 118 girls with a BMI of 18.5-24.9, 80(67.8%) girls have normal bleeding. 104(88.1%) girls have normal cycle length. 94(79.7%) girls had normal days of bleeding, and 74(62.7%) girls had dysmenorrhea.

Out of 70 girls with BMI > 25, 61(81.1%) girls have normal flow bleeding, 48(68.5%) girls have normal cycle length, 34(48.6%) girls have normals days of flow while 31(44.3%) girls have flow <3 days and 44(62.9%) girls have dysmenorrhea.

In this study, oligomenorrhoea is seen more in girls who are overweight 18(17.6% of girls among overweight). Hypomenorrhoea is seen more among overweight girls 31(44.3%). Menorrhagia is seen more in girls who are underweight 24(38.7% of underweight girls). Dysmenorrhea is seen equally among the 3 groups but the p-value> 0.05 hence is not statistically significant.

In a study by Megha et al, menorrhagia was more common in underweight girls, but the results were not statistically significant and hypomenorrhea was more common among girls with higher BMI and girls with higher BMI were the maximum girls with oligomenorrhoea [5]. Few other studies have similar findings as those of Megha et al [10,11,12,13,14,15,16].

In this study, the association of BMI with common medical conditions associated with menstrual irregularities are as follows: 8(12.9%) out of 62 girls with BMI <18.5, 1(0.9%) out of 118girls with normal BMI and 15(21.4%) out of 70 girls with BMI>25 have anaemia. Girls who were underweight and overweight had anaemia more when compared to girls with normal BMI. This result is statistically significant.

4(6.5%) out of 62 girls with BMI <18.5, 12(10.2%) out of 118 girls with normal range of BMI and 20(28.6%) out of 70 girls with BMI >25 have history of PCOS. More girls with BMI>25 had PCOS when compared to underweight and normal-range girls. However, the results are statistically significant as the p-value is less than 0.05.

0 girls BMI <18.5, 12(10.2%) out of 118 girls with normal range of BMI and 14(20%) out of 70 girls with BMI >25 have history of thyroid disorders. More girls with BMI>25 had thyroid disorders when compared to underweight and normal-range girls. However, the results are statistically significant as the p-value is less than 0.05.

Limitations of the study: The sample size of the study is limited, thus the generalisation of the study to a larger population could be affected. There is selection bias as the study only included adolescent girls from specific schools. The study is self-reported data hence could have recall bias. As the study is a questionnaire study, the depth of information is limited, has response bias, chances of misinterpretation of questions are high. The BMI calculation is from the measurements given by the study participants and not by physical measurement hence the potential for measurement error is high.

Conclusion

Menstrual health, menstrual hygiene awareness and early detection and treatment of any irregularities along with lifestyle modification have played a leading role in the well-being of their community and that of their county for decades. In our study mean BMI is 22+4.8. Girls with high BMI had more hypomenorrhoea oligomenorrhoea and cycle irregularities when compared to normal and low BMI girls while menorrhagia is seen more among underweight girls and the mean age of menarche is 13+1.4.

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Conflict of Interest

No conflict of interest was noted.

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