International Journal of Clinical Obstetrics and Gynaecology

Dr. Priyanka Rai
Assistant Professor, Department of
O.B.G., Uttar Pradesh University
of Medical Sciences, Saifai, Uttar
Pradesh, India

Dr. Girija Kumari
Associate Professor, Department of
O.B.G., Anugrah Narayan Magadh
Medical College and Hospital,
Gaya, Bihar, India

Dr. Kalpana Kumari
Junior Grade Professor,
Department of O.B.G., Uttar
Pradesh University of Medical
Sciences, Saifai, Uttar Pradesh,
India

Dr. Deepshikha Jaiswal
Senior Resident, Department of
O.B.G., E.S.I. Basaidarapur, New
Delhi, India

Evaluation of correlation between body mass Index with menstrual cycle pattern among young female medical students

Dr. Priyanka Rai, Dr. Girija Kumari, Dr. Kalpana Kumari and Dr. Deepshikha Jaiswal

DOI: https://doi.org/10.33545/gynae.2020.v4.i1b.448

Abstract
Introduction: Adolescence is a period of maturity, a point of physical, emotional, social and psychological change. Menstruation is described as the exclusive sign of femininity and it is a physical manifestation of complex endocrine axis. Body mass index or BMI have the most control over menstrual irregularity. The increasing trends in the prevalence of childhood obesity, early puberty and menarche, and ethnic racial differences in the effect of body mass index on the reproductive characteristics of young females around the world, warrant continuous evaluation. Hence, we aim to investigate possible variations in the influence of body mass index on the age at menarche as well as duration of menstrual cycle and menses in young girls.

Material and Method: Present study was conducted on 300 young female medical students over a period of 18 months. Young and unmarried female medical students in the age group of 17-25 years of age group were included. Married or who were on treatment for menstrual problem or had primary amenorrhoea or undergone pelvic surgery were excluded. Structured questionnaire was used to determine the occurrence of menstrual problem. Body mass index was calculated and the collected data was analysed between the relationship parameter i.e. body mass index and menstrual abnormalities.

Result: The mean age of the study population was 21.98 yrs. The mean of BMI in the study population was found to be $21.42 kg/m^2$. Irregular menses (including short and long cycles) is highly significantly associated with underweight and overweight BMI as clear with P- value of 0.0001 and 0.0001 respectively. Irregular cycles were seen in 45 cases out of which 9 were having Polymenorrhea i.e. cycle length less than 21 days, 10 were having irregular cycle with no fixed length, and 26 were having oligomenorrhea. Out of 45 cases with irregular cycle 19 were in underweight category, 9 in overweight category, and 2 in obese class 2 and rest 15 in normal BMI category.

Conclusion: The present study suggests alteration in body mass index was associated with changes in menstrual pattern. Maintaining the correct weight according to the height is utmost important to avoid so many menstrual irregularities as well as long term metabolic complications.

Keywords: Body mass index or BMI, menstrual irregularities, Polymenorrhea, Oligomenorrhoea

Introduction
Menstruation is described as the exclusive sign of femininity. It is well known that the terms menstruation and menses are derived from the Latin word menses (month), which in turn relates to the Greek word 'Mene' (moon) and to the roots of the English word month reflecting the fact that the moon also takes close to 28 days to revolve around the Earth (actually 27.32 days). Factors that often play a role in the regularity and flow of a woman's menstrual cycle include hormonal changes, genetics, serious medical conditions and body mass index. Of all these factors, body mass index or BMI had the most control over menstrual irregularity. Having a high or low BMI may cause to experience an absence of menstruation, irregular menstruation and painful menstruation [1, 2]. Menstrual cycle irregularities and anovulation have been found to occur with increased frequency in women who deviate considerably from normal weight. A number of studies have shown that higher obesity grades were associated with higher probabilities of irregular pattern of menstrual cycles [3, 4]. The increasing trends in the prevalence of childhood obesity, early puberty and menarche, and ethno racial differences in the effect of BMI on the reproductive characteristics of young females around the world, warrant continuous evaluation.

Corresponding Author:
Dr. Girija Kumari
Associate Professor, Department of
O.B.G., Anugrah Narayan Magadh
Medical College and Hospital,
Gaya, Bihar, India

Medical students need to study harder and are vulnerable to stress, which may lead to dysfunction of hypothalamo-pituitary ovarian axis causing menstrual abnormalities. A number of medical conditions can cause irregular or missed menses which can be diagnosed and treated at early stage. However, this part of women's health is mostly neglected by primary health care. More than 90% of menstrual problems are preventable just by early detection and appropriate treatment. An etiological relationship between menstrual disorders, Body Mass Index (BMI), dietary habits, may be sought for early prevention [4, 5, 6]. With this backdrop, a cross-sectional study was conducted in undergraduate female medical and paramedical students in tertiary medical centre to determine average age of menarche, the patterns of menstrual cycles, prevalence and types of menstrual disorders and their association with family history, body mass index (BMI), dietary habits.

Material and Methods
The present study was conducted on 300 young female medical students of a tertiary medical centre over a period of 18 months between January 2015 to July 2016. Young unmarried female students in the age group of 17-25 years were included in the study. However, young female students who were married or who were on treatment for menstrual problem were excluded from this study. Also, young female medical students who had primary amenorrhoea or those who had undergone pelvic surgery were excluded from this study. Structured questionnaire was used to determine the occurrence of menstrual problems among young females' medical students. Consent was taken from the selected students and a structured questionnaire was given to identify menstrual problems. The questionnaire consisted detailed history of the cases like present age, daily calorie intake, socioeconomic status, daily intake of junk foods, their detailed history of menstrual cycle pattern, age of menarche (on recall basis), dysmenorrhoea, passage of clots, hypomenorrhoea, menorrhagia, premenstrual symptoms if any, medical and drug history family history, etc. Detailed history of menstrual cycle was evaluated to find out the menstrual abnormality among these theoretically described ones. Short cycles (Polymenorrhea) with cycle length less than 21 days, long cycles (oligomenorrhoea) with cycle length more than 35 days,

normal cycles from 21 to 35 days, normal duration 2 to 7 days were taken. Amount of bleeding was assessed by the number of pads used/day and presence and absence of clots. A thorough general examination with special attention to pallor, icterus, thyroid enlargement, per abdominal examination was done. Standardised weighing machine and measuring tape was used to determine the BMI among cases. BMI was calculated using the formula weight/ (height)^2 (Kg/m^2).

The collected data was analysed using descriptive (mean, median and standard deviation) and inferential statistics. The relationship between the parameters i.e. BMI and menstrual abnormality was tested using the Chi-square test and independent sample t-test.

Result
A total of 300 young female medical students were participated in this study in the age group 17-25 years. Mean age of study sample was found to be 21.98 years with standard deviation of 2.0. The socioeconomic status was determined by modified Kuppuswamy scale. The maximum number of cases 51.7% (155 cases) were found in the socioeconomically lower middle class, while 48.3% (145) cases were from upper middle-class status. None of cases were found from upper and lower socioeconomic status. The average age of menarche was 13.5 years with a standard deviation of 1.315. The mean duration of blood flow was 4.28 days with a standard deviation of 1.092. The cycle length was 29.79 days with standard deviation of 4.87. Average flow of blood during menses was 35.39 ml. The blood loss was assessed by the number of pads used per day. Most of the cases used heavy blood absorbing sanitary pads and approximately 10ml of blood was supposed to be absorbed by 1 pad. The mean of BMI was 21.42 kg/m² with a standard deviation of 2.949. Out of 211 cases (70.3%) with normal BMI only 14 cases (6.6%) had irregular menstrual cycles. Taking overweight and obese class 1 cases together, there were 20 cases (46.5%) out of 43 cases who had an irregular cycle and out of 46 underweight cases 23 cases (50%) had irregular cycles. A statically significant relationship was observed between BMI and menstrual pattern (p value 0.0001) i.e. there is more irregular cycles among underweight as well as overweight category.

Table 1: T-Test showing mean value of different parameters

Parameters	N	Mean	Std. Deviation	Std. Error Mean
Age (Years)	300	21.98	2.002	.116
Approximate Calories (kcal)	300	2226.23	253.462	14.634
Age of Menarche (Years)	300	13.50	1.315	0.076
Menstrual Cycle Duration (days)	300	4.28	1.092	0.063
Menstrual Cycle length (Days)	290	29.79	4.870	0.285
Amount (ml/days)	300	35.39	11.814	0.682
Height (cm)	300	157.11	5.389	0.311
Weight (Kg)	300	53.11	8.291	0.479

Table 2: Correlation study of BMI & Menstrual cycle pattern

BMI Group	Frequency	Menstrual cycle		Total	P-value
		Regular	Irregular		
Underweight	Count	23 (50.0%)	23 (50.0%)	46	0.0001
	% Total	7.66%	7.66%	15.3%	
Normal	Count	197 (93.36%)	14 (6.6%)	211	
	% Total	65.7%	4.7%	70.3%	
Overweight	Count	23 (56.0%)	18 (43.9%)	41	
	% Total	7.66%	6.0%	13.7%	
Obese class 1	Count	0 (0.0%)	2 (100%)	2	0.0001
	% Total	0.0%	0.7%	0.7%	
Total	Count	255	45	300	
	% Total	85%	15%	100.0%	

Other problems identified were dysmenorrhoea. Dysmenorrhoea is significantly associated with altered body mass index. Overweight and obese class 1 cases 90.69% had complaint of dysmenorrhea (p value 0.0006). In underweight category 84.78% had dysmenorrhea (p value 0.0424).

Discussion
It was observed that many young females are suffering from menstrual problems and these menstrual problems seems to have some correlation with Body Mass Index which may have future implications in term of obesity, chronic medical disease, infertility, and reproductive health [7-11]. Medical students are at high risk for developing menstrual irregularities due to stressed lifestyle, irregular food and exercise habits [4-6]. Menstrual irregularity over prolonged periods of time can cause anovulation, endometrial hyperplasia and infertility as well as deterioration in the quality of life [12, 13]. Dysmenorrhoea and PMS are most commonly related to absence from class/college, limitation in social, academic, sports and daily activities.

Binu Thapa *et al*. conducted study on 253 adolescents' females and found that almost half of the adolescents had abnormal BMI [14]. In their study there was statistically significant association between the BMI and irregular menstrual cycle (p=0.024), oligomenorrhea (p=0.027), Polymenorrhea (p=0.006) and hypomenorrhea (p=0.01). The most common menstrual problem in their study was dysmenorrhoea followed by irregular menstrual cycle and they stated that BMI plays a very important role in regulating menstrual pattern.

Similar study conducted by Tanveer Alam *et al*. on healthy female students of MBBS first year (n=50) in the age group of 18-25 years found that menstrual cycle length and duration of menses was significantly prolonged in over weight and obese groups when compared to control as well as under- weight groups [3]. However, there was significant alteration between normal and underweight group. Another study conducted by Sonia Isoduwa Osayande *et al*. on the influence of BMI on the duration of menstrual cycle and menses in young girls in two urban areas in southern Nigeria, reported that with higher BMI experienced longer menstrual cycle and menses compared to their normal weight counterparts. In their study they found that there was an increase in the average length of the menstrual cycle and menses with increased BMI (r = 0.52, 95% CI = 0.28 – 0.69, *p*< 0.0001) and (r = 0.38, 95% CI = 0.12 – 0.59, *p*< 0.05) respectively [15]. Nirmala Jaget Lakkawar *et al*. conducted study to evaluate the prevalence of menstrual abnormalities among the 200 female students in a medical school in Pondicherry, India. They found that students with higher BMI and those consuming junk foods revealed higher incidence of irregular menstruation [16]. Hemant *et al*. conducted study on 200 students (MBBS, BDS & GNM) in medical teaching institution and found that girls with high (90.4%) BMI had irregular cycles [17]. There was a statistically significant correlation between irregular cycles and high BMI ($\chi2$=49.826) (*p*< 0.001). There was also statistically significant correlation between very high and very low body fat percentages and menstrual irregularities ($\chi2$=35.839) (*p*< 0.001). Incidence of irregular menstruation was significantly associated to upper socio-economic class ($\chi2$=44.5809) (*p*< 0.001).

In our present study the mean age of the study population was 21.98 yrs. Among different age groups maximum number of cases were of 22 and 23 years. The mean of BMI in the study population was found to be 21.42kg/m². Thus, the average study population fall in normal BMI category (18.5-24.99 kg/m²). Out of 211 cases with normal BMI, 197 had regular cycles and only 14 had irregular cycles. On the other hand, out of 89 cases with abnormal BMI only 58 had regular cycles and 31 cases had an irregular cycle which is a significant number. In our present study, irregular menses (including short and long cycles) is highly significantly associated with underweight and overweight BMI as clear with P- value of 0.0001 and 0.0001 respectively. Irregular cycles were seen in 45 cases out of which 9 were having Polymenorrhea i.e. cycle length less than 21 days, 10 were having irregular cycle with no fixed length, and 26 were having oligomenorrhea. Out of 45 cases with irregular cycle 19 were in underweight category, 9 in overweight category, and 2 in obese class 2 and rest 15 in normal BMI category. Inverse and significant correlation was seen between BMI and menstrual cycle duration. P-value obtained was .007 and Pearson correlation was -0.155 suggesting less duration of menstrual flow in overweight cases and more in underweight cases. Age of Menarche was significantly associated with BMI (p-value .000). It has inverse relation with BMI i.e. age of menarche is early in high BMI group and late in lower BMI group.

A lot of stress is already there among young female generation especially those in professional colleges in today's era. Menstrual cycle irregularities and anovulation have been found to occur with increased frequency in women who deviate considerably from normal weight. An etiological relationship between menstrual disorders, Body Mass Index (BMI), dietary habits, may be sought for early prevention. It is really important to educate and counsel the present generation from young age preferably from adolescence itself about the maintenance of correct weight, food habits, menstrual patterns, and hygiene, and its abnormalities which should not be ignored as they can have long term complications.

Conclusion
The present study suggests significant association between underweight and overweight body mass index with irregular menstrual patterns in young female medical students.

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