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Association of body mass index and waist hip ratio with menstrual characteristics: A study among a group of adolescents of Kolkata city

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ABSTRACT

Aim: *Overall adiposity (BMI) and centrally distributed body fat (WHR) both are strongly associated with menstrual profile. Present study aims to find out the association of menstrual characteristics with body mass index and waist hip ratio.*

Methods: *A total number of 53 adolescent participants aged between 16 and 24 years were selected from undergraduate college. The participants were divided into five categories on the basis of their body mass index. These are: (1) underweight [BMI<18.5 kg/m^2]; (2) normal [BMI 18.5–22.9 kg/m^2]; (3) overweight [BMI 23–24.9 kg/m^2]; (4) pre-obese [BMI 25-29.9 kg/m^2] and (5) obese [BMI ≥30 5 kg/m^2]. They were also divided into two categories on the basis of their waist hip ratio: (1) lower body fat predominance [WHR ≤0.85]; (2) upper body fat predominance [WHR > 0.85].*

Results: *Underweight participants attained menarche at later age compared to obese. Participants with upper body fat predominance attained menarche at an early age than their respective counterpart. Menstrual bleeding length was significantly longer in overweight participants and among those with lower body fat predominance than their respective counterpart. Cycle length was longer among obese or the participants with upper body fat predominance.*

Conclusion: *Body mass index and waist hip ratio of participants were related with menstrual characteristics.*

Keywords: *Body mass index, waist hip ratio, menstruation, adolescent*

INTRODUCTION

Nutritional status is one of the major factors which affect the menstrual health (Dars et al., 2014; Kirchengast, 2014; Abdella et al., 2016). For example, a gain or loss in body mass significantly affects the nature of menstrual cycle. Literature reveals that the fat cells can get changed into a type of estrogen called estrone (Seibel, 2017). Thus fat cells in overweight or obese women have estrone-making capacity. This added extra estrogen can cause menstrual disorders (Fujiwara, 2007). On the other hand, lack of fat cells in underweight women does not able to produce estrone. Moreover, due to underweight their body stop to make estrone. These women have fewer periods or go longer without ovulating (Fujiwara and Nakata, 2004).

Centrally distributed body fat (WHR) and overall adiposity (BMI) both are strongly associated with menstrual irregularity. For example, Dars et al. (2014) have found a significant relationship between body mass index (BMI) and menstrual pattern. Their cross sectional study on university students from Egypt found that girls with a BMI of 25 to 29.9 had infrequent menstrual cycles, whereas BMI within 14 to 24.9 had a normal menstrual pattern. Another study on Chinese women aged 18-41 years found women with high central adiposity defined by WHR≥0.80 were more likely to have a long cycle (Zhang et al., 2012). Another study conducted on school going girls of Nepal found a statistically significant association between the BMI and irregular menstrual cycle, oligomenorrhea, polymenorrhea and hypomenorrhea (Thapa and Shrestha, 2015). Study conducted in Bhopal, on a group of medical students showed that the underweight group attained menarche at late age compared to that of the overweight and obese groups (Alam et al., 2015). A study on school going adolescent girls of Udaipur, Rajasthan explored that all girls with moderate and severe dysmenorrhea had BMI < 16.5 (Chauhan and Kala, 2012).

Under the circumstances present study aims to find out the association of menstrual characteristics with body mass index and waist hip ratio.

MATERIAL AND METHODS

Study area

The present study was conducted on a group of adolescents, who were students of an undergraduate college located in the Central Kolkata region, West Bengal. The study area was selected because of operational conveniences.

Study population

A total number of 88 participants from undergraduate courses were selected for the study. They were between the ages of 16 and 24 years. Finally 53 were recruited for this study on the basis of the following selection criteria: unmarried and with no reported major reproductive health problems. The study was conducted after getting proper approval from the college authority. Prior to the collection of data, the nature of study was explained to the participants and verbal consent of them was taken.

Data types and techniques of data collection

Data on socioeconomic variables and menstrual characteristics have been collected with the help of well-tested questionnaire / schedule (Ray, 2010). The following were the data types included in the study.

Socio-economic variables: data include age of the participant, parent's occupation, monthly household income and expenditure (in Indian National Rupees).

Menstrual characteristics: Menstrual characteristics include: age at menarche, menstrual regularity, menstrual cycle length, menstrual bleeding length, premenstrual problems (vomiting, back pain, headache, diarrhea, weakness, feels heavy body, some degree of abdominal pain, higher degree of abdominal pain, acne, flatulence), menstrual problems [painful periods (pain at the time of menstrual discharge), heavy discharge (heavy amount of menstrual discharge), scanty discharge (scanty amount of menstrual discharge)] and gynaecological problems (white discharge, itching around genital area, burning sensation during urination, increased urine frequency, urine leakage and painful urination).

Age at menarche was ascertained by asking the participants to recall the actual date and month by referring to some landmark event or other memorable personal moment (e.g. her own birthday). The list of problems was canvassed among the participants in vernacular language (Bengali). The participants were asked to respond to each of the premenstrual, menstrual and gynaecological problems in a binary format- 'yes' if they experienced and 'no' if not. The recall period regarding the experience of premenstrual, menstrual and gynaecological problems for this study was last 3 months prior to the date of interview.

Anthropometric variables: It includes height, weight, waist and hip circumferences. These were recorded following standard protocol (Lohman et al., 1998). Body mass index was derived from height and weight of study participants. The participants were divided into five categories on the basis of their body mass index. These are: (1) underweight [BMI<18.5 kg/m^2]; (2) normal [BMI 18.5–22.9 kg/m^2]; (3) overweight [BMI 23–24.9 kg/m^2]; (4) pre-obese [BMI 25-29.9 kg/m^2] and (5) obese [BMI ≥30 5 kg/m^2] (WHO, 2004). Waist hip ratio

(WHR) was calculated from waist and hip circumferences. The participants were divided into two categories on the basis of their waist hip ratio: (1) lower body fat predominance [WHR ≤0.85]; (2) upper body fat predominance/ abdominal obesity [WHR>0.85] (WHO, 1999).

Duration of data collection

The entire data was collected during the months of April and May, 2017.

Data analyses

The analyses of the data were done using the Statistical Package for Social Sciences version 16.0. Descriptive statistics were used for calculating the frequency, percentage and mean of the variables. Bivariate analyses (Pearson correlation, chi square, t test, ANOVA) were done for comparative study. Significant value of $p < 0.05$ and confidence interval of 95% were set for all the analyses.

RESULTS

Table 1: Socio economic variables

Socio economic variables	
Mean age of the participants (in years)	19.11±1.8
Occupational status of father	
Business	26(49.1)
Service	21(39.6)
Cultivation	1(1.9)
Retired	5(9.4)
Occupational status of mother	
Homemaker	44(83.0)
Business	3(5.7)
Service	6(11.3)
Median monthly household income (INR)	30000±5326
Median per capita monthly household expenditure (INR)	7500±1158

Figures in the parenthesis indicates percentage

Mean age of the participants was 19.11±1.8 years. Majority of fathers of the participants were engaged in business followed by service; overwhelming mothers were homemakers. Median monthly household income and per capita monthly household expenditure was rupees 30000±5326 and 7500±1158 respectively (table 1).

None of menstrual characters like age at menarche, menstrual cycle and bleeding length were significantly correlated with anthropometric variables like BMI and WHR (table 2).

Table 2: Correlation between menstrual characters and anthropometric variables

Menstrual character		Anthropometric variables	
		BMI	WHR
Age at menarche (in years)	Pearson Correlation	-0.234	0.093
	Sig. (2-tailed)	0.091	0.508
Menstrual cycle length (in days)	Pearson Correlation	0.014	0.046
	Sig. (2-tailed)	0.920	0.746
Menstrual bleeding length (in days)	Pearson Correlation	-0.064	-0.029
	Sig. (2-tailed)	0.650	0.836

Table 3: Mean age at menarche (in years) by BMI

BMI	N	Mean age at menarche (in years)	95% Confidence Interval for Mean		ANOVA, p value
			Lower Bound	Upper Bound	
Underweight	6	13.17±2.2	10.92	15.40	F=0.402, p value=0.806
Normal	17	12.88±1.7	12.01	13.75	
Overweight	11	12.82±1.4	11.87	13.75	
Pre obese	14	12.50±1.3	11.75	13.24	
Obese	5	12.20±0.8	11.16	13.23	
Total	53	12.72±1.5	12.32	13.14	

Mean age at menarche of the study participants was 12.72±1.5 years. Underweight participants attained menarche at later age compared to those who were obese. However, there is no significant difference regarding their mean age at menarche among these five BMI categories of participants (table 3).

Table 4: Mean age at menarche (in years) by WHR

WHR	N	Mean age at menarche (in years)	95% Confidence Interval for Mean		t test, df, p value
			Lower Bound	Upper Bound	
Lower body fat predominance	25	13.00±1.7	-0.32	1.32	t=1.221, p value=0.228
Upper body fat predominance	28	12.50±1.2	-0.34	1.34	

The participants with upper body fat predominance attained menarche at an early age than their respective counterpart. However, there was no significant difference in mean age at menarche between two WHR categories (table 4).

Table 5: Association of menstrual characteristics and BMI

	Underweight (n=6)	**Normal (n=17)**	**Overweight (n=11)**	**Pre-obese (n=14)**	**Obese (n=5)**	**Chi^2, df, p value**
Menstrual regularity	5(83.3)	15(88.2)	10(90.9)	10(71.4)	3(60.0)	chi^2 =3.586, df=4, p=0.465
Pre Menstrual problems encountered	6(100.0)	14(82.4)	9(81.8)	13(92.9)	3(60.0)	chi^2 =4.346, df=4, p=0.361
Menstrual bleeding length (days)	4.1±0.9	4.9±1.0	5.3±0.7	4.0±1.0	4.8±0.8	F=4.015., df=4, p=007.
Menstrual cycle length (days)	31.83±3.7	30.11±5.9	28.81±2.6	29.71±2.6	31.60±7.5	F=0.582, df=4, p=0.677
Menstrual problems encountered	4(66.7)	16(94.1)	10(90.9)	11(78.6)	3(60.0)	chi^2 =5.185, df=4, p=0.269
Gynaecological problems	4(66.7)	9(52.9)	7(63.6)	5(35.7)	2(40.0)	chi^2 =2.869, df=4, p=0.580

Figures in the parenthesis indicates percentage

Majority of study participants, irrespective of BMI categories reported to have regular menstrual cycle. More than half of them have experienced pre menstrual and menstrual problems. Gynaecological problems were more frequently present in underweight, normal and overweight categories than the pre obese and obese groups. Menstrual bleeding length was significantly longer in overweight participants than their respective counterpart. Cycle length was longer among obese participants (table 5).

An overwhelming section of the study participants from both WHR categories have experienced regular menstruation and menstrual problems. Significantly, participants with lower body fat reported to have more pre menstrual problems than their counterpart. More than half of these participants have gynaecological problems than those who have upper body fat predominance. Menstrual bleeding length was longer among those with lower body fat

predominance and menstrual cycle length was longer among those who have upper body fat predominance (table:6).

Results of the present study are limited in its scope due the small sample size of this research which needs to be explored further. Thus consider these results with careful perusal.

DISCUSSION

The trend in the research reveals that the underweight participants attained menarche at later age compared to those who were obese. Likewise no significant differences were found within these five BMI categories with respect of menstrual characteristics like menstrual regularity, pre menstrual, menstrual and gynaecological problems. However, significantly majority of overweight participants had longer bleeding length and those with WHR $\leq .85$ have more pre menstrual problems than their respective counterpart.

Table 6: Association of menstrual characteristics and WHR

	Lower body fat predominance (n=25)	**Upper body fat predominance (n=28)**	**chi^2, df, p value**
Menstrual regularity	21(84.0)	22(78.6)	chi^2 =0.254, df=1,P=0.441
Pre Menstrual problems encountered	24(96.0)	21(75.0)	chi^2 =4.545, df=1,P=0.037
Menstrual bleeding length (days)	30.6±5.1	29.6±3.8	t= 0.793, df=51, p=0.431
Menstrual cycle length (days)	4.6±0.8	4.7±1.2	t= -0.515, df=51, p=0.609
Menstrual problems encountered	20(80.0)	24(85.7)	chi^2 =0.306, df=1,P=0.425
Gynaecological problems	14 (56.0)	13(46.4)	chi^2 =0.484, df=1,P=0.337

Figures in the parenthesis indicates percentage

Our study corroborated with others who stated that increase in body mass index (BMI) is related to an earlier onset of menarche (Esimai and Omoniyi, 2010; Oh et al., 2012). Although not statistically significant, we observed an inverse correlation between age at menarche and BMI. In this regard another study on similar population explored that menarcheal age has negative impact on BMI (Ghosh et al., 2009). Studies stated that increased BMI during adolescence is related to faster peak growth velocity and fast sexual maturity, which are related to early onset of puberty (He and Karlberg, 2001; Lee et al.,

2007). Moreover relationship between obesity and early menarche remains controversial as most of studies were cross sectional (Jasik and Lustig, 2008). However longitudinal study did not find any relation of BMI with onset of menarche (Demerath et al., 2004).

Our study corroborates with other studies about the fact that the frequency of irregularity in the menstrual cycle increases with higher BMI (Fujiwara and Nakata, 2007; He and Karlberg 2007). Moreover, study conducted by He and Karlberg (2007) found that body fat distribution leads to amenorrhea and irregular menstrual cycles. Among our study participants, 40% of obese and 30% of pre obese have irregular menstruation; however none of them have reported amenorrhea. Pathophysiology of reproductive dysfunction in obese women stated that women with more body weight excreted less urinary luteinizing hormone, follicle-stimulating hormone, and luteal progesterone metabolites. Hypogonadism of obesity may be potentially explained by either central (hypothalamic or pituitary) or peripheral (corpus luteum) defects within the hypothalamic-pituitary-ovarian axis (Polotsky, 2010). It has been suggested that centrally distributed body fat may be more strongly associated with menstrual abnormalities than overall adiposity such as BMI (Douchi et al., 2002). The probability of having an irregular cycle increased linearly with increasing WHR (Wei et al., 2009). In contrast with others, our study participants with lower body fat predominance have menstrual regularity than their counterpart. Furthermore, significantly more number of participants with lower body fat reported premenstrual problems.

We found that both underweight and overweight had longer cycle length. Moreover, menstrual bleeding length was inversely related with WHR, but cycle length was positively related with WHR. In contrast with present finding, different cross sectional studies reported positive correlation with BMI and menstrual cycle length and bleeding length (Lu, 2006, Samir et al., 2010).

Present study found individual relation of body mass index and waist hip ratio with menstrual characteristics. Relatively few numbers of participants in each group and the cross-sectional method of data collection could be the limitations to the study.

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