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Body composition and somatotype profile of pre and post menarche stage of Bengali school girls

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Abstract
Menarche is the occurrence of a first menstrual period in the female adolescent. The average age of onset of menarche is 12.4 years. Menarche signals maturation of the adolescent female body. It commonly is associated with the ability to ovulate and reproduce. The purpose of the present study was to find out the changes on body composition, health status and somatotype of the girls before and after menarche stage and its comparison. A total of 100 girls in between the age of 11 to 15 years were selected randomly for this study. Among them 50 were in pre-menarche stage (Group-A) and rest 50 were in post-menarche stage (Group-B). Weight, Height, Body Mass Index (BMI), Chest, Waist and Hip circumference, WHR, PBF and Somatotype were considered as criterion measure in this study. Standard tools and instruments were used to collect data. Mean and standard deviation have been used as descriptive statistics and significance of difference between two group means was computed by using independent t-test. Only 0.01 level of significance was considered in this study. All statistical calculations have done by the standard statistical software. Present study found significantly higher mean value for height, weight, chest circumference, waist circumference and hip circumference among Gr-B than the Gr-A. Finding shows that all the anthropometric and body composition changes significantly among the girls reached after menarche stage. Present study have also revealed that both the pre and post menarche girls had ectomorph-endomorph body type but G2 group had significantly higher value of the endomorphy and mesomorphy than G1 group. From the findings it was concluded that the post menarche girls have higher amount of muscle and body fat than pre menarche girls.

Keywords: menarche, school girls, body composition, somatotype profile

1. Introduction
Menarche is the occurrence of a first menstrual period in the female adolescent. Menstruation is the monthly shedding of the functional layer of the uterine endometrial lining that occurs when ovulation is not followed by fertilization. It occurs approximately every 28 days, with a range from every 21 to every 45 days. The average age of onset of menarche is 12.4 years. Most menstrual periods last between 3 and 7 days, and menses that last more than 10 days is considered abnormal. Menarche signals maturation of the adolescent female body. It commonly is associated with the ability to ovulate and reproduce (Rosner and Sarao, 2019; Petry *et al.* 2019; Zhang, Hu, Yang and Chen, 2019).
There are series of physiological and anatomic changes appeared among the girls after reaching the Menarche stage. Some of the changes includes the attainment of a higher body fat, inhibition of the GnRH pulse generator in the arcuate nucleus of the hypothalamus,. secretion of estrogen by the ovaries in response to pituitary hormones, over an interval of about 2 to 3 years, estrogen stimulates growth of the uterus (as well as height growth, breast growth, widening of the pelvis, and increased regional adipose tissue), estrogen stimulates growth and vascularity of the endometrium, the lining of the uterus, fluctuations of hormone levels can result in changes of adequacy of blood supply to parts of the endometrium etc.
According to Amy and Langaker (2019) menarche is the result of complex interactions between the hypothalamic, pituitary, and ovarian hormones. It also can be affected by thyroid, adrenal, and pancreatic hormones. Thyroid hormones are necessary for normal menses, and their deficiency or excess can inhibit menarche or lead to abnormalities in existing menstrual patterns. Low adiposity can inhibit normal menarche, and it is estimated that a minimum body

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fat of 17% is necessary for menarche, with 22% body fat necessary for maintaining normal menses. The hormone leptin appears to have a role in the maintenance of normal menstrual cycles as well. Stress and obesity appear to be predictors of early menarche [11].

Osteria (1983) in his study indicated that both age and weight are related to the proportion achieving menarche. The effect of height is not as marked as that of body weight [23]. Haq (1984) conducted a study on Bangaladesh urban girls and reported that age at menarche has a positive relationship with weight, but is negatively correlated with per capita of food expenditure (PFE). The positive correlation between age at menarche and weight indicates that the higher the age at menarche, the heavier the girls, suggesting that some minimal level of body fat is necessary for the onset of menarche [24]. Wheeler (1991) found puberty was characterized by major physical alterations: sexual maturation, changes in body composition and rapid skeletal growth [28]. Bharati *et al*. (1998) conducted a study on urban girls of the Howrah district, West Bengal, India and reported that the same socioeconomic group early menarche girls were heavier and taller than the late menarche girls [31]. Bhadra *et al*. (2005) conducted a study on differences in body composition between Pre menarcheal and menarcheal Bengali Hindu girls of Madhyamgram, West Bengal, India and reported that Bengali MG girls had significantly greater mean height, weight, BMI, triceps and calf skin folds, and sum of skin folds, compared with PMG girls [35]. Goyal (2012) conducted a study on adolescents girls of Punjab and reported that the median age at menarche of the girls at Panjab pradesh was 13.25 ± 0.65 years. He has also been observed that menarche is delayed due to under nutrition and as the nutritional status improves, attainment of menarche is lowered [46]. Baniks (2014) conducted a study on 10 to 12 year old girls from Kashipur, Purulia, West Bengal, India and reported post menarche girls had higher mean anthropometric characteristics than pre menarche girls with significant difference (p>0.05). De (2016) conducted a study on nutritional status and menarcheal age of rural adolescent girls of Salboni block of Paschim Medinipur, West Bengal, India, and reported that the girls with earlier onset of menarche had higher body mass and body fat mass than the other girls prior to menarche [53]. Raje (2016) reported that all the body composition parameter except total body water percentage (TBW %) were higher in AM (attained menarche) group compared to PM (peri menarche) group [55].

Present study was conducted to find out the changes on body composition, health status and somatotype of the girls before and after menarche stage and its comparison.

2. Materials and methods
2.1 The subject
A total of 100 girls in between the age of 11 to 15 years were selected randomly for this study. Among them 50 were in pre-menarche stage (Group-A) and rest 50 were in post-menarche stage (Group-B). All the subjects were selected from Kolkata and North 24 Parganas district of West Bengal.

2.2 Criterion measure
Following criterion was measure for this study:
- Weight
- Height
- Body Mass Index (BMI)
- Chest circumference
- Waist circumference

- Hip circumference
- Waist Hip Ratio (WHR)
- Percent body Fat (PBF)
- Somatotype

2.3 Instrument and tools used
Following tools and instruments were used to collect data in this study.
- Weight machine
- Measuring tape (standard)
- Skin fold calliper
- Small Vernier's Scale
- AAHPERD Health Related Physical Fitness (1984).
- Heath & Carter Somatotyping Technique (2002).

2.4 Design of the study and Statistical procedure
The descriptive and comparative statistics were used for analysis of the data in the study. Comparison was done between the two groups Group-A (Pre-menarche stage) and Group-B (Post-menarche stage). Mean and standard deviation have been used as descriptive statistics and significance of difference between two group means was computed by using independent t-test. Only 0.01 level of significance was considered in this study. All statistical calculations have done by the standard statistical software (Excel 2010).

3. Results & Findings
The data regarding anthropometric parameters age, weight, chest, waist, hip, BMI and PBF have been presented in Table No-1. Table-1 revealed that mean value for all the anthropometric parameters - age, height, weight, chest circumference, waist circumference, hip circumference, BMI and PBF were of Gr-B were significantly higher than the Gr-A. The t-value computed for all parameters found statistically significant (*p<0.05*) in this study.

Table 1: Presentation of analyzed data and result for anthropometric parameters

Parameters	Group-A		Group-B		t-value
	Mn	SD	Mn	SD	
Age	11.40 yr	0.82	13.04 yr	0.66	11.01*
Height	141.1 cm	7.89	151.0 cm	6.80	6.73*
Weight	33.84 Kg	6.91	46.60 Kg	11.0	6.93*
Chest circumference	26.30 in	2.96	32.30 in	4.37	8.04*
Waist circumference	28.24 in	2.96	31.28 in	3.77	4.48*
Hip circumference	29.08 in	3.19	33.18 in	5.66	4.46*
BMI	16.93 Kg/m²	4.24	20.56 Kg/m²	4.58	6.73*
PBF	27.57%	5.69	37.55%	3.79	10.32*

*Significant at 0.05 level as table value of t = 1.66 at df=98

The descriptive statistics for the somatotype parameters i.e. Endomorph, Mesomorph and Ectomorph have been presented in Table No. 2. The inferential statistics (t-value) also presented in same Table-2 below.

Table 2: Presentation of analyzed data and result for physiological parameters

Parameters	Group-A		Group-B		t-value
	Mean	SD	Mean	SD	
Endomorph	5.8	1.34	7.4	1.48	5.82*
Mesomorph	0.5	0.23	0.6	0.37	7.09*
Ectomorph	3.6	1.40	2.55	1.78	3.28*

*Significant at 0.05 level as table value of t = 1.66 at df =98

Table-2 revealed that mean value for Endomorphy and Mesomorphy of Gr-B were higher than the Gr-A but the mean value for the Ectomorphy was lower among Gr-B than the Gr-A. Computed t-value indicated that all the mean differences were statistically significant (*p<0.05*).

4. Discussion
Present study found significantly higher mean value for height, weight, chest circumference, waist circumference and hip circumference among Gr-B than the Gr-A. Finding shows that all the anthropometric and body composition changes significantly among the girls reached after menarche stage. Several studies have reported the same findings for the menarche girls. Increase in body weight, BMI and body fat along with onset of menarche and puberty was reported by Baker (1985), Kaplowitz (2008) and Buyken, Karaolis-Danckert and Remer (2009). Changes in body composition, rapid skeletal and muscular growth in pubertal stage were reported by Wheeler (1991). Increase in height, chest circumference, hip and waist circumference among pubertal girls after onset of menarche was also reported by the several studies (Wheeler, 1991; Bhadra *et al*., 2005; Chatterjee *et al*., 2005; Banik, 2014; Raje, 2016).

Findings of the present study have shown that both the pre and post menarche girls had same body type i.e. ectomorph-endomorph however the three somatotype components - endomorph, mesomorph and ectomorph were significantly differ between these two groups. The Group-B had higher value of endomorphy and mesomorphy component than group-A. Findings revealed that post menarche girls had more amount of body fat and muscle mass than pre menarche state girls. However the ectomorphy component was decreased among Group-B which also indicated the increase in relative muscle and fat mass among post menarche girls after onset of puberty. Increase in fat mass and body weight was the main reason behind these changes. Along with several hormonal changes in body occurs after puberty and thus body composition a change rapidly. Similar findings have been reported by the several studies conducted on this area throughout the different part of the world. *(Li YL et al., 2006;* Ventrella *et al.* 2008; Saranga *et al., 2008;* and Polat *et al.,* 2011).

5. Conclusions
Within the limitations of the present investigations following conclusions were dawn on the basis of the obtained results:
1. There was significant difference on height, weight and BMI among pre and post menarche stage.
2. There was significant difference on chest, waist and hip circumference among pre and post menarche stage.
3. Post menarche girls had significantly higher body fat percentage (PBF) than pre-menarche girls.
4. There was significant difference on endomorph, mesomorph and ectomrph component among pre and post menarche stage.

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