Relationship of Menarche age with Anthropometric profiles

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Abstract

Menarche (first menstrual period) is the major component in the reproductive life of women. The beginning of the same determines the start up of natural reproduction process in the women's life. As this biological trait has an important cultural, social and epidemiological implication. Increasing attention has been recently devoted by scientists to understanding the causes of age variations in the timing of this event. The present cross-sectional study was designed to investigate the relation between anthropometric parameters among the adolescent girls and age at menarche. 120 school adolescent girls aged 11-14 years old were selected by purposive sampling. Anthropometric examination including height(cm), weight(kg), BMI(kg/m²), percent body fat (%BF), body frame size (BFS), waist-hip ratio (WHR) were measured and information on age of menarche were collected. The result showed the mean age of menarche was 12.58. There were a significant correlation between age at menarche and weight, height, BMI, %BF & BFS. The significant correlation showed that the higher the BMI, the lower the age of menarche. The menarche age is experiencing a decreasing trend. BMI can be considered as key factor for early menarche. However, it must be recognized that such developments will be followed by overweight, obesity, which all require a constant supervision.

Keywords: Menarche, Mean Age, BMI, %BF, BFS, WHR.

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Introduction

Menarche (first menstrual period) and menopause (end of menstruation) are the two major components in the reproductive life of women. Since the interval between two events determines the natural reproductive period during which female can procreate. As these two biological traits have important cultural, social and epidemiological implications. Increasing attention has been recently devoted by scientists to understanding the causes of age variations in the timing of these events (Thomas *et al.*, 2001). Studies shows earlier menarche is associated with attaining the critical weight more quickly. Conversely, a late menarche is associated with body weight growth that is slower prenatally, postnatal or both (Hardy *et al.*, 2000, Akohoshi *et al.*, 2002).

The landmark of pubertal events in girls is the onset of puberty, Peak Height Velocity (PHV) and menarche. Menarche is a rather late event in puberty and usually occurs after PHV is achieved (Hardy *et al.*, 2000).

The menarche age is often investigated for various reasons it is the one of the major index of the menopause. There have been studies on role of height, weight and body structure on the menarche age, however there is a disagreement on the role of these factors. Pejhan *et al.*, (2011) considered that some body fat is necessary in female adolescents and optimal weight is required for onset the menstruation.

Karaponou (2010) estimated that throughout most of the 20th century the average age at menarche has been falling by around three months each decade. In the 19th century the average age at menarche was between 17 and 18 years, by the 1990's this had dropped to between 12 and 13 year and now it is uncommon for girls as young as 8 to have menarche (Berenjy *et al.*, 2008). According to Sachan (2012) and Bagga (2000) overall mean age at menarche was 12.84 years. Menstruation is considered a sign of sexual health during the adolescence and fertility age of women. Historically, it has been celebrated

as the gift of puberty in many human societies. Puberty is the result of hormonal changes in the hypothalamus-pituitary-gonad axis. This axis is stimulated weakly by placental hormones in the female fetus and it leads to secretion of gonadotropin releasing hormone (GnRH) in the neonatal period. This hormone decreases and remains minimal up to adolescence when the occurrence of first menstruation marks it rapid increase (Bayat *et al.*, 2012).

The age at menarche (first menstruation) is clinically valuable, since it forms a basis for diagnosing delayed puberty and pathologic and hormonal disorders. The age of first menstruation is different among various ethnicities. In the United States, the average age at menarche has shifted from 12.75 to 12.54 years over a period of 25 years. The age at menarche is reportedly 12.9 years in Europe, 12.5-12.9 in different regions of India, and 13.3 years in Africa (Anderson *et al.*, 2003, Bektas, 2008). Data showing later onset of menarche among girls of parents with lower educational level, which may be a menarche tends to be earlier with urbanization. Age of menarche is also affected by ethnicity, social class differences, number of siblings, and secular trends (Gharravi *et al.*, 2008).

Higher subcutaneous fat level and BMI pre pubertal ages are associated with increased likelihood of early menarche (Pourarom *et al.*, 2003). Menarche occurred earlier in girls who were taller girls and girls with more body fat have earlier menarche. Girls who were heavier at 7 year had earlier menarche, found delayed maturation among girls who were stunted during the preschool years. Higher BMI and longer sum of skin folds were strongly associated with earlier menarche (Gharravi *et al.*, 2008, Onland-Moret *et al.*, 2005). Firsch (1974) believes that in order to short menstruation girls need to achieve a minimum weight of 47.8 kg and more importantly, their body fat should amount to 23.7 % (from 16%) therefore, the puberty starts earlier in medium obese girls (with 20-30% overweight than normal) than in girls with normal weight, in contrast, girls with malnutrition will experience a delay in menstruation (Pejhan *et al.*, 2011, Thomas *et al.*, 2001, Frisch *et al.*, 1974, Norgan *et al.*, 1997). There is a vast amount of literature at a later age will eventually grow taller compared

with women who reach their menarche at an earlier age (Onland-Moret *et al.*, 2005).

The girls who achieved menarche earlier (between 9-11 years) showed the maximum mean body weight (46 kg) among the three age groups, being 5 kg more than the mean weight of the girls in ideal age group. The late menarche group of girls showed the least mean body weight (37 kg) which was about 4.5 kg less than that of the ideal group. A similar trend was observed for maximum mean body height (154.84 cm) which was shown by girls who attained early menarche (between 9-11 years). Minimum height was observed for the girls in the late menarche age group (Pejhan *et al.*, 2011). Less extensive training or weight loss may result in anovulatory menstrual cycle, or a shortened luteal phase. These disruptions of reproductive ability are due to hypothalamic dysfunction, which is correlated with weight loss or excessive leanness. It is proposed that these associations are causal and that the high percentage of body fat (26-28%) in the mature human female may influence the reproduction. (Akahoshi *et al.*, 2002).

Materials and Methods

The study was conducted to assess the anthropometric measurements at age of menarche and to verify the association of age at menarche with anthropometric measurements in Indian conditions. All subjects were selected from Banasthali University campus, Tonk, Rajasthan for this cross-sectional study. A criterion for the selection of sample was purposive sampling. Menarche girls were studied from school side of Banasthali campus. The variables were the age of menarche which is reported by their own self. Other variables were height, weight, body mass index (BMI) classified in categories of percentile for menarche girls, because, the percentile indicates the relative position of the child's BMI number among children of the same sex and age. For children and teens, BMI age- and sex-specific percentiles are used for two reasons

- The amount of body fat changes with age.
- The amount of body fat differs between girls and boys.

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

The relevant data were collected by measuring the height (cm), weight (kg), waist circumference, wrist circumference, hip circumference and calculation of Body Mass Index (BMI) kg/m^2 , Body Frame Size (BFS), Waist-Hip ratio (WHR), Percent body fat. BMI was calculated by the formula $[\text{Weight (kg)} / \text{Height (m)}]^2$. Body fat percent is calculated by following sex specific prediction formula (Deurenberg *et al.*, 1991), Adult body fat % = $(1.20 \times \text{BMI}) + (0.23 \times \text{Age}) - (10.8 \times \text{gender}) - 5.4$, where, female gender = 0. Body frame size is calculated by formula, $R = \text{Height (cm)} / \text{Wrist circumference (cm)}$ by (source: Krause's Food, nutrition & diet therapy, 2004). Waist hip ratio is calculated by formula, $\text{WHR} = \text{waist circumference (cm)} / \text{hip circumference (cm)}$ (Source: Stanley,

2005). Data were expressed as frequency, percentage, mean and standard deviation. The whole data were analyzed by using Pearson coefficient of correlation with the help of SPSS (16.0) software.

Results and Discussion

Respondent's mean menarche age: Based on the results obtained in Table 1 the mean menarche age was 12.58 years which is similar among high school students in most western countries such as 12.4, 12.6, and 12.5 respectively in Italy, United state and UK (Region *et al.*, 2010., Freedman *et al.*, 2002., Joinson *et al.*, 2011). It was inferred from Fig. 1, that menarche age of 12 years was commonly seen in most of the subjects.

Table 1: Mean and SD of menarche age and Anthropometric parameters of subjects

Parameters	Menarche (Mean $\pm$ SD)
Age (yr)	12.58 $\pm$ 0.99
Height (cm)	154.69 $\pm$ 5.93
weight (kg)	52.24 $\pm$ 8.30
BMI (kg/m^2)	21.88 $\pm$ 3.65
Percent body fat	23.76 $\pm$ 4.28
Body frame size	10.25 $\pm$ 0.52
Waist-hip ratio	0.77 $\pm$ 0.05

Fig. 1: Percentage distribution of menarche age of subjects

Respondent's menarche age and height:

Table 2 depicted that there was significant relationships between ages at menarche and the respondent's heights at the 0.05 level. It was shown that the maximum percentage of height (45.8%) was from 151-155 cm and then only 6.6% girls reach to above 165 cm height. It revealed that the average height of menarche

girls was 154 cm. Fig. 2 scatter linear graph showed that the positive correlation between height and menarche age. Studies conducted by others showed that these students had earlier menarche and short adult height when compared to students who had menarche at a later age and taller height (Yeong *et al.*, 2010, Gharravi *et al.*, 2008, Okasha *et al.*, 2001).

Table 2: Mean age at menarche and respondent's height (cm)

Height(cm)	n=120	Percentage	Mean $\pm$ SD	
<150	19	15.8	12.6 $\pm$ 1.6	r = .312** P<0.05
151-155	55	45.8	12.1 $\pm$ 1.57	
156-160	27	22.5	12.5 $\pm$ 1.03	
161-165	11	9.1	14 $\pm$ 0.47	
>165	8	6.6	13.5 $\pm$ 1.5

Relationship of height with menarche age

Fig. 2: Relationship of height with menarche age

Respondent's menarche age and weight: It is evident from Table 3 that there was significant correlation between ages at menarche and the respondent's weight at the 0.05 level. It was shown that the maximum percentage of weight

(46.6%) was from 51-60 kg and then only 6.6% girls reached to above 71 kg. It revealed that the average weight of menarche girls was 52 kg. Fig. 3 scatter graph showed the negative correlation between weight and menarche age.

Table 3: Mean age at menarche and respondent's weight (kg)

Weight (kg)	n=120	Percentage	Mean $\pm$ SD	
<40	8	6.66	13 $\pm$ 0	r = -.333** P<0.05
41-50	44	36.6	12.8 $\pm$ 2.13	
51-60	56	46.6	12.5 $\pm$ 2.74	
61-70	4	3.3	12 $\pm$ 0	
>71	8	6.6	11.5 $\pm$ 0

Fig. 3: Relationship of weight with menarche age

Respondent's menarche age and BMI: It revealed that the average BMI of menarche girls was between 5th – 85th percentiles. Fig.4 scatter graph showed that the negative correlation between BMI and menarche age. Other studies stated that the greater the BMI, the lower the age of menarche (Pejhan *et al.*,

2011, Einy *et al.*, 2006). Table 4 illustrated that there was significant correlation between ages at menarche and the respondent's BMI at the 0.05 level. It was shown that the maximum percentage of BMI (58.06%) was from 5th – 85th percentile and then only 16.6% girl's reached to above 95th percentile.

Table 4: Mean age at menarche and respondent's BMI (kg/m²)

BMI (percentile)	n=120	Percentage	Mean $\pm$ SD	
<5th	0	0	0	r=-.449** P<0.05
5th - 85th	70	58.3	13 $\pm$ 0.97	
85th - 95th	30	25	12.125 $\pm$ 0.83	
>95th	20	16.6	11.8 $\pm$ 0.44

Fig.4: Relationship of BMI (percentile) with menarche age (yr)

Respondent's menarche age and body fat: In Table 5, it is explained that there was significant correlation between ages at menarche and the respondent's percent body fat at the 0.05 level. It was shown that the maximum percentage of percent body fat (70 %) was from 21-33% which was in healthy

range and then only 6.6 % girls reached to above 33-39% (overweight) and no one was in the obese category. It revealed that the average percent body fat of menarche girls was between 21-33%. Fig.5 scatter graph showed the negative correlation between percent body fat and menarche age.

Table 5: Mean age at menarche and respondent's percent body fat

Percent body fat	n=120	Percentage	Mean $\pm$ SD	
<21%	28	23.3	13.1 $\pm$ 1.24	r=-.405** P<0.05
21-33%	84	70	12.5 $\pm$ 2.44	
33-39%	8	6.6	11.5 $\pm$ 0.14	
>39%	0	0	0

Fig. 5: Relationship of percent body fat with menarche age (yr)

Respondent's menarche age and BFS: Table 6 showed that there was no significant correlation between ages at menarche and the respondent's body frame size at the 0.05 level. It was shown that the maximum percentage of

body frame size (48.38%) was from 10.1-11.0 which was under the medium frame size and then only 6.45% girls reached to above >11.0% (small).

Table 6: Mean age at menarche and respondent's body frame size

Body Frame Size	n=120	Percentage	Mean $\pm$ SD	
>11.0	8	6.6	13.5 $\pm$ 0.707	r=0.273 P<0.05
10.1-11.0	58	48.3	12.6 $\pm$ 1.04	
<10.1	54	45	12.3 $\pm$ 0.92	

Respondent's menarche age and waist-hip ratio: There was no significant correlation between ages at menarche and the respondent's Waist-hip ratio at the 0.05 level. It was shown that the maximum percentage of

waist-hip ratio (68%) was 0.8 which was in healthy range and then only 3.2% girls reached to above than normal. There was no correlation between waist to hip ratio and menarche age (Table 7).

Table 7: Mean age at menarche and respondent's waist-hip ratio

Waist-hip ratio	n=120	Percentage	Mean $\pm$ SD	
0.8	116	96.6	12.6 $\pm$ 0.96	r=0.042
>0.8	4	3.3	12 $\pm$ 0	P<0.05

Conclusion

The mean age at menarche is decreasing continuously from 20 years in ethnic groups. Although the main timing of puberty changes is the genetic factors, other factors such as geographical location, general health status, nutrition and socioeconomic status affect the onset of menstruation and its progression. The present study concluded that there was a significant correlation between weight, height, BMI, body frame size, percent body fat and age at menarche, but there were no significant correlation found between waist-hip ratio and age at menarche. The negative correlation showed by linear graph with weight & BMI stated that higher the weight and BMI, the lower the menarche age. Although BMI can be considered as key factor for menarche age, it must be recognized that such developments will be followed by overweight, obesity, which all require a constant supervision. Therefore, implementing educational plans to enhance the knowledge of the adolescent girls on their habits of nutrition and providing them with appropriate eating patterns is recommended, to change their lifestyle, so that implications resulting from lowered menarche age (such as preterm labor, sexually transmitted disease, cultural hassles, etc) are prevented to a large extent. Educational program implemented in schools can play a significant role in the preliminary prevention of nutritional disorders. The obesity problem in the adolescents may be solved through the cooperation of school officials, families and adolescents themselves.

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