Identifying menarcheal age and its association with body mass index in young Saudi females

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ABSTRACT

Objectives: To explore the relationship of menarcheal age with body mass index (BMI), to find mean menarcheal age in Saudi population and compare it with global data, and to create awareness in health science students on harmful effects of obesity.

Methods: A cross-sectional study carried out between February 2015 and February 2016 on 744 health sciences students of Immam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia aged 18-21 years. Weight and height was measured, and subjects were categorized into 2 groups on the basis of BMI: normal and underweight (BMI ≤24.9), and over weight and obese (BMI ≥25). The data analyzed was preformed by Statistical Package for Social Sciences version 20.0 (IBM Corp, Armonk, NY, USA).

Results: Mean menarcheal age of subjects was 13.1 years. Early menarche was observed in 35.6% of the students. Of the 21.7% overweight/obese group, 45.6% reported early menarche. The early menarcheal group had significantly higher BMI compared to late menarcheal group (p=0.021). Significant negative correlation was found between BMI and menarcheal age (p=0.0006).

Conclusion: The present study indicates a downward secular trend in the menarcheal age of the Saudi population. Moreover, a negative correlation between BMI and menarcheal age was also documented.

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The age at which menstruation begins is called menarcheal age. Menarche is considered as a reference point of puberty in girls, although it happens after peak height velocity and breast development but is an easy-to-determine, representative phenomenon.[1] Menarcheal age is a sensitive indicator of physical, biological and psychological environment which have received huge attention in the past few years. Girls with early menarche possess a higher risk of breast and endometrial cancer, psychosocial problem and cardiovascular diseases.[2] Several studies regarding menarcheal age indicate that menarche is different among various ethnicities. But most of the data is suggestive of a worldwide decrease in the mean menarcheal age.[3]

Menarcheal age is more closely related to certain exogenous factors such as BMI, nutritional status, body composition, physical activity, living conditions, and psychological stress.[2] Excess weight may have a role in causing early menarche, but this association remains controversial.[4] Lee et al[5] states that increasing trend of obesity in the USA may be a contributing factor for early menarche in their girls. Few studies reveal that increased body mass index (BMI) during childhood can cause an earlier puberty onset.[6,7] Whereas, other data suggests that increased BMI in adulthood is actually a consequence of early menarche.[8,9] Still other authors document no relationship between menarcheal age and increased BMI.[10]

This study was designed to find that either any relationship exists between BMI and menarcheal age. We aim to determine the mean menarcheal age in Saudi population and compare it with national and international values to explore that either there is a decrease in the mean menarcheal age of Saudi girls, as present studies are not conclusive. Moreover, this study also aims to create awareness in health science students, regarding harmful effects of obesity.

Methods. A cross-sectional study conducted in Immam Abdulrahman Bin Faisal University (IAU), Dammam, Kingdom of Saudi Arabia (KSA). A total of 1,127 female students from various colleges including College of Medicine and College of Applied Medical sciences including (dental college, nursing college, physiotherapy, respiratory therapy, medical lab technicians, and so on within the university were invited to participate in the study.

The inclusion criteria was 18-21 years old Saudi females who were willing to participate and were not using any medications (including hormonal contraception) for at least last 6 months.

Exclusion criteria was students with chronic medical or psychiatric condition, precocious puberty (menarche before 8 years), pathologically delayed menarche (menarche after 18 years), pregnancy and lactation were excluded from the study group.

Finally, 383 students were excluded and 744 were selected. The study tool we used was a predesigned, pretested, structured and self-administered questionnaire which was filled anonymously by the students. Reliability and validity of the questionnaire was checked by test-retest technique. A small briefing

for 15 minutes was given to the students to explain to them the terminologies used in the questionnaire. The questionnaire was designed to obtain the information about menarche age, awareness about menstruation before the onset of menarche, sources of knowledge for menarche, response at the time of menarche, and awareness about menstrual problems. Standard procedures were followed for the anthropometric measurements (light clothes, no shoes, empty bladder and rectum and a minimum of a 4-hour fast). All measurements were carried out in duplicate and the average of 2 measures was recorded. Weight was measured in kilograms and height in centimeters. Body mass index was than calculated by the formula = weight in kg/height in m^2. Subjects were categorized into 2 groups on the basis of BMI: 1) normal and underweight (BMI ≤24.9), and 2) over weight and obese (BMI ≥25).[11] The students were also divided into 3 groups on the basis of their menarcheal age: 1) early menarcheal group (menarcheal age <12 years); 2) middle menarcheal group (menarcheal age ≥12 years to ≤15 years); and 3) late menarcheal group (menarcheal age >15 years).[3] Ethical approval was given by the Deanship of Scientific Research, Immam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Statistical analysis. The statistical analysis was performed using the Statistical Package for Social Sciences version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to find out the frequencies and percentages. Independent sample t-test was used to compare the number of subjects between normal weight and overweight/obese group in all the 3 categories of menarcheal ages. Whereas comparison of mean BMI between ages of menarche was carried out by using one way ANOVA, followed by least significant difference (LSD) test for the pairwise comparison. Spearman's correlation test was performed to find the association between BMI and the menarcheal age. All the statistical tests were conducted at a 95% confidence interval (CI).

Results. We included 744 students of age group 18-21 years. Mean age of the subjects at menarche was 13.1±1.2 years. Early menarche was reported by 269 subjects (35.6%), middle menarche by 409 subjects (55%), and late menarche by 49 subjects (6%).

The distribution of the study subjects on the basis of BMI in 3 menarcheal groups are shown in **Table 1**. Approximately 21.7% of our total study population included overweight and obese individuals. In the early menarcheal group, a statistically significant difference was seen between the number of subjects with BMI ≥25 as compared to the number of subjects with BMI ≤24.9 (45.6% versus 33.4%, p=0.006). Although in the late menarcheal group the difference was also statistically significant (p=0.04), the number of subjects with BMI higher than 25 was less (3.4%) than those with BMI lower than 24.9 (8.3%). This data is indicative of the fact that most of the subjects with early menarche were overweight and obese, whereas those with the late menarche had lower BMI.

The comparison of the mean BMI between the ages of menarche, indicating a statistically significant difference in the BMI between the 3 groups of menarcheal ages as determined by one way ANOVA (p=0.037) (**Table 2**). Further analysis by LSD test revealed that early menarcheal group was having significantly higher BMI (23.17±4.75) compared to middle menarcheal (22.48±4.64, p=0.069) and late menarcheal group (21.49±3.8, p=0.021). No statistically significant difference was seen between middle menarcheal and late menarcheal group (p=0.162) (**Table 3**).

Table 1 - Distribution of the study subjects on the basis of body mass index, in early, middle, and late menarcheal groups.

Menarche (years)	BMI ≥25 (n =147)	BMI ≤24.9 (n=530)	*P*-value
Early menarche (<12)	67 (45.6)	177 (33.4)	0.006
Middle menarche(≥12 to ≤15)	75 (51.0)	309 (58.3)	0.11
Late menarche (>15)	5 (3.4)	44 (8.3)	0.04

Values are presented as numbers and percentage (%). BMI - body mass index, p≤0.05 is considered statistically significant

Table 2 - Comparison of mean body mass index between ages of menarche.

Menarche (years)	N	BMI (kg/m^2)	*P*-value*
Early menarche (<12)	244	23.17 ±4.75	0.037†
Middle menarche(≥12 to ≤15)	384	22.48 ±4.64	
Late menarche (>15)	49	21.49 ±3.8	

*one way ANOVA, †means of BMI are significantly different between ages of menarche, BMI - body mass index, p≤0.05 is considered statistically significant

Table 3 - Pairwise comparisons by least significant difference (LSD) test.

Menarche	*P*-value	95%CI (LL - UL)
Early menarche versus middle menarche	0.069	-0.1 - 1.4
Early menarche versus late menarche	0.021	0.2 - 3.1
Middle menarche versus late menarche	0.162	-0.4 - 2.4

BMI - body mass index, CI - confidence interval, mean difference is significant at the 0.05 level, Mean BMI is significantly higher in women with early menarche as compared with late menarche (by LSD test).

The results suggested that a relationship exists between BMI and menarcheal age, which was further analyzed by applying Spearman rank correlation coefficient which indicated significant negative correlation between BMI and menarcheal age (p=0.0006).

Responses regarding awareness and source of knowledge for menarche were as follows: 77% of the students indicated that they were educated about menstruation before the onset of menarche either by their mother, elder sister, school teacher or any other source. Main source of information for menarche were the school teachers (55%) and mothers/sisters (35%), followed by media (internet, television, and so on) 6.6%.

Approximately 93% of the students stated that they were suffering from some menstrual irregularity such as dysmenorrhea, menorrhagia, oligomenorrhea, premenstrual syndrome or irregular menstruation. 67% of these students mentioned that they were aware that various menstrual problems can be associated with serious underlying health problems, but still only 25% of them ever visited a doctor to consult their gynecological issues. Although this data was collected from students of health sciences, but surprisingly only 26% mentioned that they have ever attended any seminar or awareness program related to obesity and menstrual problem.

Discussion. Mean age at menarche varies internationally and especially in less developed countries. This study indicates that the mean menarcheal age of our subjects was 13.1 years, which is in accordance with 2 national studies carried out in Makkah (12.9 years) and Riyadh (13.08 years),[12,13] but lower in comparison with countries such as Ethiopia (16.9 years), Senegal (16.1 years), Bangladesh (15.8 years), Congo (13.83 years), Ghana (13.98 years), and India (13.22 years). However our results show some similarity with the regional and western countries such as Kuwait (12.41 years), Egypt (12.44 years), UK (12.7 years), and the USA (12.8 years).[3,14]

Although the mean menarcheal age of the present study group is 13.1 years, the data of concern is a huge percentage of the study participants falling into the category of early menarche (35.6%), which could be associated with higher risks of poor health.[2] As mean menarcheal age have decreased significantly in the last 100 years, reducing almost 1.5-2 months per decade in USA.[14] The study of Dosoky & Amoudi,[15] which was conducted two decades back reported the mean menarcheal age of 15.1 years, versus 13.1 years in our current study. Moreover, the comparison between the menarcheal ages of mothers and daughters also highlighted that Saudi girls are attaining menarche earlier than their mothers (13.08 versus 13.67), further supporting our reflection on a downward secular trend in menarcheal age.[12]

One of the main objectives of this study was to find the relationship between menarcheal age and BMI. This study indicated a negative correlation between BMI and menarcheal age which is in accordance with few previous studies.[6-9] Some authors suggest that a higher weight gain in childhood is related to an earlier onset of puberty [6,7] whereas other studies show that increased BMI is actually a consequence of early menarche.[8,9]

Present study also shows that subjects in the late menarcheal group have a significantly lower BMI as compared to the early menarcheal ones. Our results are supported by the fact that the data from the developing countries indicate late menarche in their populations as compared to the developed ones.[3]

Although increasing BMI is a matter of concern in KSA. With regards to the relationship between increased BMI and menarcheal age, only 3 local studies are available until date. Out of these studies, findings of Elkhair et al[13] and Dosoky & Amoudi,[15] supported our results. But the data documented by Shaik et al[10] shows no correlation between increased BMI and early menarche, the authors themselves mentioned that these findings could be due to small sample size.

Study limitation. This study documents negative correlation between BMI and menarcheal age, due to the study limitations we were not able to identify that either increased BMI of the study subjects was a cause of early menarche, or early menarche caused by BMI to raise. Moreover, we were not able to control other confounding variables such as diet analysis, physical activity and genetics. Therefore, further retrospective, prospective, and follow up studies should be carried out for exploration of this fact, and its underlying pathophysiological mechanisms.

In conclusion, although the mean age of menarche in Saudi girls lies in the category of middle menarche (13.1 years) and is comparable to most of the international values, but alarmingly a huge percentage of the subjects

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fall in the group of early menarche (35.6%). We also identified a downward secular trend in menarcheal age in the young Saudi population similar to that seen in many western countries. We observed a negative correlation between BMI and menarcheal age, and therefore we conclude that increasing BMI may be a major factor responsible for the global decline in the menarcheal age. Therefore, it is recommended to enhance the awareness about obesity and its effects on reproductive and generalized health. This can be achieved by adding obesity related health awareness lectures and seminars as a mandatory component of curriculum of all health science students.

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