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ORIGINAL ARTICLE



The relationship between short stature and menstrual pattern in a large cohort of Iranian girls

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ABSTRACT

The aim of this study was to investigate the relationship between stature and menstrual pattern. Nine hundred and seventy six girls were selected from regions within two cities in north-eastern Iran in 2015. They were assessed with respect to: their stature and menstrual pattern, age of menstruation, severity of dysmenorrhoea, duration of their menstrual cycle and flow. 841 girls had experienced menarche. 10.5% had a short stature. There were significant differences in age, height, weight and body mass index between those who had experienced their first menstrual cycle and others ($p < .001$). There were weak and negative correlation between age of menarche and height percentiles ($r = -0.12$, $p < .001$). Premenstrual syndrome, duration of menstruation cycle and bleeding period did not differ between these two groups ($p > .05$). We found that dysmenorrhoea was significantly influenced by height. Although the mean age at menarche was statistically significant among different statures, the range was narrow (12.2–12.7). Further studies considering environmental factors, including socioeconomic status and nutrition concurrently, are also required.

IMPACT STATEMENT

- **What is already known on this subject?** Various menstrual characteristics, including age of menarche, severity of dysmenorrhoea and duration of menstrual period may be associated with height. But, there have been few studies on the relationship between short stature and its impact on health status and menstrual patterns in adolescents.
- **What do the results of this study add?** There were significant differences in age, height, weight and body mass index between adolescent girls who had experienced their first menstrual cycle, and others. There were weak, negative, significant correlations between age of menarche and height percentiles. Dysmenorrhoea was significantly influenced by height.
- **What are the implications of these findings for clinical practice and/or further research?** Life style modification and nutritional interventions that optimise the height of girls may resolve their menstrual problems and dysmenorrhoea.

KEYWORDS

Short stature;
menstrual pattern;
dysmenorrhoea; menarche

Introduction

Menstrual disorders among adolescent girls are common due to relative immaturity of the hypothalamic-pituitary-ovarian axis, however, the precise incidence is unknown. Menstrual problems can be symptoms of specific conditions like polycystic ovarian syndrome and endometriosis, which if

undiagnosed and untreated may have long-term sequelae in adult life (Emans et al. 1998).

Menarche is one index of female fertility (Mohamad et al. 2005). Onset of menarche is affected by many genetic and environmental factors including ethnicity, geographic location and body mass index (Adair 2001; Wronka and

Pawlińska-Chmara 2005; Lee et al. 2007). Age at menarche is also affected by many prenatal and postnatal factors including birth size (Adair 2001), rapid postnatal weight gain (Adair 2001; Ong et al. 2007) and stressful childhood experiences (Belsky et al. 2007). The age at menarche globally has fallen dramatically during recent decades, which may be linked to other health related problems such as metabolic syndrome, cardiovascular disease, increased risk of stroke, closure of epiphyseal plates or shorter adulthood height and breast cancer (Oh et al. 2012).

Height assessment is an important measure for the evaluation of growth and development of children and adolescents. If there are abnormalities in height, this may require further medical investigations to detect the probable disorders such as renal, endocrine or genetic disease (Marchini et al. 2016). Short stature is defined as height that is significantly below the average of the general population for that person's age and sex. It is statistically defined as standing height 2 or more standard deviations (SD) below the mean for sex and age (below the 5 percentile) (Marchini et al. 2016), or when evaluating shortness in relation to family background, more than 2 SD below the mid-parental height (Ranke 2007).

Various menstrual characteristics, including age of menarche (Hozoori et al. 2017), severity of dysmenorrhoea and duration of menstrual period may be associated with height. Recent changes in the age of menarche and adult height could be due to changes in nutritional, hygienic and health status (Ahmed et al. 2009; Atay et al. 2011).

There have been few studies on the relationship between short stature and its impact on health status and menstrual pattern of adolescents. In this study we specifically aimed to investigate the relationship between stature and menstrual pattern in young girls living in northeastern Iran, in 2015. Based on our findings, we would hope to be able to apply appropriate interventions in our target population's lifestyle (such as modifications on nutritional habits and if possible in their environments). In other word, the importance of this relation can help us to solve menstrual problems. For example, nutrition plays a crucial role in menstrual patterns indirectly by affecting weight, BMI and height (Onland-Moret et al. 2005). Therefore, if some nutritional changes are applied in the target population, their height and weight will improve in a way to resolve their dysmenorrhoea and menstrual problems. We may be able to identify the age of our target population at which to best prepare them mentally and physically to encounter the menstrual changes in a healthy way. For example, if menarche occurs in taller girls, we can consider taller teenagers as target population and begin their health and sex- related educations sooner (Kabir et al. 2006).

Material and methods

This study was conducted in 2015 in Mashhad and Sabzevar, two large cities located in north-eastern Iran. This study was part of major survey conducted in these cities. Some results of this survey have been published previously (Khayyat-zadeh

et al. 2018). Here, we surveyed 976 students. We randomly selected the city areas in these cities and assessed the schoolgirls in terms of stature (to find out the short stature ones) and menstrual pattern (history and severity). After obtaining written consent from the students' parents, we distributed a checklist consisting of questions about menstrual patterns in last two months, age of menstruation, severity of dysmenorrhoea, duration of cycle and flow. Students were asked to scale their pain (during menstruation) by 6 point Likert scales including 0 (without any pain), 1 (mild), 2 (moderate), 3 (severe), 4 (very severe) and a score of 5 (most severe).

To measure height the students were asked to remove their shoes and stand against a flat wall. The height was recorded in centimetre.

We divided the participants according to their *stature normalised for age* into eight percentile groups including: <5th, 5th–10th, 10th–25th, 25th–50th, 50th–75th, 75th–90th, 90th–95th and >95th. Short stature is statistically defined as standing height 2 or more SD below the mean for sex and age (below the 5 percentile).

The Ethics Committee of Mashhad University of Medical Sciences approved this research project (IR.MUMS.fm.REC.1395.12). Statistical analysis was done using SPSS software version 22. p value < .05 was considered as significant.

Results

The mean age and body mass index (SD) of students were 14.56(1.52) and 21.14(4.29) respectively.

Eight hundred and forty-one girls out of 976 had experienced their first menstrual cycle. Nineteen students did not adequately explain if they have experienced it or not. Among the girls who had had menarche, twelve provided incomplete data (misunderstanding about cycle duration and etc.). A Mann-Whitney test showed significant differences in age, height, weight and body mass index (BMI) between those who had experienced first menstrual cycle and others ($p < .001$) (Table 1).

We found that 98 students (10.5%) had short stature. Figure 1 shows the frequency of students according to their menarche experience in each height percentile (after removing missing data). As can be seen seventeen girls (14.8%) who had not started menarche, had short stature. Chi-square test indicated there was no significant difference between menstruation experiences in different height categories ($p = .42$).

The mean age at menarche in 829 girls who had experienced menarche and presented valid data was 12.56 ± 1.12 years. The mean duration of menstrual period and menstrual cycle were 6.77 ± 1.42 and 34.05 ± 7.68 days

Table 1. Data in mature and immature girls.

	Menarche status		p value
	Yes ($n = 841$)	No ($n = 116$)	
Age (y) ^a	14.76 ± 1.5	13.21 ± 0.92	<.001
Height (cm) ^a	158.27 ± 5.8	153.29 ± 7.22	<.001
Weight (Kg) ^a	54.02 ± 11.51	43.44 ± 11.4	<.001
BMI (Kg/m ²) ^a	21.52 ± 4.13	18.44 ± 4.34	<.001

^aAll variables presented as the Mean $\pm$ SD.

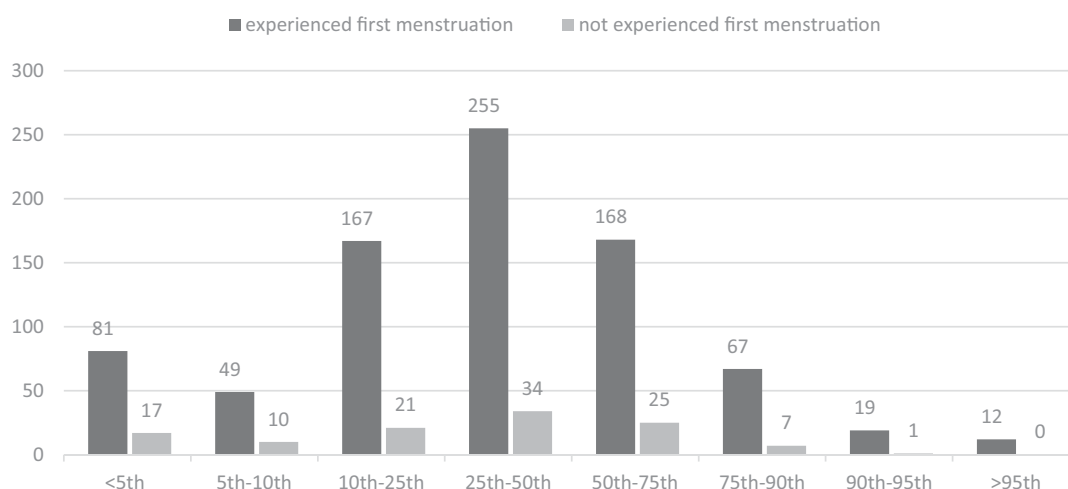


Figure 1. Number of girls in each centile for height with different menstrual status.

Table 2. Menstrual data according to students' stature.

	Height percentile		p value
	<5	>5	
Severity, N (%)			.005 ^a
Painless	5 (6.3)	48 (6.6)	
Mild	8 (10.1)	112 (15.4)	
Moderate	29 (36.7)	230 (31.6)	
Severe	15 (19)	166 (22.8)	
Very severe	8 (10.1)	113 (15.5)	
The worst	13 (16.5)	59 (8.1)	
Premenstrual syndrome (PMS), N (%)			.78 ^a
Yes	29 (47.5)	284 (45.7)	
No	32 (52.5)	337 (54.3)	
Duration of menstruation cycle, N (%)			.29 ^a
Short	2 (3)	10 (1.7)	
Normal	32 (48.5)	348 (57.9)	
Long	32 (48.5)	243 (40.4)	
Bleeding period, N (%)			.13 ^a
Short	0 (0)	15 (2.1)	
Normal	71 (92.2)	606 (84)	
Long	6 (7.8)	100 (13.9)	
Amount of menstrual flow, N (%)			.26 ^a
Little	0 (0)	22 (3.2)	
Moderate	6 (7.6)	50 (7.4)	
Heavy	73 (92.4)	607 (89.4)	
Age at menarche (mean±SD)	12.68 (1.27)	12.54 (1.1)	.18 ^b

^aChi-Square test.

^bMann-Whitney test.

The bold values shows the statistically significant values at the level of <.05.

respectively. By categorising the cycle duration into short (<21 days), normal (21–35 days) and long (>35 days), we found that 12(1.8%), 380(57%) and 275(41.2%) had short, normal and long menstrual cycle respectively.

15(1.9%), 677(84.8%) and 106(13.3%) students had short (<4 days), normal (4–7 days) and long (>7 days) menstrual days respectively.

The students described the severity of dysmenorrhoea painless (6.5%), mild (14.6%), moderate (32.2%), severe (22.7%), very severe (15.1%) and the worst (9%).

We evaluated the distribution of qualitative variables in two groups of short stature students and others. As seen in Table 2, severity of dysmenorrhoea was significantly different in these groups (0.005).

We categorised the menstrual flow into three groups: little, moderate and heavy. Little refers to using one sanitary napkin per day, while moderate and heavy refer to using 2–3

and 4 and more sanitary napkins per day (Table 2). More data on menstrual pattern is presented in Table 2.

We also investigated the relationship between body mass index with menstrual data. No significant differences were seen between BMI and categories of severity (0.4), premenstrual syndrome (0.35), amount of menstrual flow (0.14), duration of menstrual cycle (0.07) and bleeding (0.76) (Data not shown).

After dividing the group into eight height percentiles, we found that the mean age at menarche was significantly different among these groups (0.007) (Table 3). *Post hoc* tests could not determine where the difference was. A Spearman correlation test indicated weak and negative correlation between age of menarche and height percentiles ($r = -0.12$, $p < .001$), while there was no statistically significant correlation between age at menarche and height as a continuous variable ($r = 0.02$, $p = .42$).

Table 3. Mean age of menarche in different height percentiles.

Height percentile (N)	Mean age (y) at menarche (SD)	<i>p</i> value (Kruskal–Wallis test)
<5th (81)	12.68 (1.27)	.007
5th–10th (48)	12.75 (0.97)	
10th–25th (165)	12.64 (1.14)	
25th–50th (251)	12.61 (1.12)	
50th–75th (165)	12.33 (0.98)	
75th–90th (66)	12.58 (1.13)	
90th–95th (19)	12.21 (1.27)	
>95th (12)	12.33 (1.67)	

The bold values shows the statistically significant values at the level of $<.05$.

Discussion

We found a significant difference in age, height, weight and BMI of students who had or had not experienced a menstrual period. The mean age of the first menstrual period was lower among taller students.

Some studies have reported that the mean age at menarche has fallen in recent years and this appears to have been accompanied by socioeconomic changes (Graham et al. 1999; de Muinck Keizer-Schrama and Mul 2001; Onland-Moret et al. 2005). Age at menarche decreased from 16.8 to 12.7 in Korea and from 13.8 to 12.9 in Poland (Hwang et al. 2003; Gomula and Koziel 2017). The mean age of menarche in our study was 12.56 ± 1.12 years that is similar to other studies in other parts of Iran in last decade (Farahmand et al. 2011; Hozoori et al. 2017; Khoshnevisasl et al. 2017). Age at menarche is influenced by various factors in which genetic factors have the greatest impact (Onland-Moret et al. 2005). It may be important to predict early menarche because it is associated with an increased risk of metabolic syndrome, cardiovascular disease and breast cancer (Farahmand et al. 2011; Hozoori et al. 2017).

Many studies confirmed that there is a relationship between BMI and menarche age, as increase in body fat to reach critical weight is necessary for menarche to occur, but some studies found no correlation between BMI and menarche age (Demerath et al. 2004). As this study was conducted on adolescent girls with the same age range, we could not compare BMI and age at menarche. We found girls who had experienced their first menstrual cycle, had higher BMI. It has been reported that higher BMI is associated with an earlier menarche possibly because of higher leptin secreted from body fat, conversely, early menarche increases the body fat (Oh et al. 2012). Conversely, some have argued that the early menarche is responsible for the higher BMI in the future because maturation increases the body fat mass accumulation (Oh et al. 2012).

In our study similar to a study conducted in nine European countries, the mean age of the first menstrual period was lower among taller students (Onland-Moret et al. 2005). It could be against the common belief which is that height of the girls experienced menarche at earlier ages are likely to be shorter due to the oestrogen effects on epiphyseal closure (Onland-Moret et al. 2005; Pejhan et al. 2011). Although the mean height of the girls who had menstruated were taller in our study, we do not know what their final adulthood height would be, because this study was cross-

sectional, so it could not address menarche age as the predictor of final height.

In contrast to our results, in other parts of Iran it has been reported that an increase in height is associated with a delay in the age at menarche (Farahmand et al. 2011). In addition, in our study the frequency of girls who experienced menarche increased with height percentiles. It was reported that every year delay in the start of menarche is associated with an increase of approximately 0.35 cm in height (Onland-Moret et al. 2005). These inconsistent results may be due to the other environmental factors such as socioeconomic status, nutrition and genetics (Tanner et al. 1975; Onland-Moret et al. 2005). For example, some studies have shown that lack of access to nutritious food leads to delay in the onset of the menarche (Hozoori et al. 2017).

Moreover, the severity of dysmenorrhoea was significantly different between students with short stature and others. In different grades of severe pain (severe, very severe, the worst), the answers were different among two groups: In the short stature group, 13 out of 36 (36%) reported the worst degree, while this per cent is about 17% in other groups. However, there are few reports on the association of dysmenorrhoea and height. In contrast to our results, a study in Sweden reported that height does not affect the severity of the dysmenorrhoea (Sundell et al. 1990). Also, there is some evidence that *the lower the age at menarche, the greater the dysmenorrhoea*, for example, girls with the mean age of 12.3 ± 1 years had the menarche pain of 4.5 ± 3 mm (Tavallaee et al. 2011; De Sanctis et al. 2015; Hozoori et al. 2017). It seems that the severity of dysmenorrhoea is mostly influenced by various factors including early menarche, BMI, smoking, duration of menstrual flow and nutrition other than height (Sundell et al. 1990). Also, keep in mind that there are other factors we did not consider in our study which may affect the severity of dysmenorrhoea such as depression, anxiety, monthly income of the family and the history of dysmenorrhoea in students' mothers (Hailemeskel et al. 2016).

In addition to dysmenorrhoea, menstrual period seems to be the second important factor which needs to be considered, as more than 15% of the students had long bleeding episodes. Also, about 90% of students reported heavy menstrual bleeding. These items may lead to iron deficiency anaemia, physical and psychological incapacitation which can easily be prevented using prophylactic Iron (Barr et al. 1998).

Our study has some limitations. First, we did not consider environmental factors such as socioeconomic status or even nutritional habits that play important roles in the menstrual patterns. Second, because some variables such as age of first menstrual bleeding and its severity or duration were collected based on subjective, retrospective reporting, these measures may be prone to error. Third, the height at the age of menarche was not documented because this data is more likely to be reported mistakenly by students and incorrect information about height may affect our results about the main variable of this study, *short stature*. Conversely, a strong point of our study is its large number of participants, which can be a good representative of our teenage female population.

Conclusion

Height, weight, age and BMI affect menarche. Dysmenorrhoea as one of the most common menstrual disorders was significantly influenced by height, but there is no strong relation between age at menarche and height. More studies considering other factors influencing menstrual pattern and stature (e.g. nutrition, ethnicity, etc.) should be conducted. Various lifestyle adjustments including nutritional improvements (avoid excessive carbohydrates, use more fibres and proteins), in addition to health educations which provide the importance of doing physical exercises as a part of daily routine, should be considered to achieve the ideal height, body weight and BMI in girls before they experience menarche.

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Disclosure statement

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