

# Decline in menarcheal age among Saudi girls

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## ABSTRACT

**الأهداف:** لأجل تقدير سن البلوغ، وتحديد احتمال نزول الحيض مبكراً بين النساء السعوديات.

**الطريقة:** أُجريت دراسة مستقبلية مستقبيلة مستقبيلة بين طالبات مدارس البنات شملت الصغيرات اللاتي يتمتعن بصحة جيدة والمراهقات قبل سن البلوغ من شهر سبتمبر 2006 إلى يوليو 2012 الرياض، المملكة العربية السعودية. تم دعوة الطالبات المشاركات في الدراسة من خلفيات اجتماعية ومستويات اقتصادية متباينة. وعوّلت الدراسة على رصد وتسجيل: مراحل البلوغ، الطول، الوزن، كتلة الجسم، معرفة العوامل الاجتماعية والاقتصادية بما في ذلك المستوى التعليمي للوالدين. وتضمنت أيضاً مقارنة سن البلوغ لدى الفتيات مع أعمار أمهاتهن عند المرحلة نفسها.

**النتائج:** شملت عيّنة الدراسة 265 فتاة وأماً، وأوضحت النتائج أن متوسط العمر لمرحلة البلوغ عند الفتيات كان  $13.08 \pm 1.1$  سنة، وكان توزيعهن حسب الفئات العمرية  $10 \leq 11-14$ ،  $15 \leq$  كالتالي 4 (1.5%)، 239 (90.2%)، و22 (8.3%) فتاة. كما أن قياسات الجسم، مستوى تعليم الأم، ودخل العائلة المادي لم تكن عوامل ذات دلالة إحصائية مرتبطة بمرحلة البلوغ. وبلغ متوسط البلوغ لدى الأمهات  $13.67 \pm 1.4$  سنة. كما أن توزيعهن حسب فئاتهن العمرية  $10 \leq 11-14$ ،  $15 \leq$  كان كالتالي 7 (2.6%)، 172 (64.9%)، 86 (32.5%). الفتيات اللواتي وصلن إلى مرحلة البلوغ في مرحلة عمرية مبكرة مقارنة بأمهاتهن ( $p < 0.0001$ ). وقد لاحظنا نزول حيض مبكر في بدايات سن البلوغ (اختبار كوزيك للتوجه = 0.049).

**الخاتمة:** الفتيات السعوديات الآن يدخلن مرحلة البلوغ في عمر مبكر عما كانت عليه أعمار أمهاتهن؛ وقد لوحظ نزول دم الحيض خلال جيلين منهن.

**Objectives:** To estimate age at menarche and to assess trends in menarcheal age among Saudi women.

**Methods:** A prospective longitudinal study was conducted among healthy prepubertal female school children and adolescents from September 2006 to July 2012 in Riyadh, Kingdom of Saudi Arabia. Study participants were invited from diverse socioeconomic backgrounds. Tanner stage, height, weight, body mass index, and socioeconomic parameters including parent's level of education were collected. Age at menarche was compared with maternal age at menarche.

**Results:** The study included 265 girls and mothers. Mean  $\pm$  standard deviation (SD) age at menarche for girls was  $13.08 \pm 1.1$  years, and their distribution category across the  $\leq 10$  years was 4 (1.5%), 11-14 years was 239 (90.2%), and  $\geq 15$  years was 22 (8.3%) girls. Anthropometric measurements, mother's level of education, and family income were not statistically significant determining factors associated with age at menarche. Mean  $\pm$  SD age at menarche for mothers was  $13.67 \pm 1.4$  years, and their distribution category across the  $\leq 10$  years was 7 (2.6%), 11-14 years was 172 (64.9%), and  $\geq 15$  years was 86 (32.5%). Girls attained menarche at younger age compared with their mothers ( $p < 0.0001$ ). A downward secular trend in age of menarche was observed (Cuzick test for trend = 0.049).

**Conclusion:** Saudi girls attain menarcheal age earlier than their mothers, reflecting a downward secular trend in menarcheal age.

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Menarche is a unique life event for each female; as it marks transition from childhood into adulthood with all known biological and psychological consequences.<sup>1</sup> More recently, the timing of puberty gained much attention owing to the increased recognition of the association between menarche and breast cancer and cardiovascular diseases in adulthood.<sup>2,3</sup> Onset of menarche is affected by many genetic and environmental factors including ethnicity, geographic location, and body mass index.<sup>4-7</sup> Age at menarche is also affected by many prenatal and postnatal factors including birth size,<sup>7</sup> rapid postnatal weight gain,<sup>7,8</sup> and stressful childhood experiences.<sup>9,10</sup> Since the middle of the last century, age at menarche was declining at an estimated rate of 3 to 4 months per decade.<sup>1</sup> This trend might have slowed, or even stopped in some European countries, although it is still ongoing in Asia and the United States.<sup>1</sup> The status of this trend among Saudi girls is not known. In 1995, mean age at menarche was found to be 15.1 years for girls at the western part of the Kingdom of Saudi Arabia (KSA).<sup>11</sup> No data exists on age at menarche among Saudi girls since then. In this study, we aim to estimate the age at menarche for Saudi girls in the central part of KSA. Factors affecting onset of menarche was determined together with evaluation for a possible secular trend by comparing age at menarche in these girls with the age at menarche of their mothers.

**Methods.** *Study design.* This is a prospective follow-up study carried out from September 2006 to July 2012 of girls who did not attain menarche in a previous study conducted to assess pubertal characteristics among school girls in Riyadh, KSA.<sup>12</sup> The previous study included 725 students, between the age of 6 and 16, selected based on cluster sampling technique. Of these, only 269 girls attained menarche at the time the present study was conducted; and were therefore recruited into this study. Four girls were excluded as their mothers could not recall the time of their first menstrual period. Schools were selected from high, as well as low social class from the 4 regions of Riyadh City, using information from the Ministry of Planning and the Ministry of Education to construct the sample. Those who failed to recall the time of menarche were excluded from the study. The study's protocol was approved by the Research and Ethics Committee at King Abdulaziz Medical City, Riyadh, KSA, and informed consent was obtained. The study was performed according to the principles of Helsinki Declaration.

*Data collection.* Data were collected by female pediatric endocrinologists and trained pediatric endocrinology fellows. Baseline data on parents' education, work, and monthly income, including child's date of birth and medical history were collected using a structured questionnaire. A systematic data collection protocol was followed to collect data on the following variables:

*Growth parameters.* Height was measured using a wall-mounted stadiometer and recorded to the nearest 0.1 cm. Weight was measured with a beam-balance scale to the nearest 0.1 kg. Body Mass Index (BMI) was calculated according to the following formula: weight (kg) divided by height squared (meters).

*Menarche age.* Menarche age was recorded as recalled by the participant to the nearest year. Mothers were interviewed by phone separately away from their daughters.

*Parent's education.* The level of education for both parents was recorded in the questionnaire and categorized into 7 categories including: primary school, intermediate school, high school, university, higher education, professional, and so forth.

*Parent's work.* The job of both parents was recorded in the questionnaire, categorized into 6 categories: governmental, nongovernmental, business, retired, unemployed, and others.

*Family income.* The family income was recorded in Saudi Riyals and categorized into 7 categories from less than 3000 to more than 20,000 Riyals. Two more categories were added to include those who did not specify, and those who refused to answer the question regarding their income.

*Statistical analysis.* Data were summarized as proportions or medians (interquartile range). Age at menarche was categorized as  $\leq 10$ , 11-14, and  $\geq 15$ . An  $\chi^2$  or Fisher exact test was used to compare categorical data and Kruskal-Wallis test was used for continuous data. Cuzick test for trend was used to compare age at menarche for girls and mother. A logistic regression analysis was conducted to identify variables (all mothers and girls characteristics) associated with age at menarche. All tests were 2-sided and  $p < 0.05$  was considered significant. The Statistical Package for Social Sciences version 20 (IBM Corp., Chicago, IL, USA) was used to analyze data.

**Results.** Two-hundred and sixty-five girls and their corresponding mothers were included in the study. The characteristics of these participants are summarized in Table 1. Mean  $\pm$  standard deviation (SD) age at menarche for girls was  $13.08 \pm 1.1$  years, and their distribution category across the  $\leq 10$  years was 4

(1.5%), 11-14 years was 239 (90.2%), and  $\geq 15$  years was 22 (8.3%) girls. None of the socio-demographic and anthropometric characteristics of the girls or their mothers were significantly associated with age at menarche. Mean  $\pm$  SD age at menarche for mothers was  $13.67 \pm 1.4$  years, and their distribution category across the  $\leq 10$  years was 7 (2.6%), 11-14 years was 172 (64.9%), and  $\geq 15$  years was 86 (32.5%). Mean age at menarche for mothers and girls was statistically different (t-test  $p < 0.0001$ ). In addition, the trend across the 3 categories of age at menarche for girls was also statistically significantly different from their mothers' age at menarche (Cuzick test for trend = 0.049) **Figure 1**. In the logistic regression analysis conducted to identify

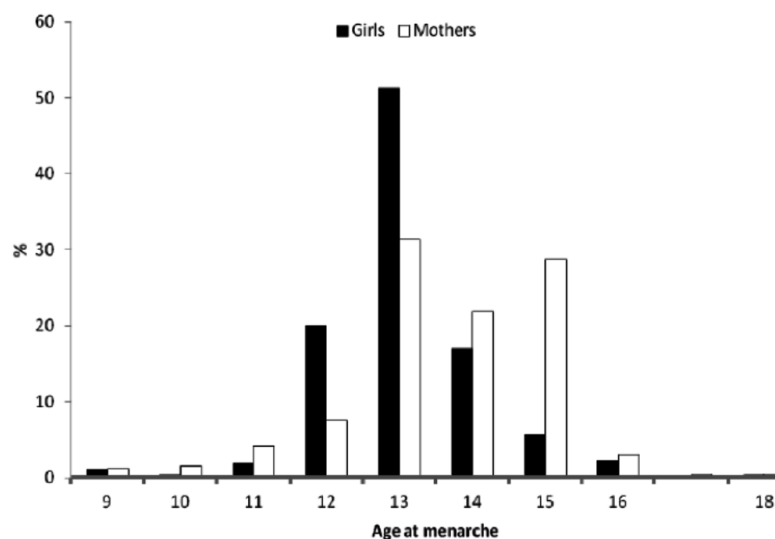
mothers and girls characteristics associated with age at menarche, no significant association was found.

**Discussion.** This study is among the studies carried out to estimate age at menarche for Saudi girls in Riyadh, KSA and to explore its association with growth parameters, mother's income, and level of education, and to compare age at menarche for girls with that of their mothers. The mean age at menarche for girls in our study was estimated at 13.08 years; 1.5% had early menarche ( $< 10$  years), and 8.3% had late menarche ( $\geq 15$  years). No statistically significant variations were found between menarcheal age groups across growth parameters, mother income and mother level

**Table 1** - Characteristics of 265 girls and mothers by age at menarche in Riyadh, Kingdom of Saudi Arabia.

Characteristics	Girls age at menarche in years			P-value*
	$\leq 10$	11-14	$\geq 15$	
Number (%) of girls	4 (1.5)	239 (90.2)	22 (8.3)	
Height (cm)	159 (153-162)	157 (152.5-161)	160 (157-165.5)	0.05
Weight (kg)	51 (40.5-67.5)	52 (47-60.3)	49 (44.3-64.7)	0.48
BMI (%)	20.4 (16.3-26.7)	20.8 (19.3-24.2)	18.5 (17.2-24.4)	0.08
<i>Mother's education level</i>				0.098
None	0	33 (13.8)	3 (13.6)	
Primary	2 (50)	83 (34.7)	12 (54.4)	
Secondary-high	1 (25)	72 (30.1)	1 (4.5)	
Tertiary	1 (25)	51 (21.3)	6 (27.3)	
<i>Family income level<sup>†</sup></i>				0.75
Low	0	17 (7.1)	2 (9.1)	
High	4 (100)	222 (92.9)	20 (90.9)	

\*P-value:  $\chi^2$  (or Fisher exact) test for categorical data and Kruskal-Wallis test for continuous data. <sup>†</sup>Mother's income level: low income  $< 3000$  Riyals per month. BMI - body mass index



**Figure 1** - An image showing Cuzick test for trend = 0.049 comparing age at menarche of 265 girls and their mothers in Riyadh, Kingdom of Saudi Arabia.

of education in this study. When compared with their mothers, girls in our study had significantly lower age at menarche. The estimated age at menarche for Saudi girls in our study is comparable to age at menarche reported lately in the literature at both regional<sup>13,14</sup> and Western countries.<sup>15-17</sup> Reported age at menarche was 12.41 years in Kuwait,<sup>13</sup> 12.44 years in Egypt,<sup>14</sup> 12.72 years in Canada,<sup>15</sup> 12.84 years in Argentina,<sup>18</sup> 12.34 years in US,<sup>16</sup> and 12.5 years in UK.<sup>17</sup> Reported age at menarche at low income countries seems to be higher; estimated at 16.9 years in Ethiopia,<sup>19</sup> 13.22 years in India,<sup>20</sup> and 15.26 years in Nigeria.<sup>21</sup> However, comparing sexual maturation age between different countries might not be appropriate owing to the underlying socio-demographic variations.<sup>22,23</sup> In contrast to what has been reported previously, no significant effect of growth parameters on the age at menarche was found in our study. Body mass index, as shown by many previous studies<sup>13,24-26</sup> has an inverse relationship with age at menarche. The exact mechanism of this relationship is not yet clear, but possible explanations may be that increased BMI during prepubertal period increases the availability of estrogen,<sup>27</sup> or, alternatively, that increased estrogen during early menarche leads to increased deposition of the fat in the peripheral adipose tissue.<sup>28</sup>

In our study, no significant effect of social class on the age at menarche has been demonstrated, although the effect of socio-demographic factors have been well demonstrated in previously reported studies at both national<sup>11</sup> and international<sup>1,15,29</sup> levels. Girls from higher socio-demographic areas were found to have earlier menarche in most of the previously reported studies. This may be explained by improved nutrition status in this group which favors earlier menarche. Al-Sahab et al,<sup>15</sup> found a different result among Canadian girls, where girls from lower socio-demographic classes were found to have earlier menarche. This has maybe explained by the higher prevalence of obesity among girls from lower socio-demographic areas in Canada<sup>30,31</sup> and lower stress levels among girls from higher socio-demographic areas leading to delayed menarcheal age.

When compared with their mothers, girls in our study attained menarche at a statistically significant lower age. The same applies when age at menarche for girls in our study is compared with that of girls from Jeddah in 1995, which was found to be 15.1 years.<sup>11</sup> This declining menarcheal age was reported in KSA before,<sup>32</sup> when a difference of 0.4 years in menarcheal age was observed when age at menarche for 2 generations of women was compared in a cancer survey. This might suggest an ongoing secular trend of

a declining menarcheal age among Saudi girls. When age at menarche for girls in Kuwait from 2 reports more than a decade apart was compared, the same decline was observed; from 12.7 years in 2000<sup>33</sup> to 12.4 years in 2013.<sup>13</sup> A similar decline in age at menarche was reported in Ireland<sup>34</sup> from 13.52 years in 1983 to 12.53 years in 2006, in US<sup>16</sup> from 12.53 years in 1988/1994 to 12.34 years in 1999/2002 and in Japan<sup>35</sup> from 12.34 years for women born 1960 to 12.2 years for women born 1980. However, this trend might have slowed, or even stopped in some European countries.<sup>1</sup>

We acknowledge the limitations of this study. The study was conducted in Riyadh region only. Therefore, our findings might not exclusively represent a vast country with different socio-demographic backgrounds like KSA, and as such, is difficult to extrapolate to the whole regions of the Kingdom. Age at menarche recorded in our study might have been subjected to recall bias, and hence represents an estimate rather than an accurate age at menarche. However, the findings of this study have important public health implications. Girls with early menarche are at increased risk of breast cancer,<sup>2</sup> and many psychosocial problems including: depression; eating disorders; poor academic achievements; and substance abuse.<sup>36</sup> Based on our study results of declining age at menarche, Saudi girls may be at increased risk of these consequences in the future. Hence, exploration for any possible cause or risk factor that leads to earlier menarche is mandatory for appropriate preventive measures planning.

In conclusion, age at menarche among Saudi girls in Riyadh is comparable to age at menarche regionally and internationally with a secular trend toward a declining age at menarche. Our data suggest that growth parameters, mother's education, and mother's income has no effect on age at menarche. However, more studies on menarcheal age are needed to determine age at menarche and associated factors at other parts of KSA.

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## References

1. Ong KK, Ahmed ML, Dunger DB. Lessons from large population studies on timing and tempo of puberty (secular trends and relation to body size): the European trend. *Mol Cell Endocrinol* 2006; 254-255: 8-12.
2. Golub MS, Collman GW, Foster PM, Kimmel CA, Rajpert-De Meyts E, Reiter EO, et al. Public health implications of altered puberty timing. *Pediatrics* 2008; 121 Suppl 3: S218-S230.

3. Sorensen K, Mouritsen A, Aksglaede L, Hagen CP, Mogensen SS, Juul A. Recent secular trends in pubertal timing: implications for evaluation and diagnosis of precocious puberty. *Horm Res Paediatr* 2012; 77: 137-145.
4. Chumlea WC, Schubert CM, Roche AF, Kulin HE, Lee PA, Himes JH, et al. Age at menarche and racial comparisons in US girls. *Pediatrics* 2003; 111: 110-113.
5. Wronka I, Pawlinska-Chmara R. Menarcheal age and socio-economic factors in Poland. *Ann Hum Biol* 2005; 32: 630-638.
6. Lee JM, Appugliese D, Kaciroti N, Corwyn RF, Bradley RH, Lumeng JC. Weight status in young girls and the onset of puberty. *Pediatrics* 2007; 119: e624-e630.
7. Adair LS. Size at birth predicts age at menarche. *Pediatrics* 2001; 107: E59.
8. Ong KK, Northstone K, Wells JC, Rubin C, Ness AR, Golding J, et al. Earlier mother's age at menarche predicts rapid infancy growth and childhood obesity. *PLoS Med* 2007; 4: e132.
9. Belsky J, Steinberg LD, Houts RM, Friedman SL, DeHart G, Cauffman E, et al. Family rearing antecedents of pubertal timing. *Child Dev* 2007; 78: 1302-1321.
10. Kim K, Smith PK. Childhood stress, behavioural symptoms and mother-daughter pubertal development. *J Adolesc* 1998; 21: 231-240.
11. El Dosoky M, Al Amoudi F. Menarcheal age of school girls in the city of Jeddah, Saudi Arabia. *J Obstet Gynaecol* 1997; 17: 195-198.
12. Felimban N, Jawdat D, Al-Twaijri Y, Al-Mutair A, Tamimi W, Shoukri M, et al. Pubertal characteristics among schoolgirls in Riyadh, Saudi Arabia. *Eur J Pediatr* 2013; 172: 971-975.
13. Al-Awadhi N, Al-Kandari N, Al-Hasan T, Almurjan D, Ali S, Al-Taiar A. Age at menarche and its relationship to body mass index among adolescent girls in Kuwait. *BMC Public Health* 2013; 13: 29.
14. Ghaly I, Hussein FH, Abdelghaffar S, Anwar G, Seirvogel RM. Optimal age of sexual maturation in Egyptian children. *East Mediterr Health J* 2008; 14: 1391-1399.
15. Al-Sahab B, Ardern CI, Hamadeh MJ, Tamim H. Age at menarche in Canada: results from the National Longitudinal Survey of Children & Youth. *BMC Public Health* 2010; 10: 736.
16. Anderson SE, Must A. Interpreting the continued decline in the average age at menarche: results from two nationally representative surveys of U.S. girls studied 10 years apart. *J Pediatr* 2005; 147: 753-760.
17. Joinson C, Heron J, Lewis G, Croudace T, Araya R. Timing of menarche and depressive symptoms in adolescent girls from a UK cohort. *Br J Psychiatry* 2011; 198: 17-23, sup 1-2.
18. Orden AB, Vericat A, Apezteguia MC. Age at menarche in urban Argentinian girls: association with biological and socioeconomic factors. *Anthropol Anz* 2011; 68: 309-322.
19. Zegeye DT, Megabiaw B, Mulu A. Age at menarche and the menstrual pattern of secondary school adolescents in northwest Ethiopia. *BMC Womens Health* 2009; 9: 29.
20. Deb R. Age at menarche in adolescent Khasi girls, Meghalaya. *Indian Pediatr* 2011; 48: 69.
21. Tunau KA, Adamu AN, Hassan MA, Ahmed Y, Ekele BA. Age at menarche among school girls in Sokoto, Northern Nigeria. *Ann Afr Med* 2012; 11: 103-107.
22. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. Relation of age at menarche to race, time period, and anthropometric dimensions: the Bogalusa Heart Study. *Pediatrics* 2002; 110: e43.
23. Reagan PB, Salsberry PJ, Fang MZ, Gardner WP, Pajer K. African-American/white differences in the age of menarche: accounting for the difference. *Soc Sci Med* 2012; 75: 1263-1270.
24. Rigon F, Bianchin L, Bernasconi S, Bona G, Bozzola M, Buzi F, et al. Update on age at menarche in Italy: toward the leveling off of the secular trend. *J Adolesc Health* 2010; 46: 238-244.
25. Kaplowitz PB, Slora EJ, Wasserman RC, Pedlow SE, Herman-Giddens ME. Earlier onset of puberty in girls: relation to increased body mass index and race. *Pediatrics* 2001; 108: 347-353.
26. Wronka I. Association between BMI and age at menarche in girls from different socio-economic groups. *Anthropol Anz* 2010; 68: 43-52.
27. Cheng G, Buyken AE, Shi L, Karaolis-Danckert N, Kroke A, Wudy SA, et al. Beyond overweight: nutrition as an important lifestyle factor influencing timing of puberty. *Nutr Rev* 2012; 70: 133-152.
28. Gaudineau A, Ehlinger V, Vayssiere C, Jouret B, Arnaud C, Godeau E. Factors associated with early menarche: results from the French Health Behaviour in School-aged Children (HBSC) study. *BMC Public Health* 2010; 10: 175.
29. Thomas F, Renaud F, Benefice E, de Meeus T, Guegan JF. International variability of ages at menarche and menopause: patterns and main determinants. *Hum Biol* 2001; 73: 271-290.
30. Langlois K, Garriguet D, Findlay L. Diet composition and obesity among Canadian adults. *Health Rep* 2009; 20: 11-20.
31. Shields M. Overweight and obesity among children and youth. *Health Rep* 2006; 17: 27-42.
32. Jabbar FA, Wong SS. Age at menarche and reproductive pattern among Saudi women. *J R Soc Health* 1988; 108: 94-96.
33. Jackson RT, Al-Mousa Z. Iron deficiency is a more important cause of anemia than hemoglobinopathies in Kuwaiti adolescent girls. *J Nutr* 2000; 130: 1212-1216.
34. O'Connell A, Gavin A, Kelly C, Molcho M, Nic Gabhainn S. The mean age at menarche of Irish girls in 2006. *Ir Med J* 2009; 102: 76-79.
35. Hosokawa M, Imazeki S, Mizunuma H, Kubota T, Hayashi K. Secular trends in age at menarche and time to establish regular menstrual cycling in Japanese women born between 1930 and 1985. *BMC Womens Health* 2012; 12: 19.
36. Mendle J, Turkheimer E, Emery RE. Detrimental Psychological Outcomes Associated with Early Pubertal Timing in Adolescent Girls. *Dev Rev* 2007; 27: 151-171.