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Is age of menarche among school girls related to academic performance?

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Abstract:
Background: There is strong evidence that the mean age of menarche has declined over the last few decades in developed and developing countries. This is of a major concern because of its enormous public health implications. This study aimed to estimate the age of menarche in Kuwait and investigate the association between menarcheal age and academic performance among high school girls in Kuwait.
Methods: A cross-sectional study was conducted on randomly selected female high school students from private and public high schools in all governorates in Kuwait. Data on the age of menarche were collected by self-administered questionnaire from the students, while data on academic performance were extracted from the students' academic records.
Results: Of the 907 students we selected, 800 (88.2%) responded. The mean age of menarche was 12.33 [95% confidence interval (CI) 12.18–12.49] years. There was no evidence for significant association between age of menarche and students' academic performance before or after adjusting for potential confounders.
Conclusion: The calculated age of menarche among contemporary girls in Kuwait is similar to that of the girls in industrialized countries. Early menarcheal age is unlikely to lead to adverse behavior that may affect academic performance in our setting.

Keywords: academic performance, age of menarche, Kuwait, Middle East, sexual maturity

DOI: 10.1515/ijamh-2016-0164

Received: December 31, 2016; **Accepted:** February 21, 2017

Introduction

There is strong evidence that the mean age of menarche has declined over the last few decades in developed [1], [2], [3], [4] and developing [5], [6], [7], [8], [9] countries. This is of a major concern because of its enormous public health implications. The early onset of menarche has been linked to many disease conditions such as metabolic syndrome [10], obesity [11], type 2 diabetes [12], ischemic heart disease and stroke [13], depression [14], eating disorders [15], breast cancer [16], ovarian cancer [17], endometrial cancer [18] and overall mortality [19].

Furthermore, it has been suggested that earlier age of menarche may create a gap between biological and social maturity, with individuals becoming biologically adult at earlier ages but remaining minors socially and legally [20]. Increasing the gap between biological and social maturity may lead to difficulties in psychosocial adjustment among individuals with lower age of menarche [20], [21], [22]. Indeed, a number of studies have linked lower age of menarche to a range of psychosocial difficulties, including mental health disorders [23], [24], [25], [26], [27], lower academic achievement [28], substance use and abuse [26], [29] and precocious sexual activity [26], [30].

Sexual maturity is a sensitive issue in the Arab states of the Gulf region and the broader Middle East, and has rarely been researched. Kuwait is one of these states with a population of four million, two-thirds of whom are non-Kuwaiti. The fertility rate is around 3.9 for Kuwaiti women; and Kuwaiti children under 15 years represent 37.5% of the Kuwaiti population. Previously, we have described the age of menarche among school girls in public schools in Kuwait [31]. It was thought that the estimated age of menarche would be different if girls from private schools were included. In this study, we calculated the age of menarche among school girls in public and private schools and investigated whether the age of menarche is related to academic performance.

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Methods

There are 107,510 students enrolled in 249 private and public high schools in Kuwait, of whom 55,601(51.7%) are females. School enrollment is extremely high in Kuwait for both males and females. This study was approved by the Research Ethics Committee at Health Science Centre, Kuwait University and the Research Ethics Committee at The Ministry of Health, Kuwait.

This is a cross-sectional study on randomly selected females attending public and private high schools in all governorates of Kuwait that would typically include females aged between 15 and 18 years. By this age, students have received their basic education on reproductive health according to the schools' curricula in Kuwait.

A multistage random cluster sampling was used to select a representative sample of female students at private and public high schools in all governorates of Kuwait. The number of students required in each governorate was based on the relative size of that governorate as judged by the number of female students in high schools. Because approximately 25% of students in high school are in private schools, 25% of the sample was selected from private schools. Separate lists of all private and public high schools in all governorates of Kuwait were obtained from the Ministry of Education. These were used to select one private and one public school in each governorate using probability proportional to size sampling technique.

Data on menarcheal age were collected using a self-administered questionnaire rather than a personal interview because the cultural norms in the Middle East may prevent the discussion of this topic which is deemed to be sensitive [32]. Particular attention was given to phrasing the questions regarding the age of menarche. Three consecutive questions were prepared, including age of the girl at menarche, date on which menarche occurred and, finally, the school grade at which menarche has occured. In order to encourage more candid response, participants were asked to complete the questionnaire in confidence while their peers were unable to see their answers. Data on school performance (students' grade in the school) were extracted from the school records. This included grades of mathematics, science, Arabic literature and total grades. Science grades were omitted because not all students in the high school study this subject.

Data on potential confounders were collected from mothers and the participating students. Data from the mothers were collected using a telephone interview and included socio-economic factors (parents' education, income, type of housing) and birth order. Weight of the participants was measured using digital weight scale (Beurer GS 19 digital scale, Ulm, Germany) to the nearest 0.1 kg after removing heavy clothes and shoes. The scales was calibrated regularly with a set of weights of known value (2 kg, 5 kg, and 10 kg) and always after moving the scales to a new location. Height was measured using a stadiometer (Seca 217 height rod, Hamburg, Germany) to the nearest 0.1 cm. Measurement was conducted either in the school theater or the school clinic. Data on physical activities and dietary intake were collected using a series of questions that have been used previously among Arab adolescents. The questionnaire of both mothers and their daughters was translated into Arabic and then independently translated back to English. The Arabic version of the questionnaire was pilot-tested on 30 mothers and daughters.

Data analysis was conducted using Stata 12 (Stata Corporation, College Station, TX, USA). Body mass index (BMI)-for-age was calculated by means of weight, height, age and gender, as determined by the World Health Organization (WHO) growth charts (WHO, Child growth Standard). Among participants who reported the exact date at which menarche occurred, age of menarche was calculated for each girl by subtracting the date of birth from the date at which menarche occurred, then the mean was calculated after checking the data for normality. Similarly, we calculated the mean age of menarche for girls who reported their age of menarche (but did not report the exact date). Among students who did only report the school grade at which they reached menarche and/or the year at which they reached menarche, age of menarche of each girls was assumed to be the average age of menarche for students in that school grade as calculated from the group of students who provided the date at which menarche occurred. In order to investigate the association between age of menarche and academic performance, we used unconditional logistic regression. We categorized the students' grades in mathematics, Arabic literature and total grade using the median of each study subject. We did not use multiple linear regression in this analysis because the outcome (students' grades) was skewed and the transformation of the outcome would make the interpretation of the results extremely difficult. Confounders were categorized into different groups and each group was sequentially introduced to the model. Several models were presented showing the impact of adjusting for different confounding groups. Age of menarche was fitted as a continuous variable in this analysis but the analysis was repeated while categorizing age of menarche into tertiles. The results of the latter analysis were reported in the text. Because of the complex structure of these survey data, we used the survey method, which gives more precise estimates of the standard error. This was conducted throughout the analysis including regression analysis.

Results

Of the 907 students selected from all governorates, 800 (88.2%) responded and participated in the study. Also there were 25 students who reported no data on their menarche, and these were excluded from the analysis. Thus the analysis below comprises 775 participants. Table 1 shows the socio-demographic characteristics of the study participants. The mean (SD) age of the study group was 16.7 (1.12) years with around three quarters of the students being Kuwaiti 607 (76.8%).

Table 1: Socio-demographic characteristics of 775 adolescent female students in public and private high schools in Kuwait, 2015.

Characteristics	Public (n = 603)		Private (n = 172)		Total (n = 775)	
	n	(%)	n	(%)	n	(%)
Age in years, mean (SD)	16.7	(1.1)	16.6	(1.2)	16.7	(1.1)
Nationality[a]						
Kuwaiti	572	(95.3)	21	(12.2)	600	(76.8)
Non-Kuwait	28	(4.7)	151	(88.4)	172	(23.2)
Father's education[b]						
No formal education	4	(0.7)	6	(3.8)	10	(1.4)
Primary/Intermediate	60	(10.8)	27	(17.0)	87	(12.2)
Secondary (high school)	143	(25.8)	34	(21.4)	177	(24.8)
Diploma	81	(14.6)	15	(9.4)	96	(13.4)
University and above	267	(48.4)	77	(48.4)	344	(48.2)
Mother's education[c]						
No formal education	23	(4.0)	14	(8.5)	37	(5.0)
Primary/Intermediate	74	(12.8)	36	(21.8)	110	(14.8)
Secondary (high school)	141	(24.3)	33	(20.0)	174	(23.4)
Diploma	81	(14.0)	15	(9.1)	96	(12.9)
University and above	261	(45.0)	67	(40.6)	328	(44.0)
Currently residing with[d]						
Both parents	520	(86.5)	156	(91.2)	676	(87.6)
Mother alone	67	(11.1)	9	(5.3)	76	(9.8)
Father alone	5	(0.8)	2	(1.2)	7	(0.9)
Other family members	9	(1.5)	4	(2.3)	13	(1.7)

[a]Missing for three participants; [b]Missing for 63 participants; [c]Missing for 31 participants; [d]Missing for four participants.

Of the 775 participants, 237 (30.6%) reported the exact date on which their menarche occurred. Estimating age of menarche from this group showed age of menarche to be 12.49 (95% CI: 12.31–12.66) years. Similarly, 404 participants reported their age at which they reached menarche; and the calculated age of menarche from this group was 12.20 (95% CI: 12.04–12.35) years. We calculated the age of menarche from these two groups and found it to be 12.31 (95% CI: 12.15–12.46) year. Of the study group, only 132 students reported the school grade at which they reached menarche and/or the year at which they reached menarche. In this group, the age of menarche of each girl was assumed to be the average age of menarche for students in that school grade as calculated from the group of students who provided the date on which menarche occurred. There were also two students who did not reach menarche at the time of this study. The age of menarche of these two students was assumed to be the maximum age of menarche reported from those who remembered the exact date of their menarche. Overall, the age of menarche was 12.33 (95% CI: 12.18–12.49). This was 12.27 (95% CI: 12.11–12.43) years and 12.55 (95% CI: 12.27–12.84) among Kuwaiti and non-Kuwaiti, respectively (p-value = 0.011). The mean age of menarche was 12.25 (95% CI: 12.10–12.39) and 12.64 (95% CI: 12.29–12.99) in public and private schools, respectively (p-value<0.001). Differences in the mean age of menarche between private and public schools remains even after stratification by nationality.

The prevalence of obesity and overweight among female students in both public and private schools in Kuwait is shown in Table 2; 172 (22.2%; 95% CI: 19.4– 25.3) and 183 (23.6%; 95% CI: 20.7– 26.8), respectively. There was no significant difference in the prevalence of obesity between public and private schools; 136 (22.6%) and 36 (20.9%), respectively (p-value = 0.6).

Table 3 shows the association between age of menarche and academic performance in mathematics, Arabic literature and total grade in univariate analysis. The students' grades in mathematics, Arabic literature and the total grade was categorized using the median of the grades in each study subject (mathematics > 77.5, Arabic literature > 75, total grades > 82). This was used as the binary outcome in logistic regression analysis. It

also shows, the association between the academic performance and several potential confounders in univariate analysis. Nationality, education of the parents and the living arrangement of the child (living with both parents, with mother only, father only, etc.) were the only variables significantly associated with academic performance in univariate analysis.

Table 2: Prevalence of obesity and overweight among 775 adolescent female students in public and private high schools in Kuwait, 2015.

BMI Categories	Public (n = 603)		Private (n = 172)		Total (n = 775)	
	n	(%)	n	(%)	n	(%)
Underweight	9	(1.5)	3	(1.7)	12	(1.5)
Normal weight	314	(52.1)	94	(54.7)	408	(52.6)
Overweight	144	(23.9)	39	(22.7)	183	(23.6)
Obese	136	(22.6)	36	(20.9)	172	(22.2)
Total	603	(100.0)	172	(100.0)	775	(100.0)

Table 4 shows the association between the age of menarche and students' academic performance before and after adjusting for various confounders. There was no significant association between age of menarche and the students' academic performance before or after adjusting for potential confounders. We also categorized students based on their age of menarche into tertiles; and repeated the same analysis fitting age of menarche as a categorical variable (data not shown). There was no association between age of menarche (fitted as a categorical variable) and students' academic performance using this analysis. We also repeated the analysis above while restricting the analysis to the students who were able to report the exact date on which they reached their menarche (data not shown). There was no association found between the age of menarche and students' performance in this analysis.

Discussion

The aim of this study was to estimate the mean age of menarche among contemporary girls in Kuwait and investigate if the age of menarche is related to academic performance. We reported the age of menarche to be 12.33 years, and found no association between age of menarche and academic performance.

The calculated age of menarche is not different from that reported in a previous study that was conducted in public schools four years ago (12.40 years) [31]. Because of the assumption that students in private schools usually have higher socioeconomic status compared to students in public schools, it was thought that students in private schools would have lower age of menarche compared to students in public schools. Our data do not support this assumption in Kuwait, and in fact suggest that students in public schools have lower age of menarche compared to students in private schools even after taking into account the nationality of students. However, most of the private schools with large number of students are of low cost in Kuwait; and indeed, the family monthly income was lower in private schools compared to public schools.

More than 15 years ago, Jackson and Al-Mousa estimated the age of menarche among adolescent girls in Kuwait to be 12.7 [33] This is higher than our estimate by about 4 months. Although a decline in the age of menarche has been described in many industrialized countries over the last few decades [1], [2], [3], [4], it is not clear whether the observed difference in the mean age of menarche between our study and this study reflects a genuine decline in the age of menarche in Kuwait or due to methodological differences.

The estimated age of menarche in our study and the previous study [31] resembles the age of menarche among contemporary girls in Western countries such as the USA 12.43 years [34], UK 12.5 years [35] and Italy 12.4 years [36]. The estimated age of menarche in Kuwait, however, seems to be lower than that reported from low-income countries such as Ethiopia 13.9 years [37], Northern Nigeria 15.26 years [38], Tanzania (14.8 years) [39], Indonesia (12.96 years)[40], India (13.22 years) [41], Bangladesh (13.12 years) [42], Ghana (12.74 years) [43], Turkey (13.04 year) [44] and Argentina (12.84 years) [45].

Table 3: Association between academic performance (mathematics > 77.5, Arabic literature > 75, total grades > 82) and age of menarche as well as various factors in univariate logistic regression analysis.

Characteristics	Total	Mathematics (>77.5 vs. ≤77.5)			Arabic literature (>75 vs. ≤75)			Total marks (>82 vs. ≤82)		
	n	Crude OR	(95% CI)	p-Value	Crude OR	(95% CI)	p-Value	Crude OR	(95% CI)	p-Value
Age of menarche (year)	775	0.98	(0.87–1.11)	0.774	0.94	(0.8–1.0)	0.253	0.97	(0.9–1.1)	0.556
Nationality										
Kuwaiti (Ref)	593	1	[Reference]	0.039	1	[Reference]	<0.001	1	[Reference]	<0.001
Non-Kuwaiti	179	1.45	(1.02–2.1)		2.39	(1.66–3.4)		2.6	(1.8–3.9)	
Educational level of father										
Primary and below (Ref)	97	1	[Reference]	<0.001	1	[Reference]	<0.001	1	[Reference]	<0.001
Secondary	177	0.73	(0.2–2.8)		0.80	(0.5–1.3)		1.31	(0.3–5.4)	
Diploma	96	1.27	(0.3–5.1)		0.50	(0.3–0.7)		2.04	(0.5–8.7)	
University degree and above	344	1.80	(0.5–6.9)		1.22	(0.8–2.0)		2.83	(0.7–11.5)	
Educational level of mother										
Primary and below (Ref)	147	1	[Reference]	<0.001	1	[Reference]	<0.001	1	[Reference]	<0.001
Secondary	174	0.75	(0.3–1.6)		1.39	(0.6–3.1)		.86	(0.4–1.7)	
Diploma	96	1.31	(0.6–3.0)		1.79	(0.8–4.1)		1.49	(0.7–3.4)	
University degree and above	328	2.48	(1.2–5.2)		2.86	(1.3–6.2)		2.39	(1.1–5.0)	
Currently residing with:										
Both parents (Ref)	676	1	[Reference]	0.013	1	[Reference]	0.025	1	[Reference]	0.088
Mother only	76	0.63	(0.4–1.1)		0.59	(0.35–0.98)		0.57	(0.3–0.95)	
Father only	7	0.16	(0.01–1.3)		2.38	(0.45–12.3)		1.22	(0.3–5.5)	
Other family members	13	0.24	(0.1–1.1)		0.23	(0.05–1.13)		0.39	(0.1–1.5)	
BMI										
Normal	420	1	[Reference]	0.817	1	[Reference]	0.712	1	[Reference]	0.764
Overweight	183	0.94	(0.7–1.4)		1.15	(0.8–1.7)		0.99	(0.7–1.4)	
Obese	172	0.88	(0.1–1.3)		0.97	(0.7–1.4)		0.87	(0.6–1.3)	
Medical condition										
Yes (Ref)	597	1	[Reference]	0.121	1	[Reference]	0.442	1	[Reference]	0.961
No	164	0.75	(0.5–1.1)		1.15	(0.8–1.7)		0.99	(0.7–1.4)	
Birth order										
First	157	1	[Reference]	0.183	1	[Reference]	0.114	1	[Reference]	0.064
Second	146	1.23	(0.8–2.0)		0.73	(0.5–1.2)		0.72	(0.5–1.2)	
Third	151	0.83	(0.5–1.3)		0.54	(0.3–0.9)		0.69	(0.4–1.1)	
Fourth	120	1.08	(0.7–1.8)		0.57	(0.4–0.96)		0.70	(0.4–1.2)	
Fifth	86	0.89	(0.5–1.6)		0.55	(.3–0.97)		0.81	(0.5–1.4)	
More than that	105	0.63	(0.4–1.1)		0.58	(0.3–0.97)		0.43	(0.3–0.7)	

Table 4: Association between academic performance (mathematics > 77.5, Arabic literature > 75, total grades > 82) and age of before and after adjusting for potential confounders.

	Model IOR (95% CI)	Model II OR (95%CI)	Model III OR (95%CI)	Model IV OR (95%CI)
Mathematics grade (>77.5 vs. ≤77.5)				
Age of menarche (year)	0.98 (0.87–1.11)	0.97 (0.84–1.11)	0.95 (0.82–1.09)	0.94 (0.81–1.09)
p-Value	0.774	0.614	0.460	0.417
Arabic grade (>75 vs. ≤75)				
Age of menarche (year)	0.94 (0.85–1.03)	0.93 (0.82–1.04)	0.91 (0.79–1.04)	0.91 (0.79–1.05)
p-Value	0.156	0.181	0.164	0.190
Total grade (>82 vs. ≤82)				
Age of menarche (year)	0.97 (0.86–1.07)	0.93 (0.83–1.04)	0.92 (0.80–1.04)	0.91 (0.78–1.05)
p-Value	0.506	0.189	0.182	0.197

Model I: unadjusted; Model II: adjusted for age of the student, type of school, nationality, mother's education, father's education, presence of medical condition; Model III: adjusted for factors in Model II in addition to physical activity and diet; Model IV: adjusted for factors in Model III in addition to obesity.

As noted above, the data on the age of menarche among adolescent girls are lacking in the Arab states in the Gulf region. Age of menarche among adult women was estimated to be 13.05 years in Saudi Arabia [46], while it was 12.70 years in Bahrain [47].These higher estimates for age of menarche of women in Saudi Arabia and Bahrain could be due to the use of different study populations (i.e. women at post reproductive age who were born several decades ago). Furthermore, a large number of women were unable to remember their menarcheal age in these studies, and even in those who did remember, self-reported age of menarche among adult women is not reliable [48]. More than a decade ago, a study in UAE estimated age of menarche to be 12.68 years [32], but the response rate in this study was less than 60% and the sample included girls from different ethnicities, which make the extrapolation of the findings problematic. Similarly, more than two decades ago, a study in Oman estimated the age of menarche to be 13.3 years [49]. From the above-mentioned review it is possible to conclude that the age of menarche has declined in Kuwait and the Arab states in the Gulf region during the last few decades. This is plausible given the changes in the life style in the region.

It has been hypothesized that early menarche affects girls' perception of self (when they compare themselves with peers) which leads to an increased risk of distress and depression that may lead to low academic performance [25]. Also, girls with early sexual maturation are more likely to select less normative friends like older boys and girls and are characterized by riskier behavior which may lead to lower academic achievement [50]. Overall, early menarche is associated with higher levels of adverse behaviors, such as drinking, smoking and early sexual activity which are powerful distractions to adolescents' academic achievement [28]. In our study, there was no association between age of menarche and school performance in mathematics, Arabic literature and total grade. This is similar to previous studies, which reported no association between age of menarche and academic performance [51], [52]. Previously, only one report found a correlation between early pubertal timing and lower grades in schools but this finding was difficult to replicate in other studies [53]. In our setting, the absence of association between menarcheal age and students' academic performance is not surprising. This is because early menarche is unlikely to lead to adverse behavior because of the strong parental restrictions on girls in Kuwaiti society.

This is one of the few studies that investigated the relationship between age of menarche and academic performance. There is no previously published report on this issue from Kuwait or the Middle East. The study covered public and private schools and because the schools' enrollment is extremely high in Kuwait, it is possible to extrapolate the findings to the whole community. However, those who refused to participate can cause bias in the calculated age of menarche. For example, if girls with early menarche felt embarrassed and refused to participate, this may lead to a higher estimate of age of menarche. Our estimate of age of menarche is low and resembles that in Western countries, thus it is unlikely that girls refrained from participation because of early menarche. We have used recall method to assess the menarcheal age rather than status quo method, the latter would require inclusion of young girls from primary and middle schools in addition to older girls from high

schools. One of the requirements of the recall method is that all participants should have reached menarche by the time of the study otherwise it will result in an underestimation of the age of menarche. In our study only two girls did not reach menarche and we assumed their age of menarcheto be the maximum age of menarche reported. Thus, it is unlikely that this will affect the calculated age of menarche.

In conclusion we have estimated the mean age of menarche among contemporary girls in Kuwait to be 12.33, which is similar to that of girls in the industrialized countries. We also estimated the prevalence of obesity and overweight among female students in high schools in Kuwait to be 22.2% and 23.6%, respectively. Age of menarche was not related to academic performance before and after adjusting for potential confounders. This is probably because early menarcheal age is unlikely to lead to adverse behavior that may affect academic performance in our setting.

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