

## Age at Menarche and its Related Factors among School Girls, in Zanjan, Iran

Parisa Khoshnevisasl<sup>1</sup>, \*Mansour Sadeghzadeh<sup>2</sup>, Saeideh Mazloomzadeh<sup>3</sup>, Akefeh Ahmadiafshar<sup>1</sup>, Leila Babri<sup>4</sup>

<sup>1</sup>Zanjan Social Determinants of Health Research Center, Department of Pediatrics, Zanjan University of Medical Sciences, Zanjan, Iran.

<sup>2</sup>Zanjan Metabolic Disease Research Center, Department of Pediatrics, Zanjan University of Medical Sciences, Zanjan, Iran.

<sup>3</sup>Zanjan Social Determinants of Health Research center, Department of Epidemiology, Zanjan University of Medical Sciences, Zanjan, Iran.

<sup>4</sup>Department of Pediatrics, Ayatollah Moussavi Hospital, School of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran.

### Abstract

#### Background

There are differences in the age at menarche in different countries and it seems that in recent decades gradually the age of puberty is declining. The aim of the present study was to determine the age at menarche and its related factors in school girls in Zanjan city, Iran.

#### Materials and Methods

This cross-sectional study was conducted on 1,500 healthy school girls between 6-17 years old who were selected on the basis of a multistage probability sampling. Age at menarche, birth weight, family size, Body Mass Index (BMI), fast food consumption, and physical activity, were recorded. Data were analyzed using SPSS version 16.0.

#### Results

Out of 1,500 students, 273 girls (18.2%) had experienced menarche with a mean age of  $12.6 \pm 1.6$  (95% confidence interval [CI]: 12.4-12.8), and a median age of 13 years. The prevalence of early menarche was 10.3%, (95% CI: 6.6%-14.1%). A significant association between menarche and BMI, frequency of fast food consumption and birth rank was observed; however, we didn't find a significant association between physical activity ( $P > 0.05$ ) and birth weight ( $P > 0.05$ ) with menarche.

#### Conclusion

The mean age of menarche in our study was  $12.6 \pm 1.6$  years old, similar to other studies in Iran, and it was significantly associated with higher BMI.

**Key Words:** Body mass index, Iran, Menarche, Puberty, Students.

\*Please cite this article as: Khoshnevisasl P, Sadeghzadeh M, Mazloomzadeh S, Ahmadiafshar A, Babri L. Age at Menarche and its Related Factors among School Girls, in Zanjan, Iran. Int J Pediatr 2017; 5(4): 4755-62. DOI: [10.22038/ijp.2017.21178.1779](https://doi.org/10.22038/ijp.2017.21178.1779)

#### \*Corresponding Author:

Dr. Mansour Sadeghzadeh, Department of Pediatrics, Zanjan University of Medical Sciences, Zanjan, Iran.

Email: [sadeghzadeh@zums.ac.ir](mailto:sadeghzadeh@zums.ac.ir)

Received date Feb. 23, 2017; Accepted date: Mar .22, 2017

## 1- INTRODUCTION

Puberty is a biological process associated with growth acceleration, appearance of secondary sexual characteristics and evolution of reproductive capability (1, 2). The hallmark of puberty in girls is Menarche, which is the most prominent event in the women's life (3), and can easily be remembered (4). There are some varieties in the age at menarche in literature (5). The age at menarche in Korea is 12.7 (6), Dutch girls 13.05 (7), Ghana 13.66 (8), USA 12.8 (9), and in different parts of Iran vary from 11.86 to 12.91 years (10-15).

In recent decades the age at menarche is gradually declining (16-19), although a study in turkey did not show the same trend (20). Genetics is one of the most important factors in the onset of menarche (21), however, other factors such as nutrition, psychological disorders, geographical and socioeconomic conditions, and exercise, have also been considered (12, 22). In addition, the effect of intrauterine growth and low birth weight on earlier and rapid puberty progression have been determined in several studies (23-24).

The effect of different factors influencing menarche is still a matter of debate. Although, a study in the USA suggested that age at menarche is not dependant to body mass index (BMI) (25); some studies showed that BMI and age at menarche were inversely related (4,20,26). Many studies concluded that exercise delays menarche age (5, 27), but other studies showed that early puberty occurred in African American girls, having recreational physical activities (28).

According to the importance of determining age at menarche in teenagers and its psychological impact, this study was designed to verify the age at menarche and its related factors in the school- age girls in Zanjan, Iran.

## 2- MATERIALS AND METHODS

This cross-sectional descriptive study was conducted to determine the age of menarche in 7-17 years old girl students of Zanjan city, Iran. Zanjan province, which is located in the North West of Iran with semi-mountainous climate has a total population of 1,020,000 (49% of the population are female). One thousand and five hundred girls from primary, middle and high schools of Zanjan were enrolled in this study by multistage probability sampling.

### 2-2. Methods

First, the list of all schools in the area with their students was extracted from the Vice Consul of Education. The population ratio in each age group in different parts of the city was calculated. The different areas of the city were categorized into three socioeconomic levels (High, moderate and low). According to population ratio in each socio-economic area a randomized sample of students was selected in different age groups.

### 2-3. Measuring tools

The data were gathered by direct interview and examination and by reviewing the health records. Each participant was examined by the researchers to confirm the health and rule out any diseases affecting growth. The age of menarche onset was asked and the secondary sexual characteristics were also recorded. In cases with positive history of menarche the date was recorded with the accuracy of 0.01. The date of birth, birth weight, birth rank, family size, parental education, place of residence (leased or personal), and the frequency of fast food consumption in a week, and physical activity were recorded in pre-designed questionnaire. Regular physical activity was defined as physical activity for 30 minutes 3 times a week (29).

### 2-4. Measurements

Weight was measured by a trained person with Seca scale (769 Digital Column Scale), and height was measured with an accuracy of 0.5 cm in standing position without shoes on a flat surface, while the legs were sticking together with the arms free around the body and hip, shoulder and back in a straight line. Body mass index (BMI) was calculated as  $\text{weight (kg)}/\text{height}^2 (\text{m}^2)$ , and the result converted into age and gender specific as defined by the growth charts provided by the Centers for Disease Control and Prevention (CDC, 2010). The BMI percentiles were categorized into four groups: underweight (below 5% percentile), normal weight (5-85% percentile), and overweight (percentile 85- 95%) and obese (percentile > 95%) (4).

### 2-5. Ethical consideration

This project was approved by the Ethics Committee of Zanjan University of Medical Sciences. All researchers are committed to the principles of the Helsinki Convention and patients' information was protected.

### 2-6. Inclusion and exclusion criteria

Inclusion criteria were: the female students with ages less than 18 years old who lived in the Zanjan city, Iran. The students who had chronic diseases and used medications such as corticosteroids and anticonvulsants, were excluded of the study.

### 2-7. Data Analyses

Data were expressed as number (percentage). Comparisons were performed by Chi-square test for categorical variables. Logistic regression models were used to evaluate the association between menarche and study variables while adjusting for various confounders. Analysis of the data was carried out using SPSS 16.0 (SPSS Inc., Chicago, IL, USA).

## 3- RESULTS

In this study, 1,500 school girls (6-17 years old) from 3 socioeconomic regions of Zanjan city, were evaluated. Depending on a population ratio of each region, 530 (35.3%), 577 (38.5%), and 393 (26.2%), students from low, moderate and high socio-economic regions, respectively, were enrolled in the study. The mean age and standard deviation (SD) of the study group was 10.4 ( $\pm 2.2$ ) years. Most of the participants (80%), were first and second child of the family and lived in their personal houses. Only 9.2% of mothers and 14% of fathers had academic education.

The socio-demographic and personal data of the students are shown in **Table.1**. Out of 1,500 cases, 273 (18.2%), had menarche experience and the mean age of their first menarche was  $12.6 \pm 1.6$  (95% confidence interval [CI]: 12.4-12.8). The minimum and maximum age of menarche were between 7 and 17, respectively, with a median of 13 years old. Early menarche defined as experiencing menarche before 11, was seen in 28 students (10.3%, 95% CI: 6.6%-14.1%). Obesity was observed in 5 (0.3%) cases (95% CI: 0.1%-0.7%), and 25 students (1.7%), were overweight (95% CI: 1.1%-2.4%). The frequency of fast food consumption in 1,431 (95.4%) of the cases was less than 2 times in a week, 212 (14.1%) girls had reported regular physical activity and in 169 (11.3%) students the birth weight was less than 2500 grams (**Table.1**).

There was a significant relationship between menarche experience and the frequency of fast food consumption in a week ( $P < 0.001$ ), birth rank ( $P < 0.001$ ), and BMI ( $P < 0.001$ ) (**Table.2**).

No significant relationship was found between menarche experience and regular physical activity ( $P = 0.15$ ), as well as birth weight ( $P = 0.959$ ). In the multiple logistic regression analysis, using BMI, birth rank,

fast food consumption, physical activity and residence status in the model, the risk of menarche was significantly and

independently associated with BMI, birth rank and fast food consumption (**Table.3**).

**Table-1:** Socio-demographic and personal data of girl students

Variables		Frequency	Percentage
Age groups	7-8.5	330	22%
	8.6-10	302	20.1%
	10.1-11.5	307	20.5%
	11.6-13	262	17.5%
	13.1-14.5	299	19.9%
Residence region		Frequency	Percentage
Different socioeconomic areas of the city	Low	530	35.3%
	Moderate	577	38.5%
	High	393	26.2%
Birth rank		Frequency	Percentage
Birth rank groups	First child	505	33.7%
	Second child	740	49.3%
	Third child	193	12.9%
	Fourth child	46	3.1%
	Fifth child	13	0.9%
	Sixth or more	3	0.2%
Residence status		Frequency	Percentage
Groups	Leased	395	26.3%
	Personal	1105	73.7%
Birth weight	< 2500	169	11.3%
	>2500	1331	88.7%
Fast food consumption	>2 per week	69	4.6%
	<2 per week	1431	95.4%
Physical activity	Yes	212	14.1%
	No	1288	85.9%
BMI	<50	1255	83.7%
	50-85	215	14.3%
	85-195	25	1.7%
	>95	5	0.3%

**Table-2:** The relationship between menarche and study variables

Variables		Negative history of Menarche Number /Percentile	Positive history of Menarche Number /Percentile	P-value
Fast-food consumption $\leq$ 2/wk	Positive	1184(96.5%)	247(90.5%)	0.001
	Negative	(3.5%) 43	(9.5%) 26	
Regular Physical activity	Yes	166 (13.5%)	46 (16.8%)	0.15
	No	1061 (86.4%)	227 (83.2%)	
Birth rank	1 <sup>st</sup>	424 (34.6%)	81 (29.8%)	0.001
	2 <sup>nd</sup>	624 (50.9%)	116 (42.5%)	
	3 <sup>rd</sup>	141 (11.5%)	52 (19%)	
	>4 <sup>th</sup>	38 (3.1%)	24 (8.8%)	

BMI	Underweight and normal	1222 (99.6%)	248 (90.8%)	0.000
	Overweight and obese	5 (0.4%)	25 (9.2%)	
Birth weight	< 2,500	138 (11.2%)	31 (11.4%)	0.959
	> 2,500	1089 (88.8%)	242 (88.6%)	

**Table-3:** The relationship between menarche and study variables using multiple logistic regression model

Variables	Odd ratio	Confidence interval	P- value
Fast food consumption			
<2 times a week	1.00		
>2 times a week	2.83	1.64-4.87	0.0001
BMI			
<50	1.00		
50-85	3.91	2.82-5.43	0.0001
>85	33.86	12.66-90.58	
Birth rank			
1	1.00	0.68-1.31	0.0001
2	0.94	1.21-2.83	
3	1.85	1.46-4.97	
≥4	2.70		

#### 4- DISCUSSION

The mean age of menarche in our study was  $12.6 \pm 1.6$  (95% CI: 12.4-12.8), with the minimum and maximum age of 7 and 17 years old. This finding is similar to the study in Kuwait (12.41 years) (4), Istanbul (12.74 years) (20), Tehran (12.68 years) (10), Maharashtra, India (12.62 years) (30), Chile (12.7 years) (31), France (12.5 years) (32), Poland (12.77 years) (33), Spain (12.83 years) (34), and different from South Etiopia (13.9 years) (35), Ethiopia, Mekelle (14.24 years) (36), Nigeria (13.66 years) (37), Uganda (13.3-13.6 years) (38), and North Korea (16 years) (39).

In Iran the age at menarche in different climatic zones are as follows: Tehran (12.68 years) (10), Shiraz (12.91 years) (11), Sabzevar (12.5 years) (12), Mazandaran (12.5 years) (13), Isfahan

(12.65 years) (14), Ahvaz (11.86 years) (15). The difference in the menarche age can be due to genetic, racial and geographical variations. For instance, it is stated that African girls have a higher age at menarche (26). Early menarche was seen in 10.3% of students compared to 8.5% in Kuwait (4), 7.8% in white American girls (40), and 6.1% in Nigeria (37). The various rates of early menarche may be due to different definition in different studies. In this study, we defined early menarche as menarche before 11 years (4); however, there are different definitions for early menarche such as a 5<sup>th</sup> percentile or below one standard deviation.

Obesity and overweight were seen in 0.3% and 1.7%, respectively, and there was a significant relationship between menarche and BMI. Several studies demonstrated the significant and negative association between BMI and menarche (4, 16, 24,

35); they showed that early maturing girls had significantly higher BMI than late maturing ones. It has been thought that the effect of BMI on puberty is due to an alteration in Leptin regulation (24). According to Frisch theory, when body fat increases from 16% to 23%, menarche occurs which is consistent with the increase in BMI (26). Raji has showed the relation between age at menarche (AM), and body weight (BW) in the formula: "AM= 15.198- 0.0275 BW" (37). The study at Uganda did not show an association between BMI and menarche, although a negative association was found between menarche and hip circumference, and it was concluded that adiponectine and leptin levels were mostly associated with hip circumference and the fat in the gluteofemorale region (38). Some authors suggested that although the BMI of adolescent girls is increasing, the age at menarche is not decreased (25).

In the present study, there was a significant relation between the frequency of fast food consumption and menarche, which is similar to a study in USA that proposed American lifestyle and diet were effective in reducing the age of puberty onset (16). The effect of fast food consumption on puberty can be explained by the fact that fast food causes obesity and increases BMI which can accelerate puberty. In our study there was no significant relationship between regular sport and menarche; while many studies stated that exercise was effective in delaying puberty (28, 30, 35). Perhaps the reason for this discrepancy is, that we trusted students' claim without any verification. We did not find a significant association between birth weight and menarche. It was expressed that children with intrauterine growth retardation have earlier puberty, or if puberty occurred in normal times, it had a faster progression (23, 24). Ibanez illustrated that girls with precocious puberty, particularly those with

low birth weight, are hyperinsulinemic and their onset of puberty is advanced up to 6 months (41). Our results are different, and it seems that it would be better, considering the growth pattern of early childhood along with birth weight (22). In the present study there was a significant relationship between birth rank and family size with menarche, so that in children who had experienced menarche, the percentage of children with higher birth rank (fourth and up), were three times more common. This result is similar to some studies (42, 43), but it is different from the study of Hossain et al., in Malaysia (44).

## 5- CONCLUSION

The mean age of menarche in our study was  $12.6 \pm 1.6$  years old; so that the age at menarche in Zanjan city, was similar to most studies conducted in Iran and other industrialized countries and it was significantly associated with higher BMI, frequency of fast food consumption in week and higher birth rank.

**6- CONFLICT OF INTEREST:** None.

## 7- REFERENCES

1. Plant T M, Barker-Gibb ML. Neurobiological mechanisms of puberty in higher primates. *Hum. Reprod. Update* 2004; 10(1): 67-77. Doi: 10.1093/humupd/dmh001.
2. Colvin CW, Abdullatif H. Anatomy of female puberty: The clinical relevance of developmental changes in the reproductive system. *Clin Anat* 2013; 26(1):115-29. Doi: 10.1002/ca.22164. Epub 2012 Sep 19.
3. Ramezani Tehrani F, Mirmiran P, Gholami R, Moslehi N, Azizi F. Factors Influencing Menarcheal Age: Results from the Cohort of Tehran Lipid and Glucose Study. *Int J Endocrinol Metab* 2014; 12(3): e16130.
4. 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.

5. Kabir N, Torkan pb, Hakemi LC. Evaluation of Age at Menarche and Relevant Factors in Physically Active Iranian Girls. *Int J Endocrinol Metab* 2007; 2: 52-60.
6. Lee MH, Kim SH, Oh M, Lee KW, Park MJ. Age at menarche in Korean adolescents: trends and influencing factors. *Reprod Health* 2016; 13: 121.
7. Talma H, Schönbeck Y, van Dommelen P, Bakker B, van Buuren S, HiraSing RA. Trends in Menarcheal Age between 1955 and 2009 in the Netherlands. *PLoS ONE* 2003; 8(4): e60056. doi:10.1371/journal.pone.0060056.
8. Cabrera SM, Bright GM, Frane JW, Blethen SL, Lee PA. Age of thelarche and menarche in contemporary US females: a cross-sectional analysis. *J Pediatr Endocrinol Metab* 2014; 27(0): 47–51. doi:10.1515/jpem-2013-0286.
9. Ameade EPK, Garti HA. Age at Menarche and Factors that Influence It: A Study among Female University Students in Tamale, Northern Ghana. *PLoS ONE* 2016; 11(5): e0155310. doi:10.1371/journal.pone.0155310.
10. Razzaghy-Azar M, Moghimi A, Sadigh N, Montazer M, Golnari P, Zahedi-Shoolami L, and et al. Age of puberty in Iranian girls living in Tehran. *Ann Hum Biol* 2006; 33(5-6):628-33.
11. Ayatollahi SM, Dowlatnabi E, Ayatollahi SA. Age at menarche in Iran. *Ann Hum Biol* 2002; 29(4):355-62.
12. Pejhan A, Yazdi Moghaddam H, Najjar L, Akaberi A. The relationship between menarche age and anthropometric indices of girls in Sabzevar, Iran. *J Pak Med Assoc.* 2013; 63(1):81-4.
13. Delavar MA, Hajian-Tilaki KO. Age at menarche in girls born from 1985 to 1989 in Mazandaran, Islamic Republic of Iran. *East Mediterr Health J* 2008; 14(1):90-4.
14. Kashani HH, Kavosh MS, Keshteli AH, Montazer M, Rostampour N, Kelishadi R, et al. Age of puberty in a representative sample of Iranian girls. *World J Pediatr* 2009; 5(2):132-5. doi: 10.1007/s12519-009-0026-1.
15. Sharifi N, Najjar Sh, Abedi P. The relationship Nutrition and Physical activity with Menarche age of Girls in Ahvaz. *Arak Medical University Journal (AMUJ)* 2014; 17(89): 19-26.
16. Slyper AH. The pubertal timing controversy in the USA, and a review of possible causative factors for the advance in timing of onset of puberty. *Clinical Endocrinology* 2006; 65:1-8.
17. Ghosh S, Mukherjee DK, Das Gupta R. A study of anthropometric and socioeconomic factors associated with delayed menarche in a Bengali 4761 Indian population with special reference to bmi and 2d:4d ratio. *Asian Journal of Medical Sciences* 2012; 3: 24-31.
18. Nabi G, Amin M, Sultan R, Kamil M. Environmental factors and puberty onset: an update. *Journal of Biology and Life Science* 2014; 5: 165-74.
19. Soliman A, De Sanctis V, Elalaily R, Bedair S. Advances in pubertal growth and factors influencing it: Can we increase pubertal growth? *Indian J Endocrinol Metab* 2014; 18(1): S53–S62.
20. Atay Z, Turan S, Guran T, Furman A, Bereket A. Puberty and Influencing Factors in Schoolgirls Living in Istanbul: End of the Secular Trend? *PEDIATRICS* 2011; 128(1): e40-5.
21. Park SW, Lee ST, Sohn YB, Cho SY, Kim SH, Kim SJ, et al. LIN28B polymorphisms are associated with central precocious puberty and early puberty in girls. *Korean J Pediatr* 2012; 55(10):388-92.
22. Yermachenko A, Dvornyk V. Nongenetic Determinants of Age at Menarche: A Systematic Review. *BioMed Research International*, vol. 2014, Article ID 371583, 14 pages, 2014. doi:10.1155/2014/371583.
23. Hernández MI, Mericq V. Pubertal development in girls born small for gestational age. *J Pediatr Endocrinol Metab* 2008; 21(3):201-8.
24. Sloboda DM, Hart R, Doherty DA, Pennell CE, Hickey M. Age at menarche: influences of prenatal and postnatal growth. *The Journal of Clinical Endocrinology and Metabolism* 2007; 92(1):46–50.
25. Demerath EW, Towne B, Chumlea WC, Sun SS, Czerwinski SA, Remsberg KE, et al. Recent decline in age at menarche: the Fels Longitudinal Study. *Am J Hum Biol* 2004; 16(4):453-7.

26. Bayat PD, Ghanbari A, Khazaei M, Ghorbani R, Amiri S. Age at Menarche and Related Factors in Girls of Urban Areas of Markazi (Central) Province of Iran. *Int. J. Morphol* 2012; 30(1):15-8.
27. Matin Homai H, Sehati Shafai F, Zoodfekr L. Comparing Menarche Age, Menstrual Regularity, Dysmenorrhea and Analgesic Consumption among Athletic and Non-athletic Female Students at Universities of Tabriz-Iran. *International Journal of Women's Health and Reproduction Sciences* 2014; 2(5): 307–10.
28. Deardorff J, Fyfe M, Ekwaru JP, Kushi LH, Greenspan LC, Yen IH. Does neighborhood environment influence girls' pubertal onset? Findings from a cohort study. *BMC Pediatr*. 2012;12:27. doi: 10.1186/1471-2431-12-27.
29. Afshariani R, Malekmakan L, Yazdankhah M, Daneshian A, Sayadi M. The effect of Exercise on the Age at Menarche in Girls at Guidance Schools of Shiraz, Iran. *Women's Health Bull* 2016; 3(1): e32425. doi: 10.17795/whb-32425.
30. Rokade S, Mane A. A study of age at menarche, the secular trend and factors associated with it. *The Internet Journal of Biological Anthropology* 2008; 3(2):1-7.
31. Codner E, Unanue N, Gaete X, Barrera A, Mook-Kanamori D, Bazaes R, Avila A, Cassorla F. Age of pubertal events in Chilean school age girls and its relationship with Socio-economic status and body mass index. *Rev Med Chil* 2004; 132(7):801-8.
32. Lalys L, Pineau JC. Age at menarche in a group of French schoolgirls. *Pediatr Int*. 2014; 56(4):601-4. doi: 10.1111/ped.12296.
33. Oblacińska A, Jodkowska M, Tabak I, Mikiel-Kostyra K, Palczewska I. Physical development and puberty of Polish 13 year old adolescents in the first decade of 21st century. Current status and secular trend of growth and maturation in the last 30 years. *Med Wieku Rozwoj* 2010; 14(3):235-45.
34. Cabanes A, Ascunce N, Vidal E, Ederra M, Barcos A, Erdozain N, et al. Decline in age at menarche among Spanish women born from 1925 to 1962. *BMC Public Health* 2009; 9: 449. doi: 10.1186/1471-2458-9-449.
35. Ayele E, Berhan Y. Age at menarche among in-school adolescents in sawla town, south Ethiopia. *Ethiop J Health Sci*. 2013; 23: 3:189-99.
36. Gebremariam H, Gebremariam A, Tesfay G, Adem OS, Assefa H. Mean Difference of Age at Menarche and Body Mass Index among Government and Private High-School Students of Mekelle City, Northern Ethiopia. *J Nutr Food Sci*. 2015; S3: 4. doi:10.4172/2155-9600.S3-004.
37. Raji Y, Osonuga OA, Shittu OI, Akinsomisoye OS, Togun VA, Azeez MO. Age at Menarche and its Predicting Factors in Cities of Ibadan and Ogbomoso of Southwestern Nigeria. *Journal of Medical Sciences* 2006; 6(5):772-8.
38. Odongkara Mpora B, Piloya T, Awor S, Ngwiri T, Laigong P, Mworozzi EA, et al. Age at menarche in relation to nutritional status and critical life events among rural and urban secondary school girls in post-conflict Northern Uganda. *BMC Women's Health* 2014; 14:66.
39. Ku SY, Kang JW, Kim H, Kim YD, Jee BC, Suh CS, et al. Age at menarche and its influencing factors in North Korean female refugees. *Human Reproduction* 2006; 21(3): 833–36.
40. Adair LS, Gordon-Larsen P: Maturation timing and overweight prevalence in US adolescent girls. *Am J Public Health* 2001; 91(4):642–44.
41. Ibanez L, Jimenez R, de zegher F. Early puberty-menarche after precocious pubarche: relation to prenatal growth. *Pediatrics* 2006; 117(1):117-21.
42. John J, Verma M, Chhatwal J. Physiological Variables, Psychosocial Factors and Age at Menarche among Punjabi Girls. *Indian Journal of Physiology and Pharmacology* 2014; 58(2): 141-6.
43. Emst C, Angst J. Birth order: Its influence on personality. New York: Springer-Verlag; 2012.
44. Hossain G, Wee As, Ashaie M, Kamarul T. Adult anthropometric measures and socio-demographic factors influencing age at menarche of university students in Malaysia. *Journal of Biosocial Science* 2013; 45(5): 705-17.