

Age of Menarche in Relation to Socioeconomic Status, BMI, Physical Activity and Stress Among High School Girls

Huma Khalid, Komal Khawar, Maheen Fawad, Mahrukh Farhat, Mahum Imran, Myera Shahnawaz, Mazia Shahid, Pashmal Yousaf, Qurrat-ul-Ain, Rubab Saleem, Saba Ahmed, Rabbiya Sarwar, Hyder Ali Khan, Ayesha Humayun*

Department of Public Health and Community Medicine, Shaikh Khalifa Bin Zayed Al-Nahyan Medical College, Shaikh Zayed Postgraduate Medical Institute, Shaikh Zayed Medical Complex, Lahore.

ABSTRACT

Over the past 50 years, the average age of onset of menarche has significantly declined and found to be a risk factor for breast cancer. **Objectives:** The research objective is to assess the effect of socioeconomic status, BMI, physical activity and stress on the age of menarche of school girls of urban and peri-urban communities in Lahore. **Methods:** This cross-sectional study estimated the age at menarche and investigated its relationship with socioeconomic status, BMI, physical activity and stress. It was carried out in 2 schools of peri-urban and urban communities of Lahore, selected through convenience sampling. The data was collected from adolescent girls (aged 13-17 years) from grades 9 and 10 through self-constructed questionnaire. All 199 adolescent girls experiencing menstruation were enrolled in the study. **Results:** The estimated average age at menarche was 12.66 ± 1.12 years collectively and 12.92 ± 1.21 and 12.37 ± 1.59 in girls of peri-urban and urban schools respectively. Mean age of menarche was not significantly different in categories of BMI, levels of physical activity and stress but showed statistically significant difference in categories of socio-economic status. **Conclusion:** It was concluded that mean age of menarche is influenced by socio-economic status.

Key words: Age at Menarche, BMI, stress, Physical activity, socio-economic status, Adolescents

INTRODUCTION

Growth is an increase in size of body as a whole or the size attained by certain parts of the body. Development is a psychological phenomenon and is referred to the refinement of behaviors as expected by the society. Growth and development are the two phenomena that go hand in hand and make up a whole individual. However, the rate of development and growth vary and is governed by various factors such as nutrition, socioeconomic status, geographic and genetic predisposition.¹

One of the conditions having a deep impact on growth and development is the age of pubertal events and hence, is considered socially, culturally and medically significant. Apart from its psychosocial importance, early puberty is known to be linked with elevated risk of carcinoma, obesity

and diabetes.² Since it is not possible to accurately measure the degree of pubertal development, epidemiological studies often use the age at menarche to indicate sexual maturity as this event is considered as an important reproductive milestone and is well recalled many years later.

The changes that take place at the time of puberty in young females are:

- The ovaries start secreting Estrogen, a female hormone, causing breast enlargement which will be used later for lactation.
- Growth is accelerated during that period because of the release of large amounts of Growth Hormone
- The height of the individual increases by 20 cm on average.
- The secretion of Estrogen causes cyclical changes in the thickening of the uterus. Every

28 days, this is sloughed off as menstrual blood and is known as the menstrual phase. This is the stage where a female is fertile and is able to reproduce.³

The first menstrual cycle is known as Menarche. Girls experience menarche at different ages. The age of onset of reproductive events has shown a downward trend across different populations over the last hundred years in most of the developed world. Numerous studies have been conducted in countries like England⁴, France⁴, Israel⁵, China⁶ and the USA⁷ which have documented a declining trend in the age of menarche.

Even though menarche has a strong genetic component⁸ and follows a familial pattern, socioeconomic factors also play a vital role. Menarcheal age is significantly altered by nutritional status, recurrent infectious diseases, chronic disease, pollution and exposure to environmental estrogens and endocrinal disrupters⁹. Scarce literature is available on determining age of menarche and factors influencing them in Pakistani population. Considering the effects of menarche on adolescent health and the influence of socioeconomic factors in governing these changes, we considered it necessary to assess the relationship of socioeconomic status, BMI, physical activity and stress with age of menarche in girls in our socio-cultural context. The research objective is to assess the effect of socioeconomic status, BMI, physical activity and stress on the age of menarche of school girls of urban and peri-urban communities in Lahore.

METHODOLOGY

A cross-sectional study conducted between April and May, 2015 on grade 9 and 10 girls from schools, one in urban and one in peri-urban area of Lahore. Girls with history of severe dysmenorrhoea, history of any consultation or treatment for any Gynaecological issue and use of any medications to regulate menstruation were not included in study. All 199 students in both classes of two schools were enrolled in the study. A questionnaire was constructed and pre-tested on girls from a nearby school and then modified in the light of pre-test

results. A formal administrative permission was taken from the principal of each school before conducting the research. Among the two schools, one was located in the Johar Town (KIPS school) and the other in Shamki Bhattiyan area (Govt. Secondary High School). 199 girls of classes 9 and 10 were enrolled in the study conveniently after taking verbal informed consent.

Questionnaires were filled out for identifying the age of menarche and other variables. It took 15-20 minutes to fill out each questionnaire. The team was divided into 3 groups on 3 stations. Group 1 collected personal profile, group 2 on station 2 inquired level of stress and physical activity whereas at Station 3 weight and height were recorded. The questionnaires were filled out by the team members themselves to ensure understanding of the questions by the subjects and authenticity and completeness of the data collected.

Age at menarche

The normal age of menstruation for a normal particular girl is determined by her genes and family history. Normally human females start to menstruate usually 8-13 years of age. (10) Age of menarche was taken as continuous numerical data.

Socioeconomic status

Socioeconomic status has been shown to have a significant effect on the age of the onset of menarche¹¹. In this study it was determined on the basis of the monthly family income and the number of family members and the per capita income was calculated. According to WHO poverty can be defined as income below 2 U.S. dollars a day¹². Therefore, for the purpose of this research low socioeconomic status is defined as per capita income below 2 U.S. dollars a day and per capita income above 5 U.S. dollars a day is considered as high socioeconomic status. According to the International Monetary Fund (IMF) the Implied Purchasing Power Parity (PPP) conversion rate was reported at 30.05 in Pakistan and therefore, the value of 2 U.S. dollars is 60.1 Pakistani rupees¹³. A government and a private school were selected to conduct this research because pupils of government school are more likely to belong to low socioeconomic status and those of private school are more likely to belong to high socioeconomic status.

Self-reported physical activity

According to some researchers, energy expenditure is also an important factor contributing to age of menarche along with energy intake¹⁴. Students were asked questions to assess their physical activity and then correspondingly placed in one of the following groups: High, moderate or mild physical activity. Students were placed in high physical activity group if they were part of school sports team and/or work outside of their homes to earn a living. Moderate physical activity group included those girls who help out their mothers in household work and/or play sports during recess. Girls in mild physical activity group were those who neither work at home nor participate in sports.

Self-perceived level of stress

The psychosocial acceleration theory suggests that girls who live in stressful environments experience menarche at an early age which maximizes their chance of leaving descendants¹⁵. So it was assumed that stress at early age directly affects age at menarche. Students were asked to grade the level of stress in their lives according to their perception. They were asked to mark themselves in one of the following groups: high, moderate or mild.

Body Mass Index

Several studies over the past 30 years have shown early attainment of menarche in girls. Increasing rates of obesity is seen in girls over the same period of time, so obesity is supposed to be an important contributory factor in early onset of menarche.¹⁶ Anthropometric method was used to calculate BMI (Body mass index). Weight and height are recorded and BMI is calculated and categorized ($BMI = \text{Weight in Kg} / \text{Height in Meters} \times \text{Height in Meters}$). BMI was classified into 6 categories: drastically underweight (less than 16.5), underweight (16.5-18.4), ideal (18.5-24.9), overweight (25-29.9), obese (30-34.9) and morbidly obese (35-39.9).¹⁷

Data entry was carried out on SPSS version 21. Data was described using tables to compare mean age of menarche of both communities and to compare it with other variables of the study that were socioeconomic status, physical activity, stress

and BMI. Independent sample t test was applied on the means of age of menarche in the two communities to determine whether the difference between the two means was significant. Association of socio-economic status, BMI, physical activity and stress was also assessed.

Human participant protection was ensured following principles of Helsinki's declaration. Scientific and ethical review of this research was done by Department of Public Health and Community Medicine at Shaikh Zayed Medical Complex.

RESULTS

Menarche occurred between 9 to 16 years in the girls who participated in our research. The mean age of menarche was 12.66 ± 1.12 . Out of a total of 199 girls, 109 belonged to a Peri-urban area and 90 were in Urban area. Mean age of menarche in Peri-Urban area came out to be 12.92 ± 1.21 and that in Urban area was 12.37 ± 1.59 .

When we compared socioeconomic status with Age of Menarche, we classified total girls into Lower, Middle and Upper classes and found out that most of the girls in Lower Class attained Menarche between 12 to 13 years (60%) while 38% of middle class girls got Menarche at 13 years. Moreover, 50% of the girls in Upper Class reached Menarche at 12 years (Table 1)

We classified BMI into five categories: drastically underweight, underweight, ideal, Overweight and Obese. Out of the total girls, 47 were in the drastically underweight category and most of them (46.8%) achieved Menarche at 13 years. 62 girls fell in the underweight category, 33.9% of them attained Menarche at 12 years. 80 girls were found to be ideal, out of which 43.8% of them attained Menarche at 12 years. 8 girls were overweight, out of which 62.5% attained menarche at 12 years. 2 girls were obese and both of them reached age of menarche at 13 years (Table 1).

Physical Activity was classified into Heavy, Moderate and Mild work based on self perception of students. 119 girls formed the majority by falling in the Mild category. 40.3% of them attained Menarche at 12 years while 78 of them fell in the moderate category and 37.2% got their first period

Table 1: Distribution of different factors according to categories of age of menarche.

		Age of menarche (Years)					Total
		9-11	12	13	14	15-19	
Socio-economic status	Lower class	3 (6.00%)	15 (30.00%)	15 (30.00%)	10 (20.00%)	7 (14.00%)	50
	Middle class	6 (12.00%)	11 (22.00%)	19 (38.00%)	12 (24.00%)	2 (4.00%)	50
	Upper class	8 (8.10%)	50 (50.50%)	34 (34.30%)	5 (5.10%)	2 (2.00%)	99
BMI	Drastically underweight	3 (6.40%)	15 (31.90%)	22 (46.80%)	5 (10.60%)	2 (4.30%)	47
	Underweight	7 (11.30%)	21 (33.90%)	14 (22.60%)	15 (24.20%)	5 (8.10%)	62
	Ideal	7 (8.80%)	35 (43.80%)	28 (35.00%)	6 (7.50%)	4 (5.00%)	80
	Overweight	0 (0.00%)	5 (62.50%)	2 (25.00%)	1 (12.50%)	0 (0.00%)	8
	Obese	0 (0.00%)	0 (0.00%)	2 (100.00%)	0 (0.00%)	0 (0.00%)	2
Physical activity	Heavy work	0 (0.00%)	0 (0.00%)	1 (50.00%)	1 (50.00%)	0 (0.00%)	2
	Moderate	6 (7.70%)	28 (35.90%)	29 (37.20%)	10 (12.80%)	5 (6.40%)	78
	Mild	11 (9.20%)	48 (40.30%)	38 (31.90%)	16 (13.40%)	6 (5.00%)	119
Stress	High	2 (15.40%)	5 (38.50%)	1 (7.70%)	4 (30.80%)	1 (7.70%)	13
	Moderate	3 (4.10%)	37 (50.70%)	25 (34.20%)	5 (6.80%)	3 (4.10%)	73
	Low	12 (10.60%)	34 (30.10%)	42 (37.20%)	18 (15.90%)	7 (6.20%)	113

at 13 years. Only 2 girls fell in the heavy work category, 1 of which attained Menarche at 13 while the other one at 14 years. (Table 1)

Our variable, Stress was classified into high, moderate and low (self perceived). 113 girls were the majority by falling in the Low stress category out of which 37.2% had their first period at 13 years. 73 fell in moderate category, 50.7% of them achieved menarche at 12 years while 13 of them fell in the high category out of which, 38.5% attained Menarche at 12 years (Table 1).

For our research, the independent t-test was chosen as the appropriate test to determine whether the difference between the means of age of menarche in the two communities was significant or

not. The T-test was also applied to determine the difference in means by defining different groups like socioeconomic status, BMI, physical activity and stress. The mean difference between the age of menarche of two communities was significant but the association between stress, BMI and physical activity was not significant (Table 2).

DISCUSSION

Early menarche is associated with breast cancer¹⁸ and its incidence is rapidly increasing, alarming epidemiologists to conduct studies exploring trends in risk factors in Pakistani population¹⁹. Secular trends towards early menarche

Table 2: Mean difference in age of Menarche.

	Mean age of menarche	Mean difference	Sig. (2-tailed) Value
Community			
Peri-Urban	12.92	0.5507	<0.0001
Urban	12.37		
Socioeconomic Status			
Low	13.06	0.5231	0.004
Not Low	12.54		
BMI			
Undernourished	12.79	0.267	0.096
Not Undernourished	12.52		
Stress			
Mild	12.69	0.26	0.937
Moderate to heavy	12.67		
Physical Activity			
Mild	13.5	0.84	0.294
Moderate to Heavy	12.66		

need surveillance. Current study estimates the average age of menarche and its relationship with different variables. Age of menarche varies between girls and is governed by various factors such as socioeconomic status, BMI, physical activity and stress levels. This study finds a strong association between age of menarche and socioeconomic status. This study highlighted that girls belonging to the higher socioeconomic status achieved their menarche by 12 years and those belonging to middle class by 13 years and those in the lower class category by either 12 or 13 years. These results support the downward trend in age of menarche as we see in low and high socioeconomic status. The relevant statistical approach has proved that there is a statistically significant difference between the mean age of menarche in the two communities. Similar findings were reported in other studies as well.²⁰

Socioeconomic conditions have a distinct effect on the menarcheal age and it is not possible to separate these conditions from other related factors such as family size, living conditions, nutritional status etc. These factors are associated with early menarche.¹⁰

In this research, when BMI and age of menarche were compared, it was concluded that there is association between the age of menarche

and BMI. With the increase in BMI, menarcheal age decreases. This inverse association is proved in other studies as well²¹.

Comparing physical activity with menarcheal age showed that girls involved in moderate physical activity attained menarche later than those not much physically active. Other studies also supports that girls involved in physical activities had a lower chance of attaining menarche at early age²².

It has been concluded by various researches that girls who grow up under stress attain early menarche as compared to those who have not experienced it^{23,24}. However, this study does not conclude that risk of early menarche increases in girls having moderate to high stress

In conclusion, age of Menarche is significantly different in different socio-economic levels but the level of physical activity, stress and BMI do not influence age of menarche. This would have been otherwise with increased sample size or by including more settings thus increasing the generalizability of study findings. Further work is required to study the factors which are responsible for changing trend in age of menarche and role of socioeconomic status in early menarche.

REFERENCES

1. Malina, RM, Bouchard, C, Bar-Or, O. Growth, Maturation, and Physical Activity. 2nd edition. Human Kinetics, Champaign, IL; 2004.
2. Parent A-S, Rasier G, Gerard A, Heger S, Roth C, Mastronardi C, et al. Early onset of puberty: tracking genetic and environmental factors. *Horm Res Paediatr.* 2005;64:41-7.
3. Saxena R. Impact of Socio-Economic Status on Age at Menarche. *Int. j. multidiscip. approach stud.*, Feb. 2014, 01(1), p.76-82 <http://oaji.net/articles/2015/887-1427172304.pdf>
4. Okasha M, McCarron P, Smith GD, McEwen J. Age at menarche: secular trends and association with adult anthropometric measures. *Ann Hum Biol.* 2001;28:68-78.
5. Chodick G, Huerta M, Balicer RD, Davidovitch N, Grotto I. Secular trends in age at menarche, smoking, and oral contraceptive

- use among Israeli girls. *Prev Chronic Dis* [serial online]. 2005 Apr [date cited]. Available from: URL: http://www.cdc.gov/pcd/issues/2005/apr/04_0063.htm.
6. Huen K, Leung S, Lau J, Cheung A, Leung N, Chiu M. Secular trend in the sexual maturation of southern Chinese girls. *Acta Paediatrica*. 1997;86:1121-4.
 7. Wyshak G. Secular changes in age at menarche in a sample of US women. *Ann Hum Biol*. 1983;10:75-7.
 8. Anderson CA, Duffy DL, Martin NG, Visscher PM. Estimation of variance components for age at menarche in twin families. *Behavior Genetics*. 2007;37:668-77.
 9. Schoeters G, Den Hond E, Dhooge W, Van Larebeke N, Leijts M. Endocrine disruptors and abnormalities of pubertal development. *BCPT*. 2008;102:168-75.
 10. Zacharias L, Wurtman RJ. Age at menarche. *N Engl J Med*. 1969;280:868-75.
 11. James-Todd T, Tehranifar P, Rich-Edwards J, Titievsky L, Terry MB. The impact of socioeconomic status across early life on age at menarche among a racially diverse population of girls. *Annals of Epidemiology*. 2010;20:836-42.
 12. World Health Organization. Poverty 2015 [19-05-2015]. Available from: <http://www.who.int/topics/poverty/en/>.
 13. Trading Economics. Pakistan Implied Purchasing Power Parity (PPP) Conversion Rate 2009. Available from: <http://www.tradingeconomics.com/pakistan/implied-purchasing-power-parity-ppp-conversion-rate-imf-data.html>.
 14. Rokade S, Mane A. A study of age at menarche, the secular trend and factors associated with it. *The Internet Journal of Biological Anthropology*, 2009;3: 1939-45.
 15. Chisholm JS, Quinlivan JA, Petersen RW, Coall DA. Early stress predicts age at menarche and first birth, adult attachment, and expected lifespan. *Human Nature*. 2005; 16:233-65.
 16. Bazrafshan H, Behnampour N, Sarabandi F, Mirpour S. Association between puberty and weight, height and body mass index in a developing community. *JPMA*. 2012;62:454-7. http://www.jpma.org.pk/full_article_text.php?article_id=3396
 17. bmi.ca. Body Mass Index Formula. Available from: <http://bmi.ca/bmi-calculation-and-chart.php>.
 18. Apter D, VIHKO R. Early Menarche, a Risk Factor for Breast Cancer, Indicates Early Onset of Ovulatory Cycles. *J Clin Endocrinol Metab*. 1983; 57:82-6.
 19. Amirali Z, Edgar K, Azim ZA, Sadruddin S. Breast Cancer in Pakistani Females. *i-Manager's Journal on Nursing*. 2014;4:11-5.
 20. Eveleth PB. Population differences in growth: environmental and genetic factors. *Human growth*: Springer; 1979. p. 373-94.
 21. Shrestha A, Olsen J, Ramlau-Hansen CH, Bech BH, Nohr EA. Obesity and age at menarche. *Fertility and Sterility*. 2011;95: 2732-4.
 22. Moisan J, Meyer F, Gingras S. Leisure physical activity and age at menarche. *MSSE*. 1991; 23:1170-5.
 23. Moffitt TE, Caspi A, Belsky J, Silva PA. Childhood experience and the onset of menarche: A test of a sociobiological model. *Child Development*. 1992;63:47-58.
 24. Mendle J, Turkheimer E, D'Onofrio BM, Lynch SK, Emery RE, Slutske WS, et al. Family structure and age at menarche: a children-of-twins approach. *Dev Psychol*. 2006; 42: 533-542.

Corresponding Author:

Prof. Ayesha Humayun
Head, Department of Public Health and Community
Medicine, Shaikh Khalifa Bin Zayed Al-Nahyan
Medical College,
Shaikh Zayed Postgraduate Medical Institute,
Shaikh Zayed Medical Complex, Lahore.
drayeshah@gmail.com