



Impact of Habitual Activities on Age of Menarche among Bengali Adolescent School Girls

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Menarche, the first menstrual bleeding is the signal of initiation of reproductive age of girls. There is a secular decline in the average age at menarche. Age at menarche has significant impact on health in adulthood.

Objectives: The present study was an attempt to assess the mean age at menarche and to determine impact of habitual activities on age at onset of menarche.

Methods: A cross sectional questionnaire based study was conducted among school girls having age limit 10-14 years who experienced menarche not more than previous three months. Subjects were divided into two group- experimental and control. Experimental group consisted of subjects those attained menarche below 11.5 years. Subjects of control group attained menarche above 11.5 years. Quantitative data were presented as percentage and/or mean \pm standard deviation. t-test was done to determine significant of difference between physical characteristics of females early age at menarche and reference age at menarche. Chi square test and logistic regression analysis were done for analysis of our results.

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Results: 23% of study population acquired menarche at age below 11.5 years. Anthropometric parameters differed significantly between experimental and reference group. Significant association was observed between age at menarche with habitual activities. Logistic regression analysis suggested that habitual activities might be considered as determinants of early menarche.

Conclusion: Risk of early menarche increases with increasing duration of screen time and decreasing duration of daily physical activities like walking, outdoor playing and bicycle riding. Adolescent girls should encourage for physical activities and minimize including screen time.

Keywords: Early menarche; walking; playing; cycling; screen time; menstrual bleeding; outdoor playing; adolescent girls; daily physical activities.

1. INTRODUCTION

Menarche, the first menstrual bleeding, is a signal that indicates that a girl is entering into a reproductive age. Onset of menarche has been found to vary across countries. The mean age at menarche among US girls was 12.34 years [1] and India 12.6 years [2]. "Literature survey indicates that the average age of menarche has been decreased significantly in last 100 years. In the most develop countries like Europe and USA menarcheal age is decreased at a rate of 2-3 month per decade" [3]. "Recently such a decline tendency has also been reported in developing countries" [4]. Studying the age at menarche is quite interesting due to the huge public health implication associated with the changes in age at menarche. Girls with early menarche tend to have depression [5] metabolic syndromes [6], glucose intolerance [7], breast cancer [8], and cardiovascular disease [9]. "Younger age at menarche is a well-known risk for unplanned pregnancy, unsafe abortion, endometrioses sexually transmitted diseases including AIDS" [10, 11]. "Late menarche is associated with increased risk of osteoporosis" [12].

"From the early 1800s to the mid of 1950s menarche was occurred at increasingly younger ages" [3]. "The declining trend is still continuing in many parts of the world" [13,14]. "The advancement of socioeconomic and health condition in the 20th century led to shift to earlier menarcheal age. This shift was noted worldwide and called secular trend" [15,16]. "Depending on studies early menarche is defined from 9 to 11.5 years" [17].

"Various factors like socioeconomic status, genetic, heredity, ethnicity, psychological stress and chronic illness have been postulated to affect the age at menarche" [18,19]. Girls involved in physical activities had a lower chance for early menarche [20]. Physical inactivity is now considered as predisposing factors of early

menarche [21]. A recent study reported that physical inactivity and more sleeping hours induce early onset of menarche and physically inactive girls were overweight and mature at an early age [22].

During the past decades there have been remarkable change in way of living including food habit, free time activities, sleep and work patterns, lifestyle pattern and habits. With the advancement of technology and more scope of social media every section of society has declined their habitual physical activity. People including adolescent prefer to remain sedentary [23]. This study was aimed to investigate the influence of habitual activities of the individual over the menarcheal age.

2. MATERIALS AND METHODS

Subject: A cross-sectional study was done in Hooghly district and adjoining areas. The population was unmarried Bengali female adolescent students who were randomly selected from Secondary schools in the age group between 10 to 14 years who experienced menarche not more than previous three impact months to avoid significant change in physical features. It has been reported that there is no change in body weight greater than 5% in the previous three month [24]. "Students having age less than 10 years or more than 14 years, married, who have not started menstruating, Who has previous experienced of menarche more than three month, those who were taking regular drugs or hormonal therapy and suffering from chronic disorders including diabetes mellitus, clinically established hypertension, liver cirrhosis and kidney disease, suffering with secondary dysmenorrhea were excluded from the study" [25].

Sample size: This is cross sectional study using qualitative variable. Thus sample size was calculated using following equation: sample size

$= (Z_{1-\alpha/2})^2 p (1-p)/d^2$. Where $(Z_{1-\alpha/2}) =$ standard normal variate (at 5% type 1 error (confidence level 95%) where $P < 0.05$ it is 1.96. As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula. 'P' is expected proportion in population based on previous studies or pilot studies (according to previous studies girls with early age at menarche may not be more than 20%. 'd' is absolute error or precision (margin of error). It is considered as 5%. Thus sample size $= 1.96^2 \times 0.20 (1-0.20) / 0.05^2 = 245.86$. Thus for this cross sectional study at least 246 subjects should be taken. However, to accommodate a nonresponsive participant and strongest statistical power and effect size (design effect and population correction factor) the sample size was projected to 400. 426 students were participated in this study. Out of which 26 subjects' data were discarded due to some incomplete information.

Data collection: A self-administered questionnaire having questions related to their age, age when menarche appear and socioeconomic characteristics and life style. Age at menarche was obtained through recall, by calculating the time period between the day subjects menstruated first time and the date of birth.

2.1 Questionnaires for Data Collection from Participants

1. Name: 2. Address: 3. Locality: (Rural/urban/Semi urban) Under (Panchayet/Municipality/ Corporation) 4. Date of birth/Age (in year and month) 5. Date of menarche/age at menarche (in year and month) 6. Occupation: 7. Participation in exercise/yoga: (Yes/No); if Yes mention frequency/week: and duration /day 8. Participation in outdoor games: (Yes/No); if Yes mention frequency/week: and duration /day 9. Involve in bicycle riding: (Yes/No); if Yes mention frequency/week: and duration /day 10. Involve in walking: (Yes/No) if Yes mention frequency/week: and duration /day 11. TV watching: (Yes/No) if yes mention duration /day 12. Mobile phone use: (Yes/No) if Yes mention duration /day and purpose of use.

Anthropometric measurement: "Body weight was measured in light clothing and bare feet using bathroom scale accurate to 0.5kg. The scale was kept on a flat surface and adjusted with '0' mark. Now the subject was requested to

step on it in bare feet. Weight was recorded to the nearest 0.5kg. Height was measured using anthropometric rod without footwear on to the nearest 0.1 cm" [20]. "BMI was calculated from the height and weight using following equation: $BMI (kg/m^2) = weight (kg) / height^2 (m)$. WC was measured mid-way between iliac crest and lowermost margin of the ribs in quiet breathing using plastic tape" [26]. Hip circumference (HC) was measured using plastic tape at horizontal level of greater trochanters with the leg close together.

Assessment habitual activities: Information on the frequency and duration of outdoor playing, riding bicycle, free hand exercise, time spent in mobile phone for communication, whatsapp chatting, playing online games and listening songs and time spent in watching television (TV) program were retrieved from study questionnaire.

Statistical analysis: Quantitative data were presented as percentage and/or mean \pm standard deviation. t-test was done to determine significant of difference between physical characteristics of females early age at menarche and reference age at menarche. Chi square test was done for assessment of association between age at menarche and study parameters. Bivariate and multivariate logistic regression analysis was done to evaluate the impact of physical characteristics and habitual activities on early menarche. The significance level of the tests were considered at a significance level of 0.05.

3. RESULTS

Age at menarche varies from 100 month to 172 month. Mean age at menarche was 150.11 ± 9.36 month. Study population were divided into two group; Reference and experimental. Reference group consists of school girls those attained menarche at 11.5 to 14.4 years of age (138 month to 173 month). Whereas experimental group is composed of girls those attained menarche at age below 11.5 years (<138 month). Basic characteristics of control and experimental group of girls was given in Table 1. There was significant difference physical characteristics between experimental and control group of subjects.

Distribution of subjects on the basis of age at menarche was given in a Fig. 1. 23% subjects acquired menarche at an early age.

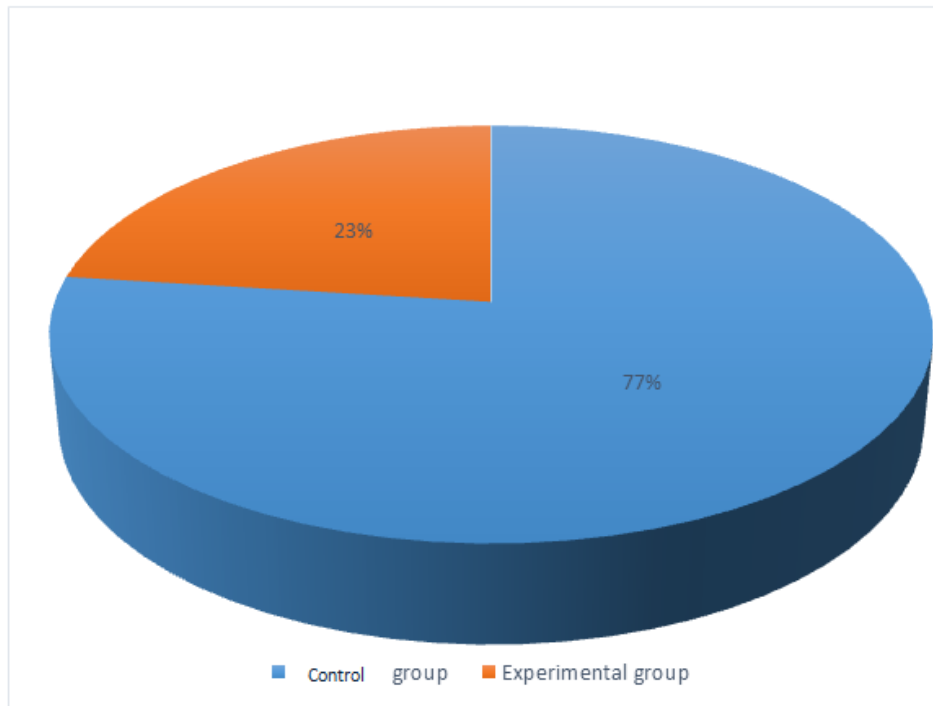


Fig. 1. Distribution of study population on the basis of age at menarche

Table 1. Comparison of basic characteristics of control and experimental group of adolescent girls

| Parameters | Control group (age at menarche 11.5 to 14.5 year) | Experimental Group (age at menarche <11.5 year) | P value |
|-----------------------------|---|---|---------|
| Number of participants | 308 (77%) | 92 (23%) | ----- |
| Height (cm) | 152.71 ± 5.80 | 152.36 ± 6.63 | > 0.05 |
| Weight (kg) | 46.77 ± 10.12 | 52.34 ± 12.77 | < 0.001 |
| Waist circumference (cm) | 59.71 ± 7.03 | 64.39 ± 7.52 | < 0.001 |
| Hip circumference (cm) | 64.99 ± 7.55 | 68.13 ± 7.47 | < 0.01 |
| BMI (kg/m ²) | 20.00 ± 3.77 | 22.39 ± 4.31 | < 0.001 |
| Waist- hip ratio (WC: HC) | 0.92 ± 0.04 | 0.94 ± 0.03 | < 0.001 |
| Waist height ratio (WC: Ht) | 0.40 ± 0.05 | 0.43 ± 0.05 | < 0.001 |

Table 2. Comparison of physical activity duration between control and experimental group

| Parameter | Control group | Experimental group | p |
|-----------------------------|---------------|--------------------|---------|
| Walking (hour/day) | 0.988 ± 0.707 | 0.591 ± 0.538 | < 0.001 |
| Playing (hour/day) | 1.144 ± 0.806 | 0.742 ± 0.567 | < 0.01 |
| Bicycle riding (hour/day) | 0.967 ± 0.691 | 0.692 ± 0.536 | < 0.02 |
| Total activities (hour/day) | 3.084 ± 1.472 | 2.069 ± 1.052 | < 0.001 |

Table 3. Comparison of screen time between Control and experimental group of girls

| Parameter | Control group | Experimental group | p |
|--------------------------------------|---------------|--------------------|---------|
| Television (hour/day) | 1.187 ± 0.747 | 1.802 ± 0.867 | < 0.001 |
| Mobile phone (hour/day) | 1.797 ± 0.975 | 2.091 ± 0.824 | < 0.05 |
| Television + mobile phone (hour/day) | 2.967 ± 1.353 | 3.890 ± 1.232 | < 0.001 |

Table 4. Chi square test for association of habitual activities with age at menarche

| Parameters Name | Subgroup | Age at menarche | | Chi square (df) | P value |
|---|----------|-------------------|-------------|--------------------|---------|
| | | 11.5 to 14.4 year | < 11.5 year | | |
| Walking (min/day) | 0-30 | 80 | 38 | 8.326 (2) | < 0.02 |
| | 31-60 | 116 | 25 | | |
| | > 60 | 112 | 29 | | |
| Playing (min/day) | 0-30 | 66 | 33 | 8.089 (2) | < 0.02 |
| | 31-60 | 128 | 33 | | |
| | > 60 | 114 | 26 | | |
| Bicycle riding (min/day) | 0-30 | 98 | 43 | 6.968 (2) | < 0.05 |
| | 31-60 | 120 | 29 | | |
| | > 60 | 90 | 20 | | |
| Walking+ Playing+ Cycling (min/day) | 0-120 | 94 | 52 | 23.120(2) | < 0.001 |
| | 121-240 | 140 | 32 | | |
| | ≥ 241 | 74 | 8 | | |
| Mobile phone use (min/day) | 0-60 | 114 | 15 | 22.621 (2) | < 0.001 |
| | 61-120 | 126 | 36 | | |
| | >120 | 68 | 41 | | |
| TV | 0-60 | 174 | 28 | 35.385 (2) | < 0.001 |
| | 61-120 | 98 | 30 | | |
| | >120 | 36 | 34 | | |
| Mobile + TV | 0 - 120 | 94 | 12 | 25.104 (2) | < 0.001 |
| | 121-240 | 154 | 40 | | |
| | > 240 | 60 | 40 | | |

Table 5. Logistic regression analysis for physical activities and age at menarche

| Parameter Name | Sub group | Age at menarche | | OR | 95% CI | p |
|--------------------------|-----------|-------------------|-------------|-------|----------------|--------|
| | | 11.5 to 14.4 year | < 11.5 year | | | |
| Walking (min/day). | 0-30 | 80 | 38 | Ref | -- | -- |
| | 31-60 | 116 | 25 | 0.454 | 0.254 – 0.810 | 0.0075 |
| | > 60 | 112 | 29 | 0.545 | 0.311 – 0.956 | 0.0343 |
| Playing (min/day) | 0-30 | 66 | 33 | Ref | ---- | --- |
| | 31-60 | 128 | 33 | 0.516 | 0.293 – 0.909 | 0.0219 |
| | > 60 | 114 | 26 | 0.456 | 0.251 – 0.828 | 0.0099 |
| Bicycle riding (min/day) | 0-30 | 98 | 43 | Ref | --- | --- |
| | 31-60 | 120 | 29 | 0.551 | 0.321 – 0.946 | 0.0308 |
| | > 60 | 90 | 20 | 0.506 | 0.277 – 0.925 | 0.0270 |
| Total physical activity | 0-120 | 94 | 52 | Ref | --- | --- |
| | 121-240 | 144 | 32 | 0.413 | 0.247 to 0.689 | 0.0007 |
| | ≥ 241 | 74 | 8 | 0.195 | 0.087 to 0.437 | 0.0001 |

Table 6. Logistic regression analysis for screen time and age at menarche

| Parameter Name | Sub group | Age at menarche | | OR | 95% CI | p |
|-----------------------------|-----------|-------------------|-------------|-------|-----------------|--------|
| | | 11.5 to 14.4 year | < 11.5 year | | | |
| Use of Mobile (min/day) | 0-60 | 114 | 15 | Ref | --- | --- |
| | 61-120 | 126 | 36 | 2.171 | 1.130 – 4.174 | 0.0200 |
| | >120 | 68 | 51 | 4.582 | 2.361 – 8.895 | 0.0001 |
| TV | 0-60 | 174 | 28 | Ref | --- | --- |
| | 61-120 | 98 | 30 | 1.902 | 1.074 to 3.369 | 0.0274 |
| | >120 | 36 | 34 | 5.634 | 3.171 to 10.862 | 0.0001 |
| Mobile + TV | 0 - 120 | 94 | 12 | Ref | --- | --- |
| | 121-240 | 154 | 40 | 2.035 | 1.016 to 4.074 | 0.0449 |
| | > 240 | 60 | 40 | 5.222 | 2.537 to 10.749 | 0.0001 |

Duration of physical activities of reference and experimental group of girls was given in Table 2. There was significant difference of duration of physical activities between experimental and reference group of subjects. Girls those spent more time in physical activity attend menarche in late age.

Duration of screen time (enjoy TV program and mobile phone) of reference and experimental group of girls was given in Table 3. There was significant difference in time spent in screen of TV and mobile phone between experimental and reference group of subjects. Girls with more screen time attend menarche in early age.

Results of chi square test for association between habitual activities with age at onset of menarche (Table 4) suggest that outdoor playing, walking, ridings of bicycle, time spent in mobile phone and time spent in TV watching significantly ($p < 0.05$) associated with menarcheal age.

We calculated odd ratio and relative risk for parameters of behavioral activities for assessment of influence for early menarche. Results of logistic regression analysis for assessment of behavioral activity and risk of early menarche was given in Table 5. Physical activities like walking, playing and bicycle riding delayed onset of menarche. Odd ratio and relative risk of early menarche decreased significantly in girls those involve in physical activities more than 30 min/day. Total duration of behavioral activities more than 2hour/day significantly decreases risk of early onset of menarche.

Risk of early menarche was more in girls those spent more time in mobile serving and TV watching. In respect to reference group (those spent 0-60 min/day in mobile) odd ratio was 2.17 and 5.7 times for girls those spent 61-120 min and more than 120 min in mobile use respectively. Like mobile phone use, similar pattern was noted for TV watching. Total screen time more than 2 hour/day significantly increases risk of early onset of menarche (Table 6).

4. DISCUSSION

The finding of this study revealed that there was significant difference in the habitual pattern between reference group and experimental group of girls. It was also found in this study that

behavioral activities whether active or sedentary plays significant role on age of onset of menarche. Physically active life style is a type of lifestyle involving more physical activities like outdoor playing, walking, bicycle riding etc. Sedentary lifestyle is a type of lifestyle involving little or no physical activity and spent time in lying down or sitting state and engaged in activities like socializing, watching TV, playing video games or using mobile phone. It is seen that girls those attend menarche at an early age are sedentary in compare with control group of girls. It is evident from the previous studies that lack of physical activity is associated with earlier onset of menarche [27].

Low physical activity and high sedentary time increases the risk of overweight and obesity particularly among adolescent girls [28]. It is also reported that obesity is associated with physical inactivity and sedentary behavior [29]. Screen time is positively associated with obesity [30]. In our study girls those attained menarche at an early age are physically inactive and involve more in sedentary time like screen time hence more chance of overweight and obese (high BMI). Results of our study reported that BMI and other anthropometric obesity indices significantly higher in girls those attained early menarche than control group. Body weight, BMI of a subject influence the age at menarche [31,32]. In our previous study we reported that increase in BMI is associated with decrease in menarcheal age [33]. The inverse relationship between BMI and age at menarche was supported by many other studies [34,35]. It has been proposed that effect of physical activity on menarche time is mediated by volume of adipose tissue [36]. The adipocyte secretes hormone leptin which increases with the amount of body fat. Leptin stimulate hypothalamus to secrete gonadotropin releasing hormone which in turn stimulate pituitary-ovarian axis and reproductive maturation in women [37].

Physical activity reduces endogenous estrogen by increasing metabolism and excretion whereas sedentary lifestyle reduces metabolism and excretion of estrogen [38]. Thus endogenous estrogen levels become high in girls those are physically less active and spent more sedentary time. It is well established that estrogen plays a major role in onset of menarche as first menstruation is anovulatory (estrogen break through bleeding). Thus endogenous high estrogen level due to less physical activity and more screen time may be one of the cause of early onset of menarche.

5. CONCLUSION

The present study reveals that behavioral activities significantly influence the age at menarche. The girls who had a sedentary lifestyle pattern attained menarche earlier compare to those who had active lifestyle pattern. Physical inactivity is one of the risk factor of early onset of menarche. Risk of early menarche increases with increasing duration of screen time and decreasing duration of daily physical activities like walking, outdoor playing and bicycle riding. Adolescent girls should encourage for physical activities along with their study scheduled and minimize sedentary lifestyle including screen time.

CONSENT AND ETHICAL APPROVAL

The study was non-invasive. The prior written permission of the Institutional authority was taken. The written informed consent was obtained from the study participants and their parents after the purpose of the study was explained. Participants were informed that the data obtained from them would be kept confidential.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Elizabeth MN. Trends in age at menarche. SIUC (Southern Illinois University Carbondale); 2011.
2. Rokad S, Mone AJ. A study of age at menarche, secular trend and factors associated with it. *J BiolAnthropol.* 2008; 3:1-7.
3. Rah JH, Shamim AA, Arju UT, Labrique AB, Rashid M, Christian P. Age of onset, nutritional determinants and seasonal variations in menarche in rural Bangladesh. *J Health PopulNutr.* 2009; 27(6):802-807.
4. Pathak PK, Tripathi N, Subramanian SV. Secular trend in menarcheal age in India- evidence from Indian Human development Survey. *PloS One.* 2014;9(11). DOI: org/10.1371/journal.pone.0121627
5. Mentle J, Ryan RM, McKone KMP. Age at menarche, depression and antisocial behavior in adulthood. *Pediatrics.* 2018;141(1):e20171703. DOI: 10.1542/peds-20171703
6. Hwang Y-S, Park E-J, Choi J-G, kim H-E, Yoo S-M. Relationship between age at menarche and syndrome in premenopausal women: Korea national health and nutrition examination survey 2013-2014. *Korea J Fam Med.* 2018;39(5):300-306.
7. Santos MP, Li Y, Bazzano L, He J, Rexorde KM, Ley SH. Age at menarche, type-2 diabetes and cardiovascular disease complications in US women aged under 65 years: NHANES 1999-2018. *BMJ NutrPrev Health.* 2023;6:e000632. Doi: 10.1136bmjnph.2023-000632
8. Petridou E, Syrigou E, Toupadaki N, et al. Determinant of age at menarche as early life predictors of breast cancer risk. *Int J Cancer.* 1996;68:193-198.
9. Lee JJ, Cook-Wiens g, Johnson BD, Braunstein GD, Berga SL, et al. age at menarche and risk of cardiovascular disease outcomes: finding from the national Heart, Lung and Blood Institute sponsored Womens' ischemia syndrome evaluation. *J Am Heart Asso.* 2019;8(12):e02123406. DOI: 10.1161/JAHA-119012406
10. Laurie B. Late age of menarche linked to lower risk for endometriosis. *American j Obsterit Gynecol;* 2010. Available:<http://www.medscape.com/viewarticle/714499>
11. Golub MS, Collman GW, Foster PM et al. Public health implications of altered puberty timing. *Pediatrics.* 2008;121(3): 218-230.
12. Yang Y, Wang S, Cong H. Association between age at menarche and bone mineral density in post-menopausal women. *J OrthopSurg Res.* 2023;18:51. DOI: org://10.1186/s13018-023-03520-2
13. Ouj U, Ve E. Age at menarche and the menstrual pattern of women Igbo state southeast Nigeria. *Affric J Reprod Health.* 2008;1(2):90-95.
14. Biro EM, Pajak A, Wolff MS, Pinney SM, Windham GC, Galvez MP et al. Age at menarche in a longitudinal US cohort. *J*

- PediatrAdoles Gynecol. 2018;31(4):339-345.
15. Terhani FR, Mirmitan 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. DOI: 10.5812/ijem.16130
 16. Hickey M, Lawson LP, Marino JL, Keelan JA, Hart R. Relationship between umbilical cord sex hormone binding globulin, sex steroids and age at menarche: A prospective cohort study. *Fertil Steril.* 2018; 110(5):965-973.
 17. Mrug S, Elliott M, Gilliland MJ, Grunbaum JA, Tortolero SR, Cuccaro P, Schuster M. Positive parenting and early puberty in girls. *Archives of Pediatrics and Adolescent Medicine.* 2008;162: 781-786.
 18. Malitha JM, Islam MA, Islam S, Al Manum ASM, Chakraborty S, Hossain MG. Early age at menarche and its associated factors in school girls (ages 10-12 years) in Bangladesh: a cross sectional survey in Rajshahi district, Bangladesh. *J Physiol Anthropol.* 2020;39:6. DOI: org//10.1186/s40101-020-00218-w
 19. Pandey M, Pradhan A. Age of attainment of menarche and factors affecting it amongst school girls of Gangtok, Sikkim, India. *Int J Contemp Pediatr.* 2017;4(6): 2187-2192.
 20. Calthrope L, Barge S, Ong KK. Systemic review and meta-analysis of the association between childhood physical activity and age at menarche. *Acta Paediatrica.* 2019;108:1008-1015.
 21. Karapanou O, Papadimitriou A. Determinants of menarche. *Reprod Biol Endocrinol.* 2010;8: 20920296.
 22. Ajita A, Jiwanjot JJ. Overweight and physical activity as a major of age at menarche in females. *Am J Sport Sci Media.* 2014;1(2):32-34. DOI: 10.12691/ajssm-2-1-6
 23. World Health Organization. Country factsheet insufficient physical activity Bahrain; January 2022. Available: <https://apps.who.int/iris/handle/10665/204241>
 24. Pulungan AB, Nugraheni RP, Advani N, Akib AAP, Devaera Y, Sjakti HA, Andarie AA. Age at menarche and body fat in adolescent girls. *Pediatr Indones.* 2020;60(5):269-276. DOI: 10.14238pi60.5.2020.269-76
 25. Banerjee P, Pramanik P. Body composition and somatic indices: Determinants of timing of menarche. *World Journal of Biology Pharmacy and Health Sciences.* 2023;15(3):059-67.
 26. Androutsos O, Grammatikaki E, Moschonis G, Roma-giannikou E, Chrousos GP, Manios Y, Kanaka-Gantenbein C. Neck circumference: A useful screening tool of cardiovascular risk in children. *Pediatric Obesity.* 2012;7:187-195.
 27. Idris M, Wolday SJ, Habteselassie F, Ghebremichael L, Andemariam M, et al. Factors associated with early age at menarche among female secondary school students in Asmara: A cross-sectional study. *Global reprod Health.* 2021;6:e51.
 28. Mo Z, Wang H, Zhang B, Ding G, Popkin BM, Du S. The effect of physical activity and sedentary behaviors on overweight and obesity among boys may differ from those among girls in China: An open cohort study. *J Nutr.* 2022;152:1274-1282.
 29. Lavie CJ, Ozemek C, Carbone S, Katzmarzyk PT, Blair SN. Sedentary behavior, exercise and cardiovascular health. *Cir Res.* 2019;124:799-815.
 30. Talukder A, Dasgupta R, Hashan MR, Haider SS, Sajal IH, Sarkar M. Association between television viewing and overweight and obesity among women of reproductive age in Timor-Leste: Evidence from demographic health survey 2016. *BMJ Open.* 2021; 11(8):e045547. DOI: org/10.1136/bmjopen.2020-045547
 31. Mohamad K, Jamshidi L, Nouri JK. Is age at menarche related with body mass index? *Iranian J Publ Health.* 2013;42(9):1043-1048.
 32. Agrawal M, Agrawal A. Study of correlation between age of menarche and body mass index in adolescent. *Int J Reprod Contracep Obsteric Gynecol.* 2022;11(8). DOI: org/10.1820312320-1770.ijrcog20221931
 33. Banerjee P, Pramanik P. Body composition and somatic indices: Determinants of timing of menarche. *World J Biol Pharmacy Health Sci.* 2023;15(3):059-067.
 34. Khalid H, Khawar K, Fawad M, Farhat M, Imran M, Shahnawaz M, et al. Age of menarche in relation to socioeconomic status, BMI, physical activity and stress

- among high school girls. Proceeding S.Z.P.G.M.I. 2015;29(1):35-40.
35. Shrestha A, Olsen J, Ramlau-Hansen CH, Bech BH, Nohr EA. Obesity and age at menarche. Fertility and Sterility. 2011;95:2732-2734.
36. Roupas ND, Georgopoulos NA. Menstrual function in sports. Hormones (Athens). 2011;10:104-116.
37. Chavarro J, Villamor E, Narvaez J, Hoyos A. Socio-demographic predictors of age at menarche in a group of Colombian University women. Ann Hum Biol. 2004;31:245-257.
38. Dallal CM, Brinton IA. Association of active and sedentary behaviors with postmenopausal estrogen metabolism. Med Sci Sports Exerc. 2016;48(3):439-448.

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