Original Research Paper

Community Medicine

AGE OF MENARCHE AND ITS ASSOCIATED METABOLIC FACTORS AMONG YOUNG FEMALE ADULTS IN KERALA

Dr Anjali Lakshmanan*	Junior Resident, Department of Community Medicine, KMCT Medical College, Kozhikode, Kerala, India. *Corresponding Author
Dr Jayakrishnan Thayyil	Professor & HOD, Department of Community Medicine, KMCT Medical College, Kozhikode, Kerala, India.
Dr Navya Gangadharan	Assistant Professor, Department of Community Medicine, KMCT Medical College, Kozhikode, Kerala, India.
Dr Sruthikrishna Punathukandi	Senior Resident ,Department of Community Medicine, KMCT Medical College, Kozhikode, Kerala, India.
Dr Ahana Salam	Junior Resident Department of Community Medicine, KMCT Medical College, Kozhikode, Kerala, India.

ABSTRACT A cross-sectional study was conducted among 200 medical undergraduate students with an objective to study the age of menarche and its associated lifestyle and metabolic factors. **Materials And Methods:** Study subjects were directly interviewed with the help of a proforma which includes socio-demographic factors, anthropometric factors like BMI,waist circumference, birth weight, Biochemical parameters like Haemoglobin,Total Cholesterol,Low Density Lipoprotein(LDL),Thyroid Stimulating Hormone(TSH).Data was analysed using IBM SPSS 23. **Results:** Mean age of menarche in the study subjects was 12.9($\pm$1.24) years in which 10.8% had the onset of their menarche before 12 years.Significant association was found between early age at menarche and Waist circumference,T.cholesterol and LDL(p value< 0.05).Maternal age of menarche was found to be 16.2($\pm$0.98)years. **Conclusion:** Decline in trend in the mean age of menarche was found among young female adults compared to their mothers.It also shows a significant association between early age at menarche and metabolic risk factors like elevated total cholesterol, LDL and increased waist circumference.

KEYWORDS : *Early Menarche, Metabolic Factors, Lifestyle Factors, Young Adults*

INTRODUCTION

Menarche being a life changing event in a girl's life where she starts changing physically, mentally and emotionally.[1]Age at menarche has found to be declining in recent years at the rate of approximately four months per decade.[2]Various plausible factors influence the age of menarche in which increasing rates of childhood obesity has been postulated to be an important factor.[3]

Recent epidemiological evidences hinted at social, psychological and public health challenges stemming from the secular decline in age of menarche.[4] Several spatial variations in the age of menarche were documented within sub-national human populations. For instance, in developing countries, the mean menarcheal age ranged from 12.38 in China, 15.8 in Bangladesh, 16.2 years in Nepal, 14.3 in India (Punjab), 13.5 in Sri Lanka and while in developed countries, it varied from 13.3 years in Great Britain, 13.05 in France to 12.8 in the United States.[5]

Early age at menarche was strongly associated with psychosocial disorders, metabolic syndrome, cardiovascular disorders, substance abuse, premature parenthood, obesity, breast cancer, ovarian cancer, and delinquent behaviour, and poor academic performance.[6] Various factors which includes genetics, race, environmental conditions, nutrition, physical inactivity, geographic location, health status, psychological factors, body mass index , family size, socioeconomic status have been found to significantly related to the onset of age of menarche.[7]Girls with early menarche (< 12 years) are more prone to develop obesity, and this association would remain until adulthood, increasing the chance of developing metabolic and cardiovascular risk factors like elevated total cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, high blood sugar and hypertension[8]

Stress and emotional disturbances,increased menstrual bleeding, dysmenorrhea, and premenstrual syndrome are common menstrual abnormalities which effect female adolescents after menarche and around 75% of girls have some of these menstrual abnormalities.[9] This supports the idea that menstruation related problems should be prioritized and addressed as a community health problem.[10]

Studies on age of menarche and its associated metabolic and lifestyle factors among young adult females are limited in India. We have scarce information on age of menarche, a key vital topic in understanding adolescent reproductive health. Key literature focuses mainly on high-income countries. We need to establish trends and patterns in low-income and middle-income countries as well, to understand causes and possible implications.

OBJECTIVES

1. To study the age at menarche and its associated lifestyle and metabolic factors among study population.
2. To assess the menstrual problems among study population.

METHODOLOGY

A cross-sectional study was conducted among two batches of female medical undergraduate students of a medical college in Calicut district, Kerala. Study was conducted between January 2023 to June 2023. Data was extracted from a health screening and wellness programme conducted in the Department of Community Medicine by the same investigators. Females with bleeding disorders and congenital heart diseases were excluded from the study.

Study subjects were directly interviewed with the help of a proforma which includes socio demographic factors like age, gender, diet, age of menarche, maternal age of menarche, anthropometric factors like height, weight, BMI, waist circumference, birth weight and also the menstrual history including menstrual comorbidities. Maternal age of

menarche was collected from the mothers of subjects through telephone. The physical parameters like height and weight were measured by stadiometer and standard weighing scale respectively. Waist and hip circumference were measured in cm by using an unstretchable measuring tape. Birth weight was obtained from the birth records produced by the participants. Blood pressure was recorded using sphygmomanometer (AccuSure AS Series) and classified according to Joint National Committee-8(JNC-8)[11]. Body Mass Index (BMI) was calculated and categorized according to Asian-Pacific classification[12]. Those who attained menarche at less than 12 years were considered as early menarche. Biochemical parameters like Haemoglobin, Total Cholesterol, Low Density Lipoprotein (LDL), Thyroid Stimulating Hormone (TSH) were done from hospital lab with National Accreditation Board for Testing and Calibration Laboratories (NABL) accreditation. All the biochemical variables were categorized as per WHO classification[13,14,15,16].

Sample size was calculated by $4(SD)^2/d*d$ where standard deviation was taken as 1.24 years based on previous study conducted recently in the same country[17] with absolute allowable error of 20%. The minimum sample size calculated was 170 with a non response rate of 10%. Then the subjects were selected consecutively till 200.

The ethical clearance for conducting the study was granted by the Institutional Ethical Clearance Committee. Privacy and Confidentiality of the data was maintained and the identity of the study subjects was not mentioned anywhere in the study.

Statistical Analysis
Quantitative variables were expressed as mean and standard deviation and qualitative variables were expressed as percentage and frequency. Chi square test was used for finding the association between age at menarche and various lifestyle and metabolic factors in the study. Data was analysed using IBM SPSS 23.

RESULTS
Out of the 200 selected study subjects, 7 were excluded in the analysis due to lysed and inadequate sample for testing. Hence the final subjects taken for analysis were 193. Mean age of the study subjects were 20.5($\pm$1.18)years. Mean of physical parameters like Height and weight were 157.5($\pm$5.55)cm. and 57.8($\pm$8.9)kg respectively. The BMI was 23.1 ($\pm$4.1)kg/m^2 in which 14(7.3%) were underweight, 37 (19.2%) were overweight and 55(28.5%) were obese, Waist circumference was 79($\pm$8.9) cm out of which 81(41.5%) were having waist circumference more than 80cm. Subjects following non vegetarian diet were 187 (96.9%) and vegetarian diet were 6(3.1%). SBP was 112.5 ($\pm$9.06) mm Hg and DBP 75.2($\pm$7.3) mm Hg. Birth weight was found to be 2.88 ($\pm$0.51) kg.

Biochemical parameters like Hb was 12.4($\pm$1.2) g/dl in which 34.2% had low Hb (below 12) , T.Cholesterol was 188.3 ($\pm$28.6) mg/dl in which 41.5% had elevated cholesterol level (>200 mg/dl), LDL was 118.31 ($\pm$27.04) mg/dl in which 40.9% had high LDL levels as shown in Table 1.

Mean age of menarche in the study subjects was 12.9 ($\pm$1.2) years in which 10.8% had the onset of their menarche earlier (before 12 years). Maternal age of menarche was found to be 16.2 ($\pm$0.98) years.

Subjects with menstrual problems were found to be 42.4% (82).Various menstrual problems were Menorrhagia (20.7%; n=40), Dysmenorrhoea (9.8%; n=19), mood fluctuations (2.6%; n=5), Vomiting (6.2%;n=12), Polycystic ovarian syndrome(PCOS) (3.1%;n=6) in which daily activities of 50.8% participants got affected due to these menstrual problems.

Table 2 shows the association between the age of menarche and various factors like Birth weight, BMI, Waist circumference, SBP, DBP, Hb, Total Cholesterol, LDL, TSH . It showed a significant association between early age at menarche and Waist circumference, T.cholesterol and LDL (p value < 0.05) (Table:2). No statistically significant relationship was found between menarcheal age and anthropolometric factors like Height, Weight, BMI and Birth weight and biochemical factors like Hb and TSH.

Table 1 Baseline Characteristics				
Variable	Category	Frequency((N=193)	Percentage(%)	Mean ± SD
Mean age of Menarche(years)	<12	23	10.8	12.9±1.2
	≥12	170	88.1	
BMI(kg/m^2)	<18	14	7.3	23.1±3.9
	18-22.9	87	45	
	23-24.9	37	19.2	
	≥25	55	28.5	
Waist Circumference(cm)	<80	113	58.5	79.05±8.9
	≥80	80	41.5	
Systolic Blood Pressure (mm hg)	≤120	179	92.7	112.5±9.06
	>120	14	7.3	
Diastolic Blood Pressure (mm hg)	≤80	176	91.2	75.2±7.2
	>80	17	8.8	
Birth Weight(kg)	<2.5	31	16	2.8 ± 0.5
	≤2.5	162	84	
Haemoglobin(g/dl)	<12	66	34.2	12.4 ± 1.2
	≥12	127	65.8	
Total Cholesterol(mg/dl)	<200	113	58.5	188.3 ±28.6
	≥200	80	41.5	
Low Density Lipoprotein(mg/dl)	<130	114	59.1	118.3±27.4
	≥130	79	40.9	
Thyroid Stimulating Hormone (mIU/ml)	<0.5	8	4.1	1.7 ±0.8
	0.5-4	182	94.3	
	≥4	3	1.6	

Table 2: Association between age of menarche and metabolic factors

Variables		Early age of menarche (<12y) n = 23(10.8%)	≥12 y n=170 (89.2%)	X^2	p value
BMI	<18	0	14 (8.2)	3.48	0.32
	18-22.9	11(47.8%)	76 (44.7)		
	23-24.9	3 (13%)	34 (20)		
	≥25	9 (39.2%)	46 (27.1)		
WC	<80	9 (39.2%)	104 (61.1)	4.05	**0.04***
	≥80	14 (60.8%)	66 (38.9%)		
SBP	≤120	20 (87%)	159 (93.5%)	1.30	0.25
	>120	3 (13%)	11 (6.5%)		
DBP	≤80	19 (82.6%)	157 (92.4%)	2.39	0.12
	>80	4 (17.4%)	13 (7.6%)		
BW	<2.5	4 (17.4%)	27 (15.9%)	0.03	0.85
	≥2.5	19 (82.6%)	143 (84.1%)		
Hb	<12	10 (43.5%)	56 (32.9%)	1.00	0.31
	≥12	13 (56.5%)	114 (67.1%)		
T.cholesterol	<200	9 (39.2%)	104 (61.1%)	4.05	**0.04***
	≥200	14 (60.8%)	66 (38.8%)		
LDL	<130	9 (39.2%)	105 (61.7%)	4.29	**0.03***
	≥130	14(60.8%)	65 (38.2%)		
TSH	<0.5	0	8(4.7%)	1.73	0.63
	0.5-4	23(100%)	159 (93.5%)		
	≥4	0	3(1.8%)		

DISCUSSION

Current study was conducted among 193 young female adults to understand the mean age of menarche and its associated metabolic factors. Menarcheal age of the study subjects was 12.9(± 1.2) years , similar to that reported by Tarannum et al in India[17] and the maternal age of menarche was 16.2(± 0.9) years. This shows that there is a huge decline in the trend of age of menarche in two generations, which might be due to several factors like increased consumption of fast food, oily and fried foods, nutritional deficiency, inadequate sleep and sedentary lifestyle in new generations. The mean ages of menarche among Indian girls reported in two other recent studies Radha SS and Solanki S et al et al were 12.1 and 12.4 years respectively[18,11]Similar finding was reported in the study conducted by Pathak PK et al. on "Secular Trends in Menarcheal Age in India-Evidence from the Indian Human Development Survey" where a secular decline of a month per decade in the age of menarche was found.[19]

In this study it was observed that 60.8 % of the participants with early menarche had elevated total cholesterol and LDL levels which could be due to nutritional and lifestyle factors. 34.2% of the study participants had Anaemia which could be resulted due to early initiation of bleeding and menorrhagia as 10.8% of the participants had the onset of their menarche earlier and 20.7% of the participants had Menorrhagia.

Current study demonstrated a negative association between early age at menarche and waist circumference (p=0.04), T.cholesterol(p=0.04) and LDL (p=0.03). However found no significant relationship between age of menarche and anthropometric factors like height, weight, BMI (p=0.32) and Birth weight(p=0.85). Increased consumption of junk food and nutritional deficiency due to lack of fruits and vegetables in the diet, inadequate sleep, lack of physical activity would be a possible mediator of this association.

In this study, 42.4% of the study population suffer from various menstrual problems like Menorrhagia (20.7%), Dysmenorrhoea (9.8%), mood fluctuations (2.6%), Vomiting(6.2%), PCOS (3.1%). 50.8% participants'daily activities got affected due to these menstrual problems. Supporting to this study findings, in a study conducted by Manisha et.al. and Divya et.al in the year 2022 it was found that Premenstural symptoms, dysmenorrhea, and irregular menstrual periods affected 86% , 27% and 12% people, respectively[20,21].

There are several explanations for the various factors that affect age at menarche; these include the nutritional status and environmental conditions as well as genetic determinants. Furthermore the recruitment of study subjects and the type of study have a great impact of the age at menarche and its other influencing factors . This study has the advantage of doing the study in a population where young female adults from all part of the state were included in this study setting. Furthermore, the amount of intra-observable variability in the data is likely to be minimal, because all the laboratory measurements were evaluated by the same person in the laboratory which is NABL accredited

CONCLUSION

Decline in trend in the mean age of menarche was found among young female adults compared to their mothers. It also shows a significant association between early age at menarche and metabolic risk factors (elevated total cholesterol, LDL and increased waist circumference) which in turn is a major risk for developing various Non Communicable diseases in future.

REFERENCES:

1. Namboothri NG, Chacko VI, Rashmi A, Shreyaswi S, Manjula A. (2020). Factors influencing age at menarche – a school based cross sectional study. *Indian Journal of Community Health*, *32*(2), 444–446. https://doi.org/10.47203/ijch.2020.v32i02.025
2. Lehmann, A., Scheffler, C., & Hermanussen, M. (2010). The variation in age at menarche: An indicator of historic developmental tempo. *Anthropologischer Anzeiger*, *68*(1), 85–99. https://doi.org/10.1127/0003-5548/2010/0086
3. Kaplowitz, P. B., Slora, E. J., Wasserman, R. C., Pedlow, S. E., & Herman-Giddens, M. E. (2001). Earlier onset of puberty in girls: Relation to increased body mass index and Race. *Pediatrics*, *108*(2), 347–353. https://doi.org/10.1542/peds.108.2.347
4. Walvoord, E. C. (2010). The timing of puberty: Is it changing? does it matter? *Journal of Adolescent Health*, *47*(5), 433–439. https://doi.org/10.1016/j.jadohealth.2010.05.018
5. Thomas, F., Renaud, F., Benefice, E., Meeus, T. de, & Guegan, J.-F. (2001). International variability of ages at menarche and menopause: Patterns and main determinants. *Human Biology*, *73*(2), 271–290. https://doi.org/10.1353/hub.2001.0029
6. Pierce, M. B., & Leon, D. A. (2005). Age at menarche and adult BMI in the Aberdeen Children of the 1950s cohort study. *The American Journal of Clinical Nutrition*, *82*(4), 733–739. https://doi.org/10.1093/ajcn/82.4.733
7. Gaudineau, A., Ehlinger, V., Vayssiere, C., Jouret, B., Arnaud, C., & Godeau, E. (2010). Factors associated with early menarche: Results from the French health behaviour in school-aged children (HBSC) study. *BMC Public Health*, *10*(1). https://doi.org/10.1186/1471-2458-10-175
8. Bleil, M. E., Adler, N. E., Appelhans, B. M., Gregorich, S. E., Sternfeld, B., & Cedars, M. I. (2013). Childhood adversity and pubertal timing: Understanding the origins of adulthood cardiovascular risk. *Biological Psychology*, *93*(1), 213–219. https://doi.org/10.1016/j.biopsycho.2013.02.005
9. Lee LK, Chen PCY, Lee KK, Kaur J.(2006) Menstruation among adolescent girls in Malaysia:A cross-sectional school survey. Singapore Med J. ;47:869–74.
10. Stang, J. (n.d.). *Guidelines for adolescent nutrition services*. Google Books.

https://books.google.com/books/about/Guidelines_for_Adolescent_Nutritio n_Serv.html?id=g_fwMgEACAAJ

11. Solanki, Dr. S., Soni, Dr. A., Randa, Dr. V., & Choudhary, Dr. R. (2021). A study to determine age at menarche in adolescent school girls of Indore city, M. P. India. *International Journal of Medical Research & Review*, 9(2), 70–75. https://doi.org/10.17511/ijmrr.2021.i02.03

12. Armstrong, C. (2014, October 1). *JNC 8 guidelines for the management of hypertension in adults.* American Family Physician. https://www.aafp.org/pubs/afp/issues/2014/1001/p503.html

13. Expert Panel on the Identification, E. (1998, September 28). *Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults.* Archives of Internal Medicine. https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/209654

14. *FAO Statistical Yearbook 2021 - World Food and Agriculture - World.* ReliefWeb. (2021, November 4). https://reliefweb.int/report/world/fao-statistical-yearbook-2021-world-food-and-agriculture

15. Grundy, S. M., & Stone, N. J. (2019). 2018 American Heart Association/American College of Cardiology Multisociety Guideline on the management of blood cholesterol. *JAMA Cardiology*, 4(5), 488. https://doi.org/10.1001/jamacardio.2019.0777

16. Garber, J. R., Cobin, R. H., Gharib, H., Hennessey, J. V., Klein, I., Mechanick, J. I., Pessah-Pollack, R., Singer, P. A., & Woeber for the American Association, K. A. (2012). Clinical practice guidelines for hypothyroidism in adults: Cosponsored by the American Association of Clinical Endocrinologists and the American Thyroid Association. *Thyroid*, 22(12), 1200–1235. https://doi.org/10.1089/thy.2012.0205

17. Tarannum, F., Khalique, N., & Eram, U. (2017). A community based study on age of menarche among adolescent girls in Aligarh. *International Journal Of Community Medicine And Public Health*, 5(1), 395. https://doi.org/10.18203/2394-6040.ijcmph20175820

18. Radha, S., & Chellappan, V. (2015). Age at menarche and its relation with nutritional and socioeconomic status—a study among adolescent school girls. *International Journal of Medical Science and Public Health*, 4(6), 777. https://doi.org/10.5455/ijmsph.2015.15012015157

19. Pathak, P. K., Tripathi, N., & Subramanian, S. V. (2014). Secular trends in menarcheal age in India-evidence from the Indian Human Development Survey. *PLoS ONE*, 9(11). https://doi.org/10.1371/journal.pone.0111027

20. Upadhyay, M., Mahishale, A., & Kari, A. (2023). Prevalence of premenstrual syndrome in college going girls - A Cross Sectional Study. *Clinical Epidemiology and Global Health*, 20, 101234. https://doi.org/10.1016/j.cegh.2023.101234

21. Divya, S., Thomas, T. M., Ajmeera, R., Hegde, A., Parikh, T., & Shivakumar, S. (2023). Assessment of the menstrual problems among teenage girls: A tertiary care center study. *Journal of Pharmacy and Bioallied Sciences*, 15(Suppl 1). https://doi.org/10.4103/jpbs.jpbs_495_22