Original Article

Adiposity markers and its association with age at menarche: A comparative study among rural and urban Meitei females of Manipur, North-East India

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ARTICLE INFO

ABSTRACT

Background: Menarche is a critical biomarker in the reproductive life of females. Early age at menarche may represent an indicator of adult adiposity. The study examines the association of various adiposity markers with age at menarche in rural and urban Meitei females of Manipur, India.

Methods: A cross-sectional study was conducted among rural and urban Meitei females of Manipur of age 18–45 years. Detailed information of the participants was taken with the help of proforma. Various anthropometric and physiological measurements were also recorded.

Results: Mean age at menarche was 12.5 years for urban females and 13.1 years for rural females. Females of urban and rural areas under overweight category of BMI had higher odds of attaining early menarche. Odds of having early menarche were found to be highest among those with risk category of waist hip ratio, waist height ratio and waist circumference in both rural and urban females.

Conclusion: Females with higher body mass index, high waist-to-hip ratio and waist height ratio were found to be at risk of early menarche.

1. Introduction

One of the major biological event or physiological change which takes place among girls during puberty is the onset of menarche, the first menstrual period. Menarche, the symbolic start of womanhood [1] is one of the most significant milestones in a woman's life [2]. Girls attain menarche at different ages. The average age at menarche ranges from 10 to 16 years in most girls [3,4], but it shows a remarkable range of variation between individual and population [5]. It is also influenced by variables such as genetic factors, body mass index [6], body composition [7], nutritional status, urban and rural conditions [8].

Early menarche is associated with an increased risk of certain diseases and is reported to be one of the significant risk factors for metabolic syndrome such as obesity [9], type 2 diabetes and other cardiovascular disease [10].

Early age at menarche, together with other indicators of early biological maturity has been shown to be associated with increased adult body mass index (BMI). Adiposity in childhood and factors that promote the accumulation of body fat are associated with an earlier age at menarche [11] that increases adiposity tracks from childhood to adulthood [12]. Early age at menarche may be one of the influencing factors of high blood pressure [13]. Girls with higher waist circumference, waist-height ratio, hip circumference, hip-height ratio, body fat percentage and mid-upper arm circumference are prevalent to attained early menarche [14]. Improved nutritional status has been attributed causing lowered age at menarche [15]. Not many studies have been conducted on relationship between age at menarche and adiposity measures in North-East India. The present study was therefore undertaken to find out the association of various adiposity markers with age at menarche in rural and urban Meitei females of Manipur, India.

2. Methodology

The present cross-sectional study was carried out among Meitei females residing in urban and rural areas of *Imphal West district*, Manipur. A total of 400 females of age group 20–45 years were studied 200 each from urban and rural areas. Before taking the detail information and measurements, the purpose of the study was explained to each participants and a consent form was taken

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from them. Ethical clearance was taken from Department Ethical committee.

Age at menarche was recorded using 'recall method'. Anthropometric measurements such as stature, body weight, mid upper arm circumference, minimum waist circumference and maximum hip circumference were taken using standardized techniques according to Weiner and Lourie [16]. Body mass index (BMI), was calculated from the height and weight using the equation: BMI = weight (kg)/height^2 (m). The studied participants were classified on the basis of BMI following WHO International Standard and recommended cut-off points for Asians. Waist hip ratio (WHR) and Waist height ratio (WHtR) were also calculated. Physiological measurements taken were systolic blood pressure and diastolic blood pressure. JNC VII, 2003 classification was followed for blood pressure.

2.1. Statistical analysis

SPSS (Statistical Packages for Social Sciences) version 16.0 was used to carry out statistical analysis. Descriptive statistics of mean and standard deviation were used to examine the data. Risk factors of the variables were determined by using multinomial logistic regression. Pearson correlation coefficient was used to determine the relationship between age at menarche with anthropometric and physiological variables.

3. Results

Basic measurements between the rural and urban females are shown in Table 1. Mean age at menarche was found to be significantly lower among urban females (12.5 years) as compared with rural females (13.1 years). Mean values of weight, waist circumference, systolic blood pressure, diastolic blood pressure, pulse rate, body mass index and waist hip ratio were found to be significantly higher among urban females as compared to rural females. Waist height ratio was found to be higher in urban females as compared to rural females and was not statistically significant.

Distribution of subjects according to categories of adiposity and cardiovascular markers is shown in Table 2. Among urban females, 4.5 percent were found to be underweight, 57 percent were normal and 38.5 percent were under over-weight category of BMI while among rural females, it was found to be 13.5 percent, 50 percent and 36.5 percent respectively. It was found that among urban females, 84.5 percent females were in normal and 15.5 percent to be under risk category with respect to waist circumference. While among rural females, it was found to be 83 percent and 17 percent respectively.

Distribution of partcipants according to categories of age at

Table 1
Basic measurements.

Variables	Mean ± S.D		t-test
	Urban	Rural	
Age at menarche (years)	12.5 ± 1.60	13.1 ± 1.20	−4.99***
Height(cm)	153.5 ± 4.96	152.9 ± 4.39	1.09
Weight(kg)	53.8 ± 7.97	51.6 ± 8.19	2.72**
Mid upper arm circumference(cm)	24.5 ± 2.58	24.1 ± 14.35	0.33
Minimum waist circumference(cm)	74.5 ± 8.90	73.0 ± 8.75	1.67
Maximum hip Circumference(cm)	90.0 ± 7.24	87.3 ± 7.53	3.64***
Systolic blood pressure(mmHg)	119.8 ± 7.98	117.4 ± 7.95	2.95***
Diastolic blood pressure(mmHg)	80.3 ± 6.05	78.3 ± 5.89	3.38***
BMI(kg/m^2)	22.8 ± 3.55	22.0 ± 3.41	2.36***
WHR	0.80 ± 0.06	0.79 ± 0.65	4.02***
WHtR	0.47 ± 0.061	0.47 ± 0.058	1.39

***p < 0.001, **p < 0.01.

Table 2
Distribution of participants according to adiposity and cardiovascular markers.

Variables	Urban	Rural
	N(%)	N(%)
BMI		
Under weight	9(4.5)	27 (13.5)
Normal	114(57)	100(50)
Over-weight	77(38.5)	73 (36.5)
WC		
Normal	169(84.5)	166(83)
Risk	31(15.5)	34(17)
WHR		
Normal	113(56.5)	147(73.5)
Risk	87(43.5)	53(26.5)
SBP		
Normal	144(72)	153(76.5)
Pre-hypertensive	49(24.5)	45(22.5)
Hypertensive	7(3.5)	2(1)
DBP		
Normal	148(74)	157(78.5)
Pre-hypertensive	35(17.5)	32(16)
Hypertensive	17(8.5)	11(5.5)

menarche is shown in Table 3. In urban females, 20.5 percent had menarche at < 12 years, 31.5 percent at an age of 12 years and 48 percent >12 years. In rural females, 27.5 percent had menarche at <13 years, 39.5 percent at 13 years and 33 percent at >13 years.

Odds ratios of adiposity markers and blood pressure as risk of early menarche is shown in Table 4. Urban females and rural females under overweight category of BMI were 1.34 times and 3.33 times more risk of having early menarche. Urban females who were under risk category of WHR, WHtR, WC and ratio were 1.15 times, 1.33 times and 0.89 chances of attaining early age at menarche while it was 1.04, 0.86 and 0.95 respectively for rural females. Pre-hypertensive (Systolic blood pressure) urban females were 1.43 times risk of early menarche while it was 1.15 times for rural females. Pre-hypertensive (Diastolic blood pressure) urban females were 1.11 times risk of early menarche while it was 1.01 times for rural females.

Among urban females it was found that, 56.5 percent females were in normal and 43.5 percent to be under risk category with respect to waist hip ratio. While among rural females, it was found to be 73.5 percent and 26.5 percent respectively. Among urban females, 72 percent were found to have normal diastolic blood pressure, 24.5 percent were pre-hypertensive and 3.5 percent were hypertensive. However, among rural females, it was found to be 76.5 percent, 22.5 percent and 1 percent respectively. Among urban females, 74 percent were found to have normal diastolic blood pressure, 17.5 percent were pre-hypertensive and 8.5 percent were hypertensive. In case of rural females, 78.5 percent were found to have normal diastolic blood pressure, 16 percent were pre-hypertensive and 5.5 percent were hypertensive.

4. Discussion

In the present study mean age at menarche of the rural females (13.1 years) was found to be significantly higher than urban females

Table 3
Distribution of participants according to categories of age at menarche.

Variables	Urban		Rural		
Age at menarche	N	%	Age at menarche	N	%
Less than 12	41	20.5	Less than 13	55	27.5
12	63	31.5	13	79	39.5
Above 12	96	48	Above 13	66	33

Table 4
Risk of adiposity and cardio-vascular among women attaining early menarche.

Variables	Categories	Urban			Rural		
		Age at menarche <12			Age at menarche <13		
		N (%)	Exp (B)	CI (95%)	N (%)	Exp (B)	CI (95%)
BMI	Overweight	77(38.5)	1.34	[0.65,2.74]	73(36.5)	3.33	[1.19,9.68]
	Normal	123(61.5)	0ª		127(63.5)		
WHR	Risk	87(43.5)	1.15	[0.55,2.30]	53(26.5)	1.04	[0.38,2.89]
	Normal	113(56.5)	0ª		147(73.5)		
WHtR	Risk	62(31)	1.33	[0.63,2.82]	59(29.5)	0.86	[0.30,2.49]
	Normal	138(69)	0ª		141(70.5)		
WC	Risk	31(15.5)	0.89	[0.43,2.42]	34(17)	0.95	[0.40,2.48]
	Normal	169(84.5)	0ª		166(83)		
SBP	Pre-hypertensive	56(28)	1.43	[0.69,2.95]	47(23.5)	1.15	[0.48,2.71]
	Normal	144(72)	0ª		153(76.5)		
DBP	Pre-hypertensive	52(26)	1.11	[0.47,2.62]	43(21.5)	1.01	[0.39,2.52]
	Normal	148(74)	0ª		157(78.5)		

CI = Confidence Interval.
0ª = Reference (normal).
Dependent category = BMI, WHR, WHtR, SBP, DBP.
Reference category = Age at Menarche.

(12.5 years). This data is parallel to the existing literature that the age at menarche in urban areas is early than the rural [17]. Early menarche among urban females could be due to better economic status and improved nutrition as compare to rural females. Historically, improved nutrition and socio-economic status has been attributed to causing a decline in the age of menarche [18,19]. also observed menarcheal age of 12.8 years in a study carried out among Punjabi Arora girls. The median of menarcheal age of present study of rural area was 13 years which is concordant with the findings carried out in secondary school girls in Zhejiang Province, China [20].

Mean of mid-upper arm circumference and minimum waist circumference were found to be slightly higher among urban females as compared to rural females and it was not found to be statistically significant. Other studies observed significantly higher mean waist circumference in urban women as compared to rural women [21]. Mean of maximum hip circumference was found to be higher among urban females as compared their rural counterparts and was statistically significant. The reason could be due to good nutritional status among urban females. Similar findings were reported by Kowsalya et al. [22].

In developing countries, high blood pressure is one of the risk factors for cardiovascular diseases, and the estimated 7.1 million deaths especially among middle, and old-age adults is due to high blood pressure [23]. Mean systolic blood pressure (SBP) was found to be higher among urban females (119.8 mmHg) than rural females (117.4 mmHg) but was not statistically significant. Mean diastolic blood pressure (DBP) was found to be significantly higher in urban females (80.3 mmHg) than rural females (78.3 mmHg) and this difference was significant. Studies indicate higher mean SBP and DBP in urban females than their rural counterparts [24].

Mean body mass index (BMI) and waist hip ratio (WHR) were found to be significantly higher in urban females than rural females in the present study. This could be due to improved nutritional status, increased in consumption of high calorie food, carbonated drinks, sedentary life style and less physical activity among urban females. Other study also reported significantly higher WHR in urban females as compared to their rural counterparts [25].

Both urban and rural females who were overweight have more chances of having early menarche. Girls with higher BMI at childhood attain menarche earlier than their normal weight counterparts [26]. The association between early onset of menarche with higher BMI in post menarcheal girls is apparently related to the ability of leptin (a fat-derived protein) to stimulate pulsatile secretion of gonadotropin-releasing hormone (GnRH) by the hypothalamus, resulting in stimulation of the pituitary-ovarian axis for the accumulation of critical amount of fat (nearly 16 kg) to begin puberty [27]. Urban females under risk category of WHR, WHtR and WC were more likely of attaining early menarche. Urban as well rural females who were pre-hypertensive attained early menarche. A recent study demonstrated that early age at menarche was separately associated with the rate of high blood pressure, high systolic pressure and high diastolic pressure [13]. Halfon et al. [28] showed that the prevalence of elevated blood pressure was significantly higher in post-menarcheal girls than in pre-menarcheal girls. Higher risk of hypertension in early menarche may be a combined effect of higher body mass index, waist hip ratio and waist height ratio. Studies in different population have also suggested that BMI, waist circumference [29] and waist height ratio [30] would be good predictor for hypertension in adolescents.

5. Conclusion

Age at menarche differed significantly among urban and rural females.The present study shows that in both urban and rural areas, early menarche occurred in females with higher adiposity markers such as BMI, WHR, WHtR and physiological markers such as SBP and DBP. Females with higher body mass index, more waist-to-hip ratio and waist height ratio were found to be at risk of early menarche.

Recommendations

There is a need to focus attention on females with higher adiposity markers as it may trigger early menarche and reports on early matured females were found to associate with several risk factors.

Conflicts of interest

None.

Acknowledgement

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2018.11.028.

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