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A Comparative Study on Menarcheal and Non-Menarcheal Girls in Nagaland, North-East India

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Abstract: Certain turning points in a person's life are significant. For girls, such significance is the first menstruation (or menarche), which marks the transition from being a girl to womanhood. The study aimed to ascertain the mean age at menarche, compare menarcheal and non-menarcheal girls, and determine the relationship between menarcheal status and body mass index (BMI), waist-to-hip ratio (WHR), socioeconomic status (SES), and lifestyle. The cross-sectional study was conducted among adolescent girls aged 10 to 15. Anthropometric measurements were taken, and BMI and WHR were calculated. Data on socioeconomic status and lifestyle were also obtained. Analysis was done using IBM SPSS Statistics 26. Statistical analyses such as independent sample t-test, chi-square or Fisher's exact test, and binary logistic regression were used to evaluate the data collected. P-value <0.05 was considered statistically significant for all analyses. The mean age and mean menarcheal age of the girls under study were 12.54±1.71 years and 12.29±1.09 years, respectively. A positive correlation ($p<0.001$) was found between menarcheal status and the anthropometric variables. Furthermore, a statistically significant relationship was also noted between menarcheal status and BMI, WHR, SES, and lifestyle. Thus, the study shows that there is a decline in mean age at menarche, which could lead to premature menopause and various health issues associated with it in adulthood.

Keywords: Adolescence, Anthropometry, BMI, Menarche, Socioeconomic Status.

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Introduction

There are certain turning points in a person's life that are significant psychologically and/or culturally because they indicate the need for a change in self-identity. For girls, the first menstruation, or menarche, may be especially significant because it indicates the onset of sexual maturity, marking the transition from being a girl to womanhood (Ruble & Brooks-Gunn, 1982). It is also a critical stage of growth and development associated with physiological and social changes that occur during adolescence (10 to 19 years) (Pao & Meitei, 2022). The relationship between menarcheal age and anthropometric measures is vital in understanding the significant effects of menarcheal age on disease in the later life of adolescent girls (Malitha *et al*., 2020).

Menarche usually occurs between 10 and 16 years of age, but it varies from individual to individual and is determined by female biology, genetics, and environmental factors during childhood (Marques *et al*., 2022; Sinha & Ali, 2020). Improved health and nutrition have decreased the average age of menarche in both developed and developing countries (Pandey & Pradhan, 2017). In India, the average of menarche is 12.5 years (Ramraj *et al*., 2021). Girls who attain early onset of menarche are associated with various factors, such as increased body mass index (BMI) in childhood and adolescence, improvement in socioeconomic conditions, and unhealthy lifestyle (Guo & Ji, 2011; Yermachenko & Dvornyk, 2014; Kurnia *et al*., 2020). Age at menarche is also strongly related to anthropometric parameters such as weight, height, and body mass index (BMI) (Karapanou & Papadimitriou, 2010). Early onset of menstruation is associated with cardiovascular diseases in adolescence (Leung *et al*., 2008), which may result in increased morbidity and mortality in later life (Walvoord, 2010). It can also lead to premature menopause (Kurnia *et al*., 2020). On the other hand, delayed menarche has been identified as a significant risk factor for irregular menstrual cycles, low peak bone mass, and osteoporosis (Finer & Philbin, 2010; Rosenfield & Bordini, 2013).

Although there have been numerous studies on the menarcheal age of adolescent girls, the Naga population has been the subject of very few. In fact, there are no studies on the Angami Naga that address the age of menarche and the related factors. In order to provide useful information for future population references, the present study was conducted to ascertain the age at menarche, compare menarcheal and non-menarcheal girls, and determine the relationship between menarcheal status and body mass index (BMI), waist-to-hip ratio (WHR), socioeconomic status (SES), and lifestyle.

Materials and Methods

A cross-sectional study was carried out among the Angami adolescent girls in the Kohima district of Nagaland, North-East India. A stratified random sampling technique was used to collect data. The villages were categorised into five groups according to their administrative blocks, and one village was randomly selected from each block, viz., Chedema Village, Jakhama Village, Kidima Village, Khonoma Village, and Nerhema Village. A total of 650 adolescent girls were taken as the study sample. The study included all adolescent girls who appeared to be in good health, ideally those between the ages of 10 and 15 years. Girls who were physically or mentally challenged, married, or had children were not included in the study.

Anthropometric measurements such as height (cm), weight (kg), waist circumference (cm), and hip circumference (cm) were taken using standard techniques. BMI was calculated as the ratio of body weight to the square of height (kg/m^2) and was further classified into underweight (<18.5 kg/m^2), normal (18.5-22.9 kg/m^2), overweight (23-24.9 kg/m^2), and obese (≥25 kg/m^2) using Asia-Pacific classification (Lim *et al*., 2017). WHR was calculated as the ratio of waist to hip circumference. The cut-off for WHR was set at ≥0.85, whereby those lower than 0.85 were considered normal, and those greater than or equal to 0.85 were considered risky (WHO, 2008). Data on age at menarche was obtained using the recall method. Data on lifestyle was obtained using a simple lifestyle questionnaire (SLIQ), which consisted of questions on five components: diet, activity, alcohol consumption, smoking, and stress (Godwin *et al*., 2008). Modified Kuppuswamy socioeconomic scale (Sood & Bindra, 2022) was used to determine socioeconomic status, which was calculated using the parents' educational qualification, occupation, and family income.

Data was entered using Microsoft Excel 2016 (MS Excel), and statistical analysis was done by IBM SPSS Statistics 26. The anthropometric measurements were statistically analysed to determine the mean and standard deviation of height, weight, waist circumference, hip circumference, BMI, and WHR. An independent sample t-test was used to estimate the significance of the difference between menarcheal and non-menarcheal girls. Chi-square or Fisher's exact test was used to assess the significance between categorical variables. The relationship between menarcheal status and the anthropometric variables was also examined using Pearson's correlation. Binary logistic regression was used to evaluate the association between the dependent (menarcheal status) and independent variables (BMI, WHR, SES, and lifestyle). P-value <0.05 was considered statistically significant for all analyses.

Ethical Consideration

Data were collected after obtaining institutional ethical committee approval and informed written consent from the heads of the institutions.

Results

In the present study, the minimum age at which menarche was attained was 10 years (5.00%), and the maximum age was 15 years (1.18%). The majority of the girls attained menarche at 12 years of age (33.53%), followed by 13 years of age (29.12%). As a result, the mean age of menarche in the present study was found to be 12.29±1.09 years (Table 1).

Table 1: Frequency, percentage, and mean age of menarche

Age at menarche	*N=340*	*%*	*Mean age*
10	17	5.00	12.29±1.09
11	63	18.53	
12	114	33.53	
13	99	29.12	
14	43	12.65	
15	4	1.18	

Table 2 shows the mean menarcheal age of adolescent girls based on various factors. In BMI, we see that the mean menarcheal age is least among the obese (11.85±1.21 years), followed by underweight (12.26±1.07 years), normal (12.34±1.11 years) and overweight (12.37±1.01 years). Girls with a higher waist-to-hip ratio (11.83±0.98 years) showed a higher prevalence of attaining menarche than those who had a normal waist-to-hip ratio (12.32±1.09 years). In the case of socioeconomic status, girls belonging to the upper (12.00±0.82 years) and upper middle (12.00±1.00 years) classes attained menarche earlier than those from the lower middle (12.33±1.05 years) and upper lower (12.29±1.15 years) socioeconomic class. Furthermore, girls who have an intermediate lifestyle (12.19±1.07 years) attained menarche earlier than those who have a healthy lifestyle (12.35±1.11 years).

The descriptive statistics of various anthropometric variables for menarcheal and non-menarcheal girls are shown in Table 3. The mean age of the adolescent girls under study was 12.54±1.71 years. The overall mean height, weight, BMI, waist circumference, hip circumference, and waist-to-hip ratio was found to be 148.91±9.12 cm, 40.91±9.75 kg, 18.21±2.89 kg/m^2, 62.87±6.41

Table 2: Mean menarcheal age according to the different variables

Variables	*N=340*	*%*	*Mean menarcheal age*
Body Mass Index			
Normal	188	55.29	12.34±1.11
Underweight	120	35.29	12.26±1.07
Overweight	19	5.59	12.37±1.01
Obese	13	3.82	11.85±1.21
Waist-to-Hip Ratio			
Normal	322	94.71	12.32±1.09
Risk	18	5.29	11.83±0.98
Socioeconomic status			
Upper	4	1.18	12.00±0.82
Upper Middle	15	4.41	12.00±1.00
Lower Middle	147	43.24	12.33±1.05
Upper Lower	174	51.18	12.29±1.15
Lifestyle			
Intermediate	125	36.76	12.19±1.07
Healthy	215	63.24	12.35±1.11

cm, 80.15±8.57 cm, and 0.79±0.06 respectively. The table also reveals that the menarcheal girls were taller (154.77±5.31 cm), heavier (47.13±7.21 kg), and had a higher BMI (19.63±2.52 kg/m^2), waist circumference (65.84±5.95 cm), and hip circumference (85.70±5.82 cm) as compared to that of non-menarcheal girls

Table 3: Descriptive statistics (Mean and Standard Deviation), independent sample t-test, Pearson correlation of menarcheal status and anthropometric variables

Anthropometric variables	*Menarcheal (N=340)*		*Non-Menarcheal (N=310)*		*Total (N=650)*		*t (P-value)*	*r (P-value)*
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*		
Age (years)	13.66	1.26	11.31	1.23	12.54	1.71	24.13 (<0.001)	-0.69 (<0.001)
Height (cm)	154.77	5.31	142.49	8.06	148.91	9.12	23.12 (<0.001)	-0.67 (<0.001)
Weight (kg)	47.13	7.21	34.10	7.32	40.91	9.75	22.85 (<0.001)	-0.67 (<0.001)
Body Mass Index (kg/m^2)	19.63	2.52	16.65	2.43	18.21	2.89	15.34 (<0.001)	-0.52 (<0.001)
Waist Circumference (cm)	65.84	5.95	59.62	5.20	62.87	6.41	14.13 (<0.001)	-0.49 (<0.001)
Hip Circumference (cm)	85.70	5.82	74.06	6.78	80.15	8.57	23.56 (<0.001)	-0.68 (<0.001)
Waist-Hip Ratio	0.77	0.06	0.81	0.05	0.79	0.06	-9.05 (<0.001)	0.34 (<0.001)

(height-142.49±8.06 cm; weight- 34.10±7.32 kg; BMI- 16.65±2.43 kg/m^2; waist circumference- 59.62±5.20 cm; hip circumference- 74.06±6.78 cm). However, the non-menarcheal girls had a higher waist-to-hip ratio (0.81±0.05) than the menarcheal girls (0.77±0.06). Furthermore, the independent t-test also showed a significant difference ($p<0.001$) between the means of anthropometric variables and menarcheal status. Likewise, Pearson's correlation also showed that there is a significant ($p<0.001$) positive correlation between the menarcheal status and the anthropometric variables.

Table 4 reveals that more than half, that is, about 56.92% of the adolescent girls were underweight, 3.69% were overweight, and 2.31% were obese. In comparison with non-menarcheal girls, who had a higher percentage of underweight (38.46%), menarcheal girls had a higher percentage of overweight

Table 4: Difference between menarcheal and non-menarcheal girls in association with variables under study (BMI, WHR, SES, and Lifestyle).

Variables	*Menarcheal*		*Non-Menarcheal*		*Total*		χ^2	*P-value*
	n	*%*	*n*	*%*	*n*	*%*		
Body Mass Index							136.43	<0.001
Normal	188	28.92	53	8.15	241	37.08		
Underweight	120	18.46	250	38.46	370	56.92		
Overweight	19	2.92	5	0.77	24	3.69		
Obese	13	2.00	2	0.31	15	2.31		
Total	340	52.31	310	47.69	650	100.00		
Waist-to-Hip Ratio							26.21	<0.001
Normal	322	49.54	254	39.08	576	88.62		
Risk	18	2.77	56	8.62	74	11.38		
Total	340	52.31	310	47.69	650	100.00		
Socio-Economic Status							21.12	<0.001
Upper	4	0.62	0	0.00	4	0.62		
Upper Middle	15	2.31	12	1.85	27	4.15		
Lower Middle	147	22.62	89	13.69	236	36.31		
Upper Lower	173	26.62	206	31.69	379	58.31		
Lower	1	0.15	3	0.46	4	0.62		
Total	340	52.31	310	47.69	650	100.00		
Lifestyle							5.58	0.019
Unhealthy	0	0.00	0	0.00	0	0.00		
Intermediate	125	19.23	87	13.38	212	32.62		
Healthy	215	33.08	223	34.31	438	67.38		
Total	340	52.31	310	47.69	650	100.00		

(2.92%) and obesity (2.00%). Approximately 88.62% of the population had a WHR of less than or equal to 0.85, while 11.38% had a WHR of greater than 0.85. The upper-lower socioeconomic class accounted for the majority of adolescent girls (58.31%), followed by the lower-middle class (36.31%), upper-middle class (4.15%), and the upper (0.62%), and lower classes (0.62%). The table also shows that no girls led an unhealthy lifestyle but rather one that was healthy (67.38%) and intermediate (32.62%). The chi-square test further shows that the variables and menarcheal status have a statistically significant relationship ($p<0.05$).

Binary logistic regression was used to evaluate the association between menarcheal status and BMI, WHR, socioeconomic status, and lifestyle (Table 5). Girls with a BMI greater than 23kg/m^2 were 6.46 times (OR: 6.46; 95% CI: 4.40-9.49; p-value: <0.001) more likely to attain menarche earlier than their counterparts. In the case of WHR, normal adolescent girls are more likely to attain menarche than those at risk (OR: 0.25; 95% CI: 0.13-0.46; p-value: <0.001). In addition, girls from the upper/upper middle/lower middle class are more likely to attain early menarche than the girls from upper lower/lower socioeconomic class (OR: 2.11; 95% CI: 1.48-3.02; p-value: <0.001). Furthermore, girls who lead an unhealthy/intermediate lifestyle are (OR: 0.57; 95% CI: 0.39-0.83; p-value: <0.001) more likely to attain menarche earlier than the ones who lead a healthy lifestyle.

Table 5: Association between Menarcheal status and BMI, WHR, SES and Lifestyle using binary logistic regression

Variables	*OR*	*95% CI*		*P-value*
		Lower	*Upper*	
BMI greater than 23 kg/m^2	6.46	4.40	9.49	<0.001
WHR (normal/risk)	0.25	0.13	0.46	<0.001
SES (Upper/upper middle/lower middle)	2.11	1.48	3.02	<0.001
Lifestyle (unhealthy/intermediate/healthy)	0.57	0.39	0.83	0.004

Discussion

The mean age of the Angami adolescent girls under study was 12.54±1.71 years. The majority of the adolescent girls attained menarche between 12 and 13 years of age, with a mean age at menarche of 12.29±1.09 years. According to a study by Pathak *et al*. (2014), the northern region had the highest mean age at menarche, followed by the central and western regions, and the northeastern region had the lowest mean age at menarche. Our study supports this finding

because the mean age of menarche in the present study was found to be lower than that of the western region- Maharashtra (12.68±0.77 years) (Behel & Raje, 2021), central region- Madhya Pradesh (13.2±1.24 years) (Solanki *et al*., 2021), southern region- Karnataka (12.4±1.0 years) (Belavaneki & Kour, 2022), northwestern region- Rajasthan (13.41 ± 1.07 years) (Choudhary & Gupta, 2019), north-central region- Uttar Pradesh (12.52±1.41 years) (Tarannum *et al*., 2017), eastern region- West Bengal (12.75±1.06 years) (Agrawal & Agrawal, 2022). In addition, when compared with the findings from North-East India, the mean age at menarche of the present study was found to be lower than those of Manipur (13.43±1.43 years) (Pao & Meitei, 2022), Tripura (12.53±0.12 years) (Saha & Roy, 2022), Sikkim (12.52±1.58 years) (Pandey & Pradhan, 2017), Assam (12.51±1.22 years) (Nagi & Dkhar, 2022), Meghalaya (13.22 ± 0.88 years) (Deb, 2011) but found to be higher than that of Arunachal Pradesh (11.2±0.06 years) (Basumatary & Medhi, 2022).

Comparing menarcheal girls with non-menarcheal girls, we find that the menarcheal girls were found to be taller, heavier, and had a higher BMI, waist circumference, and hip circumference when compared to that of non-menarcheal girls. Similar findings have been reported by Pramanik *et al*. (2015) among Bengali girls. A correlation between menarcheal status and anthropometric variables was also observed.

The present study further reveals that girls with higher BMI (≥25kg/m^2) tend to attain menarche earlier than their counterparts, which is in accordance with the findings of Bralić *et al*. (2012), Li *et al*. (2017), Pratiwi and Artaria (2020), and Agrawal and Agarwal (2022). In the present study, non-menarcheal girls had a higher prevalence of underweight than the menarcheal girls. On the other hand, menarcheal girls had a higher prevalence of overweight and obesity. The study also shows that girls with higher waist-to-hip ratios also tend to attain early menarche. Similar findings have been reported by Żurawiecka and Wronka (2021) and Pandey *et al*. (2023). However, the data further shows that non-menarcheal girls had a higher waist-to-hip ratio than the menarcheal girls in the present study. Behel and Raje (2021) reported that socioeconomic status was found to significantly influence the age of menarche. This is true in our study, as girls from higher socioeconomic status attained menarche earlier than those from lower socioeconomic status. In fact, the majority of menarcheal girls were also from higher socioeconomic status. According to Kurnia *et al*. (2020), adolescents with unhealthy lifestyles will tend to experience early menarche. Likewise, the present study also found that girls who lead an unhealthy or intermediate lifestyle attain menarche earlier than those who lead a healthy

lifestyle. The study also reveals that there is an association between menarcheal status and BMI, WHR, SES, and lifestyle.

Conclusion

The present study's mean age at menarche shows a decline in the menarcheal age, which could lead to premature menopause and various health issues associated with it in adulthood. Menarche typically occurs earlier in girls from higher socioeconomic classes, with higher BMI and waist-to-hip ratios. Early menarche has also been attributed to an unhealthy lifestyle. In addition, compared to non-menarcheal girls, menarcheal girls were taller, heavier, and had higher BMIs, waist circumferences, and hip circumferences.

Limitations of the Study

The present study considered adolescent girls aged 10 to 15 years as data on age at menarche was dependent on the recall method, which implies that the younger adolescent girls may report their menarcheal age more accurately than the older adolescent girls as the event was more recent.

Conflict of Interest

There is no conflict of interest.

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