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Age at menarche and body mass index (BMI) among adolescent secondary school girls in Port Harcourt, Nigeria

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Abstract: ***Background****: menarche is one of the most significant milestones in a woman's life with nutritional status being one of the important non genetic determinants of menarcheal age.*
Objective*: to determine the relationship between age at menarche and anthropometric measurements among adolescent secondary school girls in Port Harcourt, Nigeria.*
Methods*: four hundred and seventy nine adolescent girls were interviewed on age at menarche and their weights and height were measured. Body Mass Index (BMI) was calculated in kg/m^2. The relationship between ages at menarche and anthrometric measurements were ascertained.*
Results*: three hundred and fifty (73.1%) of the subjects were post menarcheal while 129 (26.9%) were pre menarcheal. The mean age at menarche was 12.80 ± 1.22 years. Obesity and overweight were more prevalent in post menarcheal subjects while underweight was more prevalent in the premenarcheal group. Post menarcheal subjects were comparably more stunted. Subjects who had attained menarche in early adolescence had significantly higher BMI at 10, 12 and 13 years respectively.*
Conclusion*:The mean age at menarche in adolescent secondary school girls in Port Harcourt was 12.80 ± 1.22 years. Anthropometric indices which were associated with a reduced menarcheal age were obesity, overweight and stunting.*
Keywords: *age at menarche, adolescent girls, weight, height, body mass index*

I. Introduction

Menarche being the onset of menstruation, is one of the most significant milestones in a woman's life.[1-3]It is the most widely used indicator of sexual maturation in females as well as the most accurately recalled indicator of puberty among girls[4] because unlike other pubertal changes that are gradual, menarche is a distinct event with a sudden onset.[5]

The first scientific records on age at menarche was 158 years ago.[6] Over time, the age at menarche has been found to show a steady decline of about 2 to 3 months per decade in developed countries,[7] and about 6 months per decade in developing countries[8] though there is evidence in the literature to show that the trend toward earlier puberty is fast becoming a global phenomenom.[9-10]

The mean age at menarche varies from population to population and is known to be a sensitive indicator of various characteristics of the population including nutritional status, geographical location, environmental conditions and socio-economic status.[1-3] Genetic factors probably account for approximately 10% to 15% of the observed variation in age at menarche[11] while nutritional status is one of the most important non genetic determinants.[12] In general, better nourished girls have been found to attain menarche earlier than undernourished girls.[13] In a study comparing age at menarche and anthropometric characteristics between girls from Nigeria and Niger Republic, it was found that the Nigerian girls had comparably higher anthropometric indices with comparably lower ages at onset of menarche.[14]

Age at menarche has been studied in different parts of Nigeria[10,14-20] including Port Harcourt where the present study was done. The previous studies in Port Harcourt[15-16] examined the influence of social class on the age at menarche and the differences in ages at menarche in rural and urban adolescents respectively. The present study was therefore carried out in Port Harcourt, South of Nigeria to examine the influence of anthropometry on the age at menarche.

II. Methodology

Over a four week period in April 2010, a cross-sectional descriptive study was carried out in Port Harcourt City, capital of Rivers State of Nigeria. Rivers State is located in the South-South geo-political zone of Nigeria.

Subjects

Through a stratified multi staged sampling method, four hundred and seventy nine adolescent girls aged between 10 and 19 years from eight selected secondary schools in Port Harcourt Local Government area of Rivers State (PHALGA) were recruited into the study. Those with chronic illnesses like heart diseases, asthma or disabilities like scoliosis and kyphosis were excluded, as the underlying illness may negatively affect their growth thus creating a bias.

The subjects were classified according to their ages into early (10 to 14 years), middle (15 to 17 years) and late (18 to 19 years) adolescence respectively.[21]

Permission for the study:

Permission for the study was obtained from the Research and Ethics Committee of the University of Port Harcourt Teaching Hospital and Rivers State post primary school education board. Consent was obtained from individual school principals and parents/students.

Sampling

Age at menarche was obtained from each subject using the status quo methodwhere girls in different age groups were asked whether or not they had experienced their first menses.[22] The subjects that had experienced their first menses were asked to recall the age at first occurrence.

Weight was measured using a well calibrated portable bathroom scale (Hana scale, model BR-9011). The subjects were weighed standing on the scale with their shoes off. The scales were checked before each measurement for zero adjustment and standardized according to WHO recommendations.[23] Height was measured using a portable stadiometer with a simple triangular head board. When measuring the height, the subjects were made to stand straight without shoes and heads erect such that the external auditory meatus and lower border of the eye were in one horizontal plane. All measurements were taken twice by both investigators and the average taken. A third measurement was taken if the first two differed by > 0.5kg for weight and 0.5cm for height.

BMI was calculated using the formula weight/height^2 (kg/m^2). The subjects whose BMI for age were < 5th percentile of the National Centre for Health Statistics (NCHS) reference population were considered to be underweight, those whose BMI for age were between the 5th and 85th percentile were considered as having normal weight and BMI ≥ 85th but < 5th percentile were considered at risk of being overweight. Those with BMI > 95th percentile were considered to be obese and those whose height for age was < the 3rd percentile were said to be stunted.[24]

Data analysis: Data was analyzed using the Statistical Package for Social Sciences (SPSS) software version 14[85] and Epi Info version 6.04. Distributions were described as means and standard deviations. Analysis of variance was used to test statistical significance with respect to continuous variables while Chi-square was used for discreet variables. A probability value of less than 0.05 was considered statistically significant at 95% confidence interval.

III. Results

Age and stage of adolescence of study population.

The subjects ages ranged from 10 to 19 years with a mean of 14.01 ± 2.05years. As shown in table 1, 277 (57.8%) of them were in early adolescence, 181 (37.8%) were in mid adolescence while 21 (4.4%) were in late adolescence.

Table 1: Stage of adolescence

Age Group(years)	No. (%)	Percentage
Early 10-14	277	57.8
Mid 15-17	181	37.8
Late 18-19	21	4.4
Total	**479**	**100**

Sexual maturity in the subjects.

Of the 479 females in the study population, 350 (73.1%) were postmenarcheal, while 129 (26.9%) were premenarcheal. More than half (53.4%) of the subjects in early adolescence were postmenarcheal, while all females in mid and late adolescence had attained menarche as shown in Table 2. The youngest age at menarche was 9 years and the oldest was 16 years. The mean age at menarche was 12.80 ±1.22 years with a median age of 13 years.

Table 2: Stage of adolescence by menarche status.

Adolescent Stage	Premenarcheal No	(%)	Postmenarcheal No	(%)	Total	(%)
Early 10-14 yrs	129	(46.6)	148	(53.4)	277	(100)
Mid 15-17yrs	0	(0.0)	181	(100.0)	181	(100)
Late 18-19yrs	0	(0.0)	21	(100.0)	21	(100)
Total	**129**	**(26.9)**	**350**	**(73.1)**	**479**	**(100)**

Anthropometry

As shown in table 3, the mean weight was 49.62 ± 10.59kg. There was a steady increase in weight with increasing age, except at 19 years.

The mean height was 1.57± 0.08m. There was an increase in height with increasing age except at 17 and 19 years respectively.

A steady increase in growth was reflected by the BMI which showed a gradual increase with age except at 19 years. The mean BMI at 10 years was 16.68 ± 2.34kg/m^2 and by 19 years it had risen to 21.89 ± 2.15kg/m^2. The overall mean BMI was (20.01 ±3.50kg/m^2).

Table 3: Anthropometry at various ages

Age (years)	Weight for age (kg) No. (Mean ± SD)	Mean height (m) No. (Mean ± SD)	BMI (kg/m^2) No. (Mean ± SD)
10	25 (33.02 ±5.82)	25 (1.42 ± 0.09)	25 (16.34±2.11)
11	27 (38.70±10.68)	27 (1.49 ± 0.07)	27 (17.22±3.60)
12	71 (46.28±9.40)	71 (1.55 ± 0.08)	71 (19.21±3.09)
13	71 (48.41±9.15)	71 (1.56 ± 0.07)	71 (19.84±3.07)
14	81 (51.40±8.86)	81 (1.59 ± 0.06)	81 (20.13±2.93)
15	92 (52.16±7.72)	92 (1.60 ± 0.07)	92 (20.34±2.90)
16	56 (54.36±10.50)	56 (1.60 ± 0.06)	56 (21.38±4.59)
17	35 (54.60±7.86)	35 (1.59 ± 0.06)	35 (21.57±3.05)
18	15 (60.47±10.16)	15 (1.61 ± 0.07)	15 (23.23±3.20)
19	6 (58.50±6.57)	6 (1.60 ± 0.08)	6 (22.85±2.07)
Total	**479 (49.62±10.59)**	**479 (1.57 ± 0.08)**	**479 (20.01±3.50)**

Menarche and weight status.

The prevalence of underweight was found to be 3.1% amongst the postmenarcheal girls while it was 5.4% in the premenarcheal girls. Obesity and overweight were more prevalent amongst the postmenarcheal females than in the premenarcheal females as shown in Table 4. This difference was however not statistically significant. The mean age at menarche in those who were underweight was 13.10 ± 1.14years which was later than the mean age at menarche 12.80 ±1.22 years for the study (Table 5). Post menarcheal girls were more stunted than their counterparts, though this was not statistically significant p = 0.52 (Table 6).

Table 4: Menarche and weight status

Nutritional status	Pre menarcheal	Post menarcheal	P value
Normal	112 (86.8)	290 (82.6)	0.36
Underweight	7 (5.4)	11 (3.1)	0.37
Overweight	7 (5.4)	38 (10.9)	0.07
Obese	3 (2.3)	11 (3.1)	0.87
Total	**129 (100)**	**350 (100)**	

Table 5: Mean age at menarche in various weight categories

Nutritional status	No.	Mean age at menarche(yrs)
Normal	290	12.91 ± 1.15
Underweight	11	13.09 ± 1.14
Overweight	38	11.94 ± 1.37
Obese	11	12.09 ± 1.22
Total	**350**	**12.80 ± 1.22**

Table 6: Relationship between menarche status and stunting.

Height for age	Pre menarche No (%)	Post menarche No %	P value
Stunted	2 (1.6)	11 (3.1)	0.52
Normal	127 (98.4)	339 (96.9)	0.45
Total	**129 (100)**	**350 (100)**	

Effect of menarche on anthropometry

In Table 7, comparisons between subjects aged between 10-14 years were done to determine if presence of menarche affected their anthropometry. By mid and late adolescence all the females had attained menarche. Those who had attained menarche between 10-13 years were significantly heavier than their counterparts who had not. They were also taller at 11 and 12 years and had a higher BMI at 10, 12 and 13 years respectively.

Table 7: Effect of menarche on anthropometry.

Age (years)	Menarche		Mean Weight (kg)			Mean Height (m)			Mean BMI (kg/m^2)		
	Pre no	Post no	Pre	Post	p	Pre	Post	p	Pre	Post	P
10	24	1	32.3	50.0	0.00*	1.41	1.55	0.12	16.16	20.81	0.03*
11	26	1	37.7	65.0	0.00*	1.48	1.66	0.01*	16.98	23.60	0.07
12	43	28	43.3	50.9	0.00*	1.53	1.58	0.03*	18.46	20.37	0.01*
13	28	45	43.3	51.1	0.00*	1.55	1.57	0.26	18.07	20.73	0.00*
14	8	73	47.8	51.8	0.23	1.57	1.60	0.29	19.23	20.24	0.36

*significant P value

IV. Discussion

The mean age at menarche in the present study was 12.80 ±1.22 years. This is lower than the 13.19 ± 1.32 years reported by Ikaraoha et al[16] in Port Harcourt where the present study was also done. Though the reason for this difference is not clear, it may be due to the fact that the former study[16] was done 5 years before the present study. Several authors[7, 8, 25, 26] have reported a decrease in the age at menarche over time. Amaza et al[17] reported a slightly higher age at menarche of 13.0 years in Maiduguri, Northern Nigeria the same year the present study was carried out while Umeora and Ugwuatu[25] reported a much higher mean age of 15.0 ± 2.0 years in 12 rural communities in Ebonyi State 5 years earlier. Raji et al[10] in 2006, also reported a comparably higher mean age at menache of 13.66 ± 1.82 years at Ibadan and Ogbomosho in Western Nigeria. The difference in menarcheal age may be as a result of tribal differences in the four study populations as reported by Danborno and Oyibo[14] in Nigeria and Prakash et al[27] in India. The subjects in the present study are predominantly Ijaws, those in the Maiduguri study are predominantly Hausas while those in the Ebonyi State study and Western Nigeria study are predominantly Igbos and Yorubas respectively. The menarcheal age in the Ebonyi study[25] may also be comparably lower because the study was done in rural communities whereas the present study was done in an urban area. More studies on the influence of tribe on menarcheal age need to be carried out in Nigeria.Trentham-Dietz et al[28] in Wisconsin and Gumanga and Kwame-Aryee RA[29] in Accra Ghana reported lower mean ages at menarche of 11.4 years and 12.5 years respectively. This is not surprising as these countries have better economies than Nigeria where the present study was done and age at menarche has been shown to be lower with improved socio-economic conditions.[8,15]

The mean age at menarche for the underweight subjects in the present study was lower than that of subjects with normal weights. This is similar to findings by other authors in Nigeria[10, 20] and other countries.[8, 28] Raji et al[10] and Goon et al[20]in Nigeria, Trentham-Dietz et al[28]in Wisconson and Bagga and Kulkarni[8] in India all reported a lowering of age at menarche with an increase in weight.Tunau et al[30]reported age at menarche of 15.32 years among rural secondary school girls in Sokoto. This may be much higher than the 12.80 ±1.22 years found in the present study because their subjects had a comparably lower mean weight of 47.60kg as against 49.62 kg in the present study.

In the present study, the post menarcheal subjects were found to be more stunted than their pre-menarcheal counterparts. This is similar to findings by Simondon et al[31]in Sudanwho reported that significantly stunted girls attained menarche earlier than mildly stunted girls. Other authors in Nigeria[10, 18, 20]and India[8]have also shown an inverse relationship between height and age at menarche. Bosch et al[32] in Matlab, Bangladesh found that adolescent stunting stood out as the most important determinant of age at menarche.

The present study showed that subjects who had attained menarche in early adolescence had higher BMI than their pre-menarcheal counterparts. This is similar to findings by Goon et al,[20]and Raji et al.[10]Danborno and Oyibo[14] studied the anthropometric and menstrual characteristics of girls from Nigeria and Niger Republic. They found that the Nigerian girls had significantly higher BMI and significantly lower menarcheal ages when compared with their Niger Republic counterparts. Acharya et al[33] in South Delhi, India reported a menarcheal mean age of 13.34 ± 1.26 years which is higher than that of the present study. This may be due to the fact that their subjects had a mean BMI of 16.80 which is much lower than the mean BMI of 20.01 in the present study.

V. Conclusion

The mean age at menarche in adolescent secondary school girls in Port Harcourt was 12.80 ± 1.22 years. Anthropometric indices associated with a reduced menarcheal age were obesity, overweight and stunting.

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