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Age, seasons and influence of body mass index on menarche among secondary school girls in Port Harcourt, Nigeria

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Abstract

Menarche is a significant marker of maturity and puberty in girls, and it is a transition influenced by different biophysical factors. This study was carried out to determine the age, seasons and the influence of body mass index (BMI) on menarche. A total of 450 girls' between the ages of 10 and 19 years participated in the study. Age at menarche was obtained via the recall quo cross sectional method. Parameters measured were; standing height (SH), weight (Wt) and BMI. A total of 373 (82.9%) girls had their menarche in their early adolescence while 77 girls (17.1%) had their menarche in mid adolescence. Mean age at menarche was 13.17± 1.48 years. The average value for BMI was 20.35 ± 3.77 kg/m2, SH was 161.09 ± 6.16 cm, Wt was 52.53 ± 9.21kg. Overweight girls were observed to attain menarche earlier, followed by those whose mean weight was in the normal range .Subjects in the underweight category had higher age at menarche. Menarche was high in the months of August, July and January. Menarche occurs early among secondary school girls in Port Harcourt and among other factors, those associated with BMI and stress are important in the onset of the biological event.

Keywords: Menarche; Puberty; Adolescence; Seasons; body mass index

1. Introduction

Menarche marks a lifetime event, characterized by the first menstrual flow [1]. It is seen in female humans at the onset of puberty. Adadevoh *et al*. [2] described it as the time in the life of an individual when she becomes fully equipped and ready for procreation; characterized by the appearance of secondary sexual features. In other words, puberty involves the physical changes which the body of a child undergoes to become an adult, capable of sexual reproduction. In females, such changes include the development of the nipple, growth of pubic and armpit hair with menarche as the hallmark of internal organ advancement [3, 4, 5, 6, 7]

Menarche is the third in the cascade of events by which puberty is characterized. The first sign of puberty is breast budding known as thelarche, which begins with the appearance of a firm, tender lump under the center of the areola of one or both breasts. This is followed by the appearance of pubic hair known as pubarche which usually begin with the appearance of hairs at the armpits. Then comes menarche, which is third in the events of puberty; a major indicator of female sexual and reproductive maturity. [8, 9] In the sequence and timing of events, it usually takes place within 2 to 3 years after thelarche. However, unlike other pubertal changes that are gradual and continuous, menarche is a unique event, often with a sudden onset. It is highly correlated with other pubertal characteristics and is therefore preferred as a benchmark for sexual maturation.

Several studies and reports have shown that the age at menarche is population specific [10.11, 12] . In one study, the age at menarche (in years) was 9.1 to 17.7 with a median of 12.8 in the United States[10.11] A number of factors have

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been observed to impact the onset of menarche; including childhood obesity, [13], nutrition [14], socio-economic status [15, 16], environmental conditions [17], genetic factors [18] and certain disorders of neuro-endocrine origin. [4, 19]. Some certain measurement indicators of body size, such as weight, height and BMI are well correlated with menarche age. [20] Weight gain is said to become critical at the onset of menarche. [21] Also, early menarche has been associated with increased subcutaneous fat levels and BMI.[13] Most studies on menarcheal age in Nigeria considered BMI as the major biophysical determinant. [22, 23,24]

In recent times, the interplay of seasons and menarche has become a subject of interest, due to the influence of environmental factors on biological systems. Jee *et al.* [25] observed that certain seasons in the year favour menarche as more cases are recorded in the winter compared to Monsoon season. Menarche increases in Bangladesh population in January and December but reduces in August and September. There is however dearth of studies on the seasonality of menarche among Nigerian population. This study therefore aims to investigate seasonality of menarche and the influence of B.M.I among adolescent school girls in Rivers State, South-South-Nigeria.

2. Material and methods

It was a school-based descriptive cross-sectional status quo study among selected secondary schools in Rivers state, conducted over a ten month period between January and October, 2016. A total of one hundred and forty secondary school girls between the ages of 10-19 were recruited for the study. Nine secondary schools were selected by non-probability convenience sampling method subject to limitations imposed by the dangerous security situation in the country. The inclusion criteria included female students who had attained menarche within the recent 12 months and were in good physical and mental health, with no evidence of chronic health conditions. Female students who were yet to attain menarche or who may have attained menarche for over 12 months and those with medical conditions that can affect their biophysical features such as tuberculosis, thyroid disorders, sickle cell anaemia, were excluded from the study. Written informed consent was given by participants after the procedure for the study was explained to them. In addition, ethical approval was granted by Ethics review committee of University of Port Harcourt, Port Harcourt, Nigeria. Also, questionnaires were used to obtain relevant data from subjects who met the eligibility criteria. Menarcheal age was assessed using the "status quo" method. Heights of subjects were measured using a portable standiometer (Pyrochy®) with subjects barefooted. Body weight was determined using the digital weighing scale (Omron Body Composition Monitor BF511) accurate to 0.1kg, adjusted to the Zero mark on a flat surface. The subjects were asked to step on it barefooted and without thick clothing and stockings. The body mass index was estimated by the Body composition analyser (OMRON ® BF 500Series) after the subject's height had been captured to ensure validity of data, all measurements were taken three times and the average recorded.

Data were analyzed with Excel toolpak Windows 10. Observations were categorized by age at menarche into three groups namely; early menarche, mid menarche and late menarche. Pearson's correlation test was used to correlate menarcheal age and anthropometric variables. T-test was used to compare group means with $P<0.05$ taken as level of significance.

3. Results

Results are as presented in Tables 1 to 5. Table 1 shows age distribution of school girls at menarche, Descriptive statistics are presented in Table 2. Descriptive statistics as well as the Independent sample T-test comparing the two groups in Table 3. Frequency distribution of the month of menarche and the influence of BMI is as shown in Tables 4 and 5.

Table 1 Age distribution of adolescent school girls at menarche

Parameters	N	Min	Max	Mean	S.D
Age at menarche (month)	450	107	204	157.47	17.67
Age in years (years)	450	10	17	13.17	1.48

N = amount, S.D = Standard Deviation, Min = Minimum, Max = Maximum

Table 2 Descriptive statistics of the measured variables

Parameters	N	Min	Max	Mean	S.D
Height (cm)	450	144.00	182.00	161.09	6.16
Weight (kg)	450	36.20	95.90	52.53	9.21
BMI (Kg/m^2)	450	14.80	49.20	20.35	3.77

N = amount, S.D=Standard Deviation, Min=Minimum, Max=Maximum

Table 3 Anthropometry at various menarche category

Parameters	Menarche category	N	Min	Max	Mean	S.D	T-test	
							T-value	P-value
Height(standing)(cm)	Early (10 - 14)	373	144.00	182.00	161.07	6.28	0.02	0.88 (NS)
	Mid (15 - 17)	77	147.50	177.00	161.19	5.54		
Weight(kg)	Early (10 - 14)	373	36.20	95.90	52.60	9.35	0.13	0.72 (NS)
	Mid (15 - 17)	77	38.20	87.40	52.19	8.55		
BMI(Kg/m^2)	Early (10 - 14)	373	14.80	49.20	20.42	3.90	0.59	0.44 (NS)
	Mid (15 - 17)	77	15.90	31.00	20.05	3.08		

N = amount, S.D=Standard Deviation, Min=Minimum, Max=Maximum, S=Significant, NS=Not Significant

Table 4 Frequency distribution of months of menarche

Month of menarche	Frequency	Percentage (%)
January	53	11.78
February	21	4.67
March	28	6.22
April	45	10.00
May	32	7.11
June	37	8.22
July	45	10.00
August	66	14.67
September	53	11.78
October	15	3.33
November	25	5.56
December	30	6.66
Total	450	100

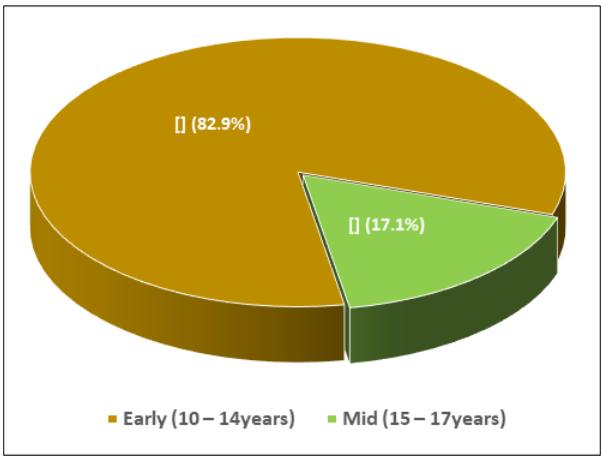

Figure 1 Pie chart showing distribution of adolescence age at menarche

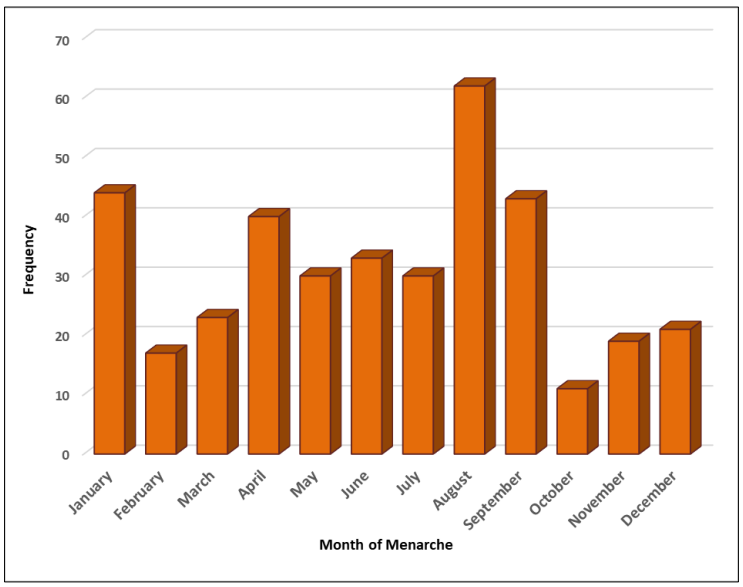

Figure 2 Frequency distribution of months of menarche for early menarche (10 – 14years)

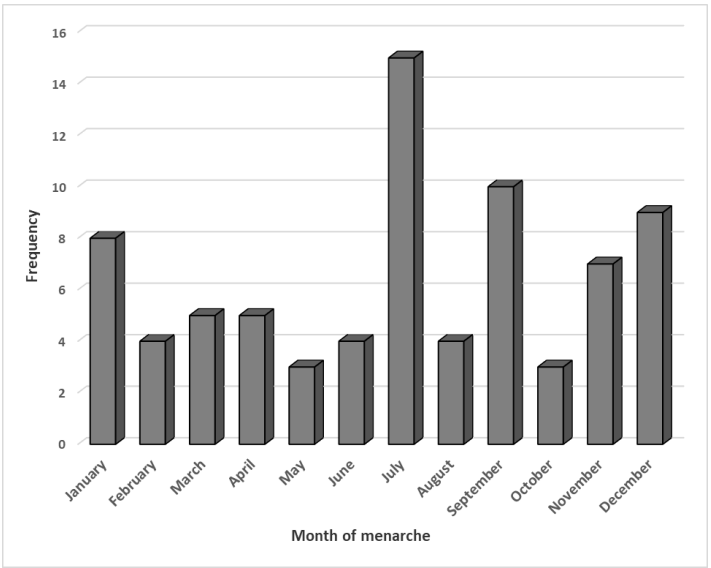

Figure 3 Distribution of months of menarche for the mid menarche (15 – 17years)

Table 5 The role of BMI in menarche

Age at menarche	Early Menarche	Mid Menarche	Total
	N	N	N
Underweight (<18.5kg/m2)	72	18	90
Normal weight(18.5-24.9 kg/m2)	267	52	319
Overweight (>25)	34	7	41
Total	373	77	450

S.D = Standard Deviation, N = Number of subjects

4. Discussions

The appearance of menarche is an important event in the reproductive life of a woman as it is a major determinant of the capacity to reproduce. [26, 27] The mean menarcheal age of school girls in Port Harcourt was in the category of early menarche (10-14 years); about 82.7% of the sampled population had attained menarche at the age of 14. This is similar to the findings of Nwakwo *et al*. [28]. The population size within early menarche category obtained in this study was higher than those from an earlier study by Adeshina and Peterside [24] with samples drawn from the same population. The difference may be attributed to improved standard of living. Also, we found in this study, average age of menarche higher than those reported for girls from France (12.5) [29], Kuwait (11.6 ±3.6) [30] and Bangladesh (12.4 ±1.0) [31]. Race, food preferences, geographical location are some factors that may be responsible for the observed difference.

Generally, it has been observed that age at menarche has decreased considerably in the past hundred years. The subjective reasons attributed for this decline include improvement in diet and economic status; health conditions and the influence of environmental conditions on female sexual maturity. A survey by Anderson *et al.* [32] showed the average age of menarche of girls in the United States dropped from 12.74 to 12.54 over a period of 25 years and American blacks had lower menarche age compared to whites. Among the Igbos of Ebonyi State in Eastern Nigeria, women with low education and socioeconomic status had menarche age of 15. ±2.0 compared to their counterpart who are educated [33, 34] The mean menarche age for European girls is reported to be 12.6 years for Italy and Greece and 15.2 years for Russia, 13.8 for Eskimos, 12.7 years for Asians. [35] The physiological implications of early and late menarche are well documented. Some studies suggest that late menarche affect fecundity, fertility and delay in ovulatory cycle [36]. Our result is similar to those reported by Sulayman et al.[37], as none of the volunteers in our study had their menarche after age 17.

Mean BMI (20.35 ± 3.77 kg/$m^{2)}$), height (161.09 ± 6.16 cm.) and weight (52.53 ± 9.21 kg) in the current study are similar to those of Chukwujekwu *et al.* [38] The height is however higher than those reported by Adesina and Peterside [24] and Nwankwo *et al*. [28] in similar population. The minimum menarcheal weight was 36.20 kg, and 26.2 % of volunteers had their weight below 48kg proposed as critical body weight for menarche.

We observed that 77 girls were underweight, 267 were of normal weight, while 34 girls were overweight. The overweight girls attained menarche early, followed by normal and the underweight girls had a longer menarcheal age. The categorization of the volunteers into early and mid menarcheal classes, revealed similar patterns but the slight difference was that in mid menarche, the normal and overweight girls attained menarche early and almost at the same time while the underweight girls attained menarche late. This is in line with the findings of Frisch and Revelle, [21] who reported that heavier girls do appear to attain menarche much earlier, compared to lighter ones. He further postulated that accumulation of body fat up to a minimum of 17% of body weight is necessary for the onset of menarche in girls.

The volunteers studied attained menarche mostly in August (66 persons, 14.7%), September (53 persons, 11.8%) and January (52 persons, 11.6%) while onset of menarche least occurred in October (14 persons, 3.1%) as shown in Table 4. Among Indians, menarche occurred with two monthly peaks of frequency in July–September and in December–January. [39]. An important contributing factor to the occurrence of menarche seen in this study may be due to reduction in stress levels and physical activity. Students are always on holiday in Port Harcourt between July – August and December and are therefore free from stress associated with school activities. A less-stressful atmosphere during school holiday has been postulated to trigger the onset of menarche by influencing the hypothalamus and the hypothalamohypophyseal gonadal axis [40, 41, 42]

5. Conclusion

The mean age at menarche among Port Harcourt secondary school girls is 13.7. A higher proportion of participants are in the category of early menarche. None of the participantts was in the group of late menarche. BMI was observed to positively influence the age of menarche; girls with higher BMI tend to achieve menarche quite early. The less stressful seasons of the year are most favourable for menarche.

Compliance with ethical standards

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Disclosure of conflict of interest

The Authors declare they had no conflicts of interest in this research.

Statement of informed consent

All participants were adequately informed about details of the study. They signed the consent form voluntarily.

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