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## **PUBERTAL DEVELOPMENT IN NIGERIAN IGBO GIRLS**

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### **ABSTRACT**

The aim of the study is to investigate the age at onset of pubertal development in Nigerian Igbo girls, in order to define normal, precocious and delayed puberty. The present study included a cross sectional sample of 500 normal Nigerian Igbo girls of high and middle socio-economical class living in Awka. Their ages ranged from 10 to 20 years. Height and Weight were measured using the standard anthropometric instruments (height meter and weight balance) in centimetres. Pubertal assessment was made according to Tanner staging the mean menarcheal age (MMA) was estimated using probit analysis. Breast development was assessed by inspection. In girls, mean ages at breast stage were 10.02±0.831 years for B2, 11.6±0.628 for B3, 12.09±0.847 for B4 and 14.08±0.845 for B5. Mean ages at pubic hair stage (P) were 10.74±0.894 years for P2, 11.42±0.880 for P3, 12.41±0.907 for P4 and 14.53±1.040 for P5. Mean age at menarche was 12.07±1.109 year. Menarcheal age was earlier in overweight and obese children at 90<sup>th</sup> and 97<sup>th</sup> percentile compared with that in children of normal weight. The mean age at attainment was compared with other countries. Girls of the present study started pubertal development and achieved menarche earlier than those of previous studies. Difference between the present study and other worldwide studies can be attributed to various genetic and nutritional factors.

**Keywords:** *Menarche, Precocious puberty, Puberty, Pubarche, Thelarche, Menarche*

### **INTRODUCTION**

Derived from the Latin *puberatum* (age of maturity), the word *puberty* describes the physical changes to sexual maturation. Puberty is the process of physical changes by which a child's body matures into an adult body capable of sexual reproduction to enable fertilization. It is initiated by hormonal signals from the brain to the gonads; the ovaries in the girl. In response to the signals, the gonads produce hormones that stimulate libido and the growth, function, and transformation of the brain, bones, muscles, blood, skin, hair, breast, and sexual organs. Physical growth-height and weight-accelerates in the first half of puberty and is completed when the child has developed an adult body. Until the maturation of their reproductive capabilities, the pre-pubertal, physical differences between boys and girls are the genitalia, the penis and the vagina. On average, girl's puberty begins at age 10-11. Girls usually complete their puberty by age 15-17. The major land mark of puberty for females is menarche, the onset of menstruation, which occurs on average between age 12-13 (Apter, 2000). In the 21<sup>st</sup> century, the average at which children especially girls, reach puberty is lower compared to the 19<sup>th</sup> century, when it was 15 for girls (Dabelow, 2007). This can be due to any number of factors, including improve nutrition resulting in rapid body growth, increased weight, and fat deposition, or exposure to endocrine disruptors such as xenoestrogens, which can at times be due to food consumption or other environmental factors. Puberty which starts earlier than usual is known as precocious puberty. Puberty which starts later than usual is known as delayed puberty. Notable among the morphologic changes in size, shape, composition, and functioning of the pubertal body is the development of secondary sex characteristics, the "filling in" of the child's body from girl to woman.

Adolescence is one of the most complex transition in life; representing change from childhood to adulthood. During this dynamic period, the individual rapidly develops and changes morphologically (The United Nations Children's Fund (UNICEF, 2002). In 1970, Dr. Marshall and Dr. Tanner published a landmark paper standardizing this sequence, and the series of changes have subsequently been known as the Tanner stages.

This study therefore aims at investigating the age at onset of pubertal development in Nigerian Igbo girls.

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### **MATERIALS AND METHODS**

**Study Design:** this is a descriptive cross-sectional study investigating the female students of the Amaenyi Girls Secondary School and St. John of God Girls Secondary School Awka for the age at onset of their pubertal development.

**Study Area:** the study was done on female students of the Amaenyi Girls Secondary School and St. John of God Girls Secondary School, Awka, the State Capital of Anambra State, South-Eastern Nigeria.

**Study Population:** these are the students of the above mentioned schools. There were 513 students in the junior and senior classes at the time of study and out of which 500 students were randomly selected.

**Instrument for Data Collection:** the materials used for the study include:

1. Height meter
2. Weight meter

#### **Validity of Instrument**

- The height meter was capable of measuring to the nearest centimetre. It was manufactured by Calcon International Private Limited Pune – Maharashtra, India.
- The weight balance measured the body weight to the nearest centimetre. It was manufactured by Naugra Export Ambala-haryana, India (Republic of India)

**Ethical Considerations:** the following measures were ethical issues considered in the course of the study;

1. Ethical approval was obtained was obtained from the Ethical Committee, Faculty of Basic Medical Sciences, Nnamdi Azikiwe University, Nnewi Campus.
2. Consent was obtained from the students
3. The importance of the research was well explained
4. Confidentiality of every information given was assured

**Parameters in Data Collection:** the following parameters, age, sex, height, weight, breast, pubic hair and menarcheal age were determined and recorded.

**Methods of Data Collection:** in the study, height and weights was measured using standard anthropometric instrument in centimetre. All the measurements were taken by one observer to avoid inter observer bias. Self administered structured questionnaire and oral interview was used. The questionnaire contained question which explored the age at onset of puberty.

**Data Analysis:** data was processed using the statistical software package (SPSS version 16). Tables and bar charts were also used for analysis. The mean and standard deviation of the different variables were obtained too.

#### **Methods**

The present study included a cross-sectional sample of 500 normal Awka girls aged from 10 to 20 years. Participants were selected by simple random sampling from school students. Pubertal development was evaluated using Tanner classification. Breast development was assessed by inspection. Average age of onset of puberty events was determined by probit analysis. Height was measured using a height meter rule to the nearest mm. Body weight was measured to the nearest 100g (weighing balance). Body mass index (BMI) was calculated from the ratio weight/height square ( $\text{kg/m}^2$ ).

#### **Student Selection**

##### *Inclusion Criteria*

1. Absence of growth retardation
2. Absence of systemic disease
3. No restriction of normal physical activity
4. No medication

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**RESULTS AND DISCUSSION**

**Table 1: Demographic Variables**

Age	Frequency	Percentage
10-12	4	0.8
13-15	159	31.8
16-18	300	60
19-21	37	7.4
<b>Total</b>	500	100
<b>Mean <math>\pm</math>SD</b>	16.14 $\pm$ 1.56	
<b>Ethnic Group</b>		
<b>Igbo</b>	500	91.8

**Table 2: Age Statistics**

	Number	Mean $\pm$ SD	3	10	25	50	75	90	97
<b>Age</b>	500	16.14 $\pm$ 1.560	14.00	14.00	15.00	16.00	17.00	18.00	19.00

**Table 3: Age at Menarche Statistics**

Number	Age	Height	Weight	BMI	Percentile						
	(mean $\pm$ SD)	(m)	(kg)	(kg/M <sup>2</sup> )	3	10	25	50	75	90	97
220	12.07 $\pm$ 1.109	1.59	50.80	20.08	10.612	11.000	11.300	12.000	13.000	13.000	13.697

**Table 4: Height and Weight Statistics**

	Number	(Age)	Percentile								
		Mean $\pm$ SD	3	10	25	50	75	90	97		
<b>H</b>	500	1.59 $\pm$ 0.066	1.48	1.52	1.54	1.58	1.67	1.69	1.70		
<b>W</b>	500	50.60 $\pm$ 7.546	40.52	42.00	45.00	49.00	55.00	60.98	69.97		

**Table 5: Body Mass Index Statistics**

	Number	(Age)	Percentile								
		Mean $\pm$ SD	3	10	25	50	75	90	97		
<b>BMI</b>	500	20.03 $\pm$ 5.293	16.023	17.181	18.068	19.400	21.548	24.000	25.52		

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**Table 6: Stages of Breast Development**

Age of Puberty	Number	(Age) Mean±SD	Height (m)	Weight (kg)	BMI (kg/m <sup>2</sup> )	Percentile						
						3	10	25	50	75	90	97
<b>B2</b>	80	10.02±0.831	1.54	50.40	21.27	8.51	9.00	9.00	10.0	11.0	11.0	11.2
<b>B3</b>	140	11.06±0.828	1.51	50.10	21.97	9.70	10.0	10.5	11.0	11.9	12.0	12.2
<b>B4</b>	215	12.09±0.847	1.58	50.70	20.28	10.6	11.0	11.5	12.0	12.8	13.0	13.5
<b>B5</b>	65	14.08±0.845	1.53	50.25	21.38	12.6	13.0	13.5	14.0	14.9	15.0	15.4

**Table 7: Stage of Pubic Hair Development**

Age of Puberty	Number	(Age) Mean±SD	Height (M)	Weight (kg)	BMI (kg/m <sup>2</sup> )	Percentile						
						3	10	25	50	75	90	97
<b>B2</b>	95	10.74±0.894	1.52	50.20	21.73	9.20	9.60	10.0	10.8	11.5	11.8	12.0
<b>B3</b>	130	11.42±0.880	1.56	50.60	20.82	10.0	10.0	11.0	11.0	12.0	12.0	13.0
<b>B4</b>	201	12.41±0.907	1.59	50.80	20.08	11.0	11.0	12.0	12.0	13.0	13.0	14.0
<b>B5</b>	74	14.53±1.040	1.50	50.10	22.27	13.0	13.0	14.0	14.8	15.0	16.0	16.6

**Discussion**

In this study, the changes that occur during the onset of puberty example breast development, pubic hair, and menarche were accessed on 500 students aged 10-20 years.

It was discovered in this study that the mean age of onset was 10.02±0.831 years as seen in Table 2, at a mean weight and height of 50.40 and 1.54 with Body Mass Index of 21.37. Breast development is similar to most published data in Iran with B2 of (10.1 in 2006), Venezuela B2 (10.4) in 2000, Egypt B2 (10.7) in 1997-2001, Denmark B2 (10.8) in 1991-1993 and USA B2 (10.4W, 9.5B) in 1988-1994 and (10W, 8.9B) in 1992-1993 (Marshall and Tanner, 1970). In girls, the earliest stage of maturation is an elevation of papilla (Stage 1), followed by elevation, enlargement of diameter and papilla as a small mould (stage 2), further enlargement of breast and areola with no separation of their contours (stage 3), projection of areola and papilla to form a secondary mould above the level of the breast (stage 4), and projection of papilla only due to recession of the areola to the general contour of the breast. A secular trend showing a consistent and remarkable decline of age of onset of puberty in the United States and some western European countries was noted in the mid-19<sup>th</sup> and early 20<sup>th</sup> centuries. This trend was attributed mostly to improvement in general health, nutrition and other living conditions during this time frame. In 1970, Marshall and Tanner provided age references for female pubertal development; the mean age for B2 stage (Marshall and Tanner stage 2) was found to be 11.6 years in the United Kingdom, which is considered a common international reference for norms. Very similar findings have been reported in Switzerland (11.2 years) in 1983, the United States (11.5 years) in 1985 and in Sweden (11.6 years) in 1996 and the Netherlands (11.5 years) in 2001. These studies showed stabilization of onset of puberty in developed

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countries. Herman-Giddens *et al.*, published data from the National Health and Nutrition Examination Survey III (NHANES) 1988 to 1994, involving 2114 girls aged 8 to 19 years. The report showed a decline of 1.5 years in the age of breast development compared to Marshall and Tanner data and a decline in the mean age for the onset of pubic hair growth compared to earlier studies in the United States. The data were based on visual inspection without palpation of breast volume or assessment of breast size and revealed the surprisingly long interval of two years between B2 and P2 stages, whereas this interval was found to be one year by others.

This study shows the mean age of pubertal hair growth stage 2 is  $10.74 \pm 0.894$ , with a mean weight and height of 50.20 kg and 1.52m which corresponds with Lee *et al.*, reported median age of P2 10.8 years in Russian girls, which correspond to the commonly accepted age of puberty onset. Several international studies have been defining the age of pubertal onset based on pubic hair development (Gavin and McMahon, 2005), found Turkish girls entered puberty (P2) by a mean age of 11.53 years. More appropriately defining the age of puberty onset by P2 (Vorherr, 2005), carried out a prospective study to evaluate pubertal development of Greek girls. They included 204 pre-pubertal girls between the age of 8 and 10 years who were followed over an average of 7.5 years in duration. The mean age onset of puberty was 10.8 years for P2. Despite this early onset of pubic hair growth, the attainment of sexual maturity was not accelerated, with a pubertal duration of 6.2 years measured by the mean time interval of progression from P2 to attaining final height. In Egypt, on the other hand, girls had their onset of puberty hair at a mean age of 11.86 years (P2), with a pubertal duration of about 4 years, measured from the beginning of breast enlargement (Gavin and McMahon, 2005). The limitation of both studies is that they were undertaken in urban cities on middle to upper class children.

An important pubertal issue is the relationship between obesity and sexual maturation. It is proposed that fat mass is a facilitator for the timing of puberty in girls (Vorherr, 2005). Leptin levels rise in girls at the time of puberty (Vorherr, 2005). It is suggested that overweight girls with higher leptin levels are more likely to enter puberty at an earlier age (Gavin and McMahon, 2005). Our results as several other studies demonstrated an association between BMI and early pubertal timing (Bonsor, 2003; Turner-Warwick, 1990). Moreover, girls with a larger body composition (larger weight and higher height) enter the puberty at a lower age. Our results show that a weight of about 30 kg is critical for onset of puberty. A number of studies have suggested a causal link between excess body weight and an earlier timing of puberty. Frisch and McArthur (1974) first hypothesized in 1974 that a critical body weight was necessary for the onset of puberty. Support for this hypothesis includes animal studies that have demonstrated that restricting weight gain delays the timing of puberty (Anson *et al.*, 2000) as well as a number of clinical studies that have found that pubertal girls have a higher BMI compared with their similar aged pre-pubertal peers (Kaplowitz *et al.*, 2001). Longitudinal studies have investigated this issue further. Davidson *et al.*, (2003) shows that a higher BMI at 5 years and a greater increase in the percentage of body fat between ages 5 and 9 years were associated with earlier puberty in 180 white girls, offering evidence that weight status precedes pubertal timing. However, another longitudinal study of 211 white girls did not show an association between BMI during early childhood and age of menarche (Demerath *et al.*, 2004). That study only found differences in BMI between early and late maturing girls 4 to 6 years after puberty.

In two of American studies (PRO and NHANES 111) age at menarche was 12.06 and 12.16 years respectively in American girls and 12.55 and 12.88 years respectively in white girls (Jackson *et al.*, 2002; Vonderhaar, 1999). The menarche age has also been changed to a lower during the previous decades (Gavin and McMahon, 2005; Buhler *et al.*, 1993). The duration of puberty in girls (B2 to M) in Nigeria (2.4 years) was similar to results from United States (2.3 years), Denmark (2.5 years), Venezuela (2.2 years) and Egypt (1.73 years) (Vorherr, 2005), for example. Some data have indicated that the earlier girls begin the onset of secondary sexual characteristics, the longer the period until menarche is reached (Blasband *et al.*, 1999; Pitelka, 2000).

## **Conclusion**

My findings that increase body fatness is associated with early pubertal development lends support for the hypothesis that increased rates of obesity among children in the United States may be contributing to a

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possible secular trend of early maturation in US girls (Kaplowitz *et al.*, 2001). Earlier onset of puberty in girls has been associated with a number of adverse outcomes including psychiatric disorders and deficit in psychosocial functioning (Graber *et al.*, 2004), earlier initiation of alcohol use, sexual intercourse and teenage pregnancy (Deardorff *et al.*, 2005), increase in adult obesity (Parson *et al.*, 1993), reproductive cancer. More studies are needed to identify the pathophysiologic mechanisms by which obesity leads to puberty and to determine whether intervention for weight control at an early age may slow or arrest the progression of puberty onset to the early ages in the population.

In conclusion, we found that Nigeria girl's age at B2 was 10 years. Mean menarcheal age was 12 years. Not only the onset of puberty in Nigeria girls but also the duration of puberty is similar to data from most other countries. A lower age limit for the definition of precocious puberty than the traditional 8 years is documented for Nigeria girls.

However, it should be noted that considering the rate of evolution of pubertal findings is more important than the age of their appearance. The study also shows that a weight of about 30 kilogram is critical for the onset of puberty. The time interval between B2 and menarche is longer in those with earlier breast development than in those with later onset.

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