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Quantitative Assessment of Pubertal Development among Rural and Urban Adolescents in Osun State, Nigeria: A Comparison of Two Standard Instruments

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Abstract

Introduction: *Pubertal development is a critical element in adolescents' life and is affected by several factors. Studies with quantitative assessment of pubertal development of Nigerian adolescents are rare. Concerns about valid and practical assessment of pubertal development have led to the development of several instruments, but the possibility of differences in the rating of the instrument exists. This study compared the pubertal development of rural and urban school-based adolescents in Osun State, Nigeria,*

using two widely known instruments – the Pubertal Developmental Scale (PDS) and the Sexual Maturity Scale (SMS).

Methodology: *The study involved 760 adolescents who were randomly selected through a multistage sampling process from rural and urban secondary schools in Osun state, Nigeria. Data were collected through assisted self-completion questionnaire method, with the research instrument incorporating both SMS and PDS. Data were analyzed using SPSS version 16. Agreement between the pubertal rating of the instruments was determined using Kappa statistics. Comparing of the pubertal rating of adolescents from urban and rural schools were assessed using Chi-square. Statistical significance was set at the 5% level.*

Results: *A total of 389 (51.2%) were males and 371 (48.8%) were females, and half of the participants were from rural areas. The mean age was 14.62 ± 2.39 years. Using PDS, the highest proportion of the participants in both urban (32.6%) and rural areas (35.8%) were in the mid-puberty stage, whereas using SMS, the highest proportion of adolescents were in the late puberty (urban: 36.1%; rural: 32.9%). The level of agreement between PDS and MSMS pubertal rating was poor (Kappa Statistic=0.235).*

Conclusion: *There is a difference in pubertal development of rural and urban school adolescents in Osun State with urban ones attaining puberty earlier. Careful choice of pubertal assessment instruments in clinical practice and adolescent research is warranted in view of the poor agreement between their ratings.*

Key words: *Adolescent, puberty, development, pubertal developmental scale, sexual maturity scale*

1. INTRODUCTION

Adolescence is one of the most fascinating and complex transition in human life span; a time of accelerated growth and change, second only to infancy (1). It represents a transition from childhood to adulthood with features including secondary sexual growth, changes in hormonal milieu, emotional, cognitive and psychological development(2). The World Health Organisation categorises individuals from age 10 to 19 years as adolescents (3). Adolescent development occur in a continuum, adolescents of the same age may experience growth and development differently and may move at different rates. From developmental point of view, adolescence can be subdivided into three major groups; early adolescence: 10-13years; middle adolescence: 14-16 years and late adolescence: 17-19 years (4).

The onset of adolescence is intimately synchronised with the biological changes of puberty which is accompanied by some physical changes. These biological changes transform boys and girls from physical immaturity to biological maturity. It occurs in response to changes in the body's hormone system. The endocrine system produces and adjusts levels of hormones in the body thus stimulating the body to respond in unique ways. These physical occurrences during puberty includes; growth in height, change in body composition, as well as the development of primary and secondary

sex characteristics. (5). With the onset of puberty, girls develop breast, acquire hips and have a higher ratio of fat to muscle, while boys develop wider shoulders. There is also growth and maturation of the primary sex organs. The male testes produce sperm cells and the prostate gland produces semen, while the female ovaries discharge mature ova and menstruation occurs. As the primary sex organs mature, the secondary sex characteristics distinguish males from females.

The assessment of pubertal development is an important aspect of adolescent health services. The classical tool in this respect is the Tanner staging developed by Marshall and Tanner (1). The Tanner staging (or Tanner scale) is a scale that classifies physical measurements of development based on external primary and secondary sex characteristics, such as the size of the breasts, genitalia and development of pubic hair. The stages range from 1-5 – stage 1 or pre puberty, stage 2 or early puberty, stage 3 or mid puberty, stage 4 or late puberty and stage 5 or post puberty. Due to natural differences, individuals pass through these stages at different rates, depending on the timing of puberty. Menarche, or the first menstrual period, is the most striking event in the whole process of female puberty(5), and occurs at different ages for individual adolescent girls. Age at menarche reflects numerous health aspects of a population as well as their growth and nutritional status (6). The age at menarche can be influenced by genetic factors, nutritional status, environmental conditions, socioeconomic status and level of education(6). Contrary to most studies, a study conducted in the Niger delta region of Nigeria reported lower ages at menarche for girls with low socioeconomic class(7). Similar findings were reported in a study in rural India(8). Other reports from African countries also found out that the age of menarche of rural girls were higher than those of urban girls within the same country(9).

The most direct method of assessment of puberty is via obtaining biological samples (10). This is however invasive, cumbersome and expensive and there are also ethical concerns. Assessment using non-invasive techniques is of major interest to researchers, and a number of approaches have been developed; one of these is the Sexual Maturity Scale.

The Sexual Maturity Scale (SMS) involves physical examination of the naked body by trained health professionals and the findings matched with the Tanner staging. It is a widely recognised scale and often regarded as the most standard measure of the physical assessment of puberty (11,12). It can, however, be uncomfortable, time consuming and expensive in large community surveys. Alternative rating methods that do not require physical examination but rely on self reporting, still with the use of Tanner staging as benchmark have been tried. An adaptation of SMS using an alternative rating method – “Modified SMS” was designed by Morris and Udry. This adaptation involves showing drawings of the secondary sex characteristics in the five progressive Tanner stages of development; stage 1 (pre-pubertal) through to stage 5 (adult appearance/ post pubertal). (11). Studies conducted among Hong Kong Chinese adolescents and adolescents in South Africa have shown that this

version is reliable and valid; strong correlations between self-rating and physicians' ratings have been reported (13,14), indicating that adolescents can accurately assess their own developmental stages(15). This modified approach has major advantages in that there is no need for the teenager to undress and can be more easily and rapidly applied, thereby overcoming some of the major limitation that have confronted researchers in the application of SMS in behavioural and developmental research.

Despite the modified SMS, researchers have reported that some research participants found the visual representations of secondary sex characteristics inappropriate due to the drawings shown (16).

As an alternative, Petersen et al developed the Pubertal Development Scale (PDS) where there were no visual representations. This was used in a school-based early adolescent study due to objections raised by parents and school officials against SMS (16). PDS is a self-reported instrument made up of a series of questions which reflects the five stages of pubertal development. It requires the participant to mentally visualize his or her current physical development in relation to the Tanner stages. Questions are asked about changes in growth, body hair and skin changes. Females are further asked about breast development and menstruation, while males are asked about changes of voice and growth of facial hair. It is said to contain more information on pubertal development than SMS and has also been found to be reliable and valid in some studies (13,15); Norris and Richter(14) however in their own study among urban adolescent males in South Africa found the tool to be less reliable than SMS, but the reverse was the case among Chinese adolescents in Hong Kong (13). This instrument was also used by Carskadon and Acebo who designed a scoring system for the scale (17). They adapted the scale and assessed the reliability and validity of the instrument. The items on the scale were scored using an overall maturation measure and a categorical maturation score similar to Tanner staging. In their study, each measure was obtained from independent ratings by students, teachers and parents and significant correlations were found between parents and students.

Most Nigerian literature on puberty have limited their focus to menarche, and little or no information is offered with regards to the other aspects of maturity such as breast and pubic hair development. Our literature search using the PUBMED and World of Science showed no published study on quantitative assessment of pubertal development of Nigerian adolescents. The current study aims to address this research gap. Specifically, our study aimed at comparing the pubertal development of rural and urban school adolescents in Osun State in south-west Nigeria using two standard pubertal assessment methods – the Pubertal Developmental Scale (PDS) and the Modified Sexual Maturity Scale (MSMS).

2. METHODOLOGY

2.1 Study setting and selection of participants

The study was cross-sectional in nature and carried out in school settings in Osun State, south-western

Nigeria. Participants from the three senatorial districts that made up the state were randomly chosen for the study, and a total of 800 adolescents, aged 10-19 years from rural and urban secondary schools were selected to participate in the study using multistage sampling technique that had the local government area as the sampling frame for the first stage. A total of twelve schools - six in urban area and six in rural areas – were involved in the study. The study covered both private and public secondary schools, these schools had full complement of all the classes- JSS 1- SS3.

2.2 Study Instruments and pubertal development measures

The research instrument included questions on socio-demographic characteristics as well as both SMS and PDS pubertal assessment methods.

The Modified SMS Method

The SMS methods contained drawings involving two secondary sex characteristics. For males, one drawing showed the five Tanner stages of pubic hair development while the other drawing showed the five Tanner stages of the male genitalia. For females, one drawing showed the five Tanner stages of pubic hair development while the other drawing showed the five Tanner stages of breast development. Thus, there were two (2) scores for the SMS per respondent based on the options selected. In representing the total score, an average of the two scores was computed and the final score was used to categorise the respondents into a stage (from pre pubertal to post pubertal according to Tanner). Where necessary, scores were rounded up to the higher pubertal stage.

The PDS Method

PDS involved five questions illustrating the five Tanner stages of pubertal development.

The PDS questions included;

1. What would you say about your growth in height?
2. How about the growth of body hair -genital area, armpit (and face for boys)?
3. Have you noticed any skin changes, especially pimples?

   For boys only
4. Have you noticed a deepening of your voice?
5. Have you begun to grow hair on your face?

   For girls only
4. Have you noticed that your breast have begun to grow?
5. Have you begun to menstruate?

   5b. If yes, how old were you when you started to menstruate?

The response options for the questions as designed by Carskadon and Acebo's(17) were ;

a) Has not yet begun = 1 point
b) Started less than a year ago = 2 points
c) Started more than a year ago = 3 points
d) Seems complete = 4 points

For question 5 in the girls version, Yes or No was the response option.

Yes = 4 points, No = 1 point.

The Carskadon and Acebo's scoring system was adapted and used to classify individuals into the five Tanner stages.

For boys, the sums of scores based were computed and used to indicate the level of pubertal development as follows: Pre-puberty (a score of 5 points); Early puberty (6 - 7 points); Mid-puberty (8 - 9 points); Late puberty (9 - 11 points); Post-puberty (≥12 points)

For girls, the sums of scores were computed, and the stage of pubertal development was assigned as follows: Pre-puberty (5 points); Early puberty (6 points); Mid puberty (7 -9 points); Late puberty (10 -12 points); Post-puberty (> 12 points).

2.3 Data Collection

There were separate questionnaires for males and females and data collection for both sexes took place in separate class rooms. The questions were the same for both male and female except where the question was gender specific. The latter is true for example for SMS drawings on pubertal development. The instrument was administered using assisted self-completion method in school setting with the research sessions organised to provide adequate privacy for the participants. Trained male research team members attended to male respondents only and vice versa for females. The research team was effectively supervised during data collection. Consent was obtained from parents and guardians of selected respondents. The study protocol was approved by the Research Ethics Committee of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, and approval was also obtained from the Local Inspectorate of Education and authorities of each school where the research took place.

2.4 Data analysis

The data obtained were entered and analyzed using SPSS 16.0. Chi square was done to explore statistical association between variables as well as to determine relevant association between stages of pubertal development among rural and urban respondents. Statistical significance was set at the 5% level.

3. RESULTS

Seventy hundred and sixty students out of the 800 students randomly selected for the study participated, giving a response rate of 95%.respondents consisted of 389 males(51.2%) and 371females (48.8%). An equal number of participants (380) were from the rural and the urban areas, and the female-male ratio was roughly 1:1 in both locations. The overall mean age was 14.62 years ± 2.39; the mean age was 14.90 years ± 2.44 for rural and 14.34 years ±2.31 for urban (p=0.003). A significantly higher proportion of rural students compared to the urban were from public schools (80.0% vs. 67.9% urban, p<0.001) (Table I).

The highest proportion of the participants in both urban (32.6%) and rural areas (35.8%) are in the mid-puberty stage when assessed by the PDS method, and there was no statistically significant difference between the urban and rural participants. (Figure I)

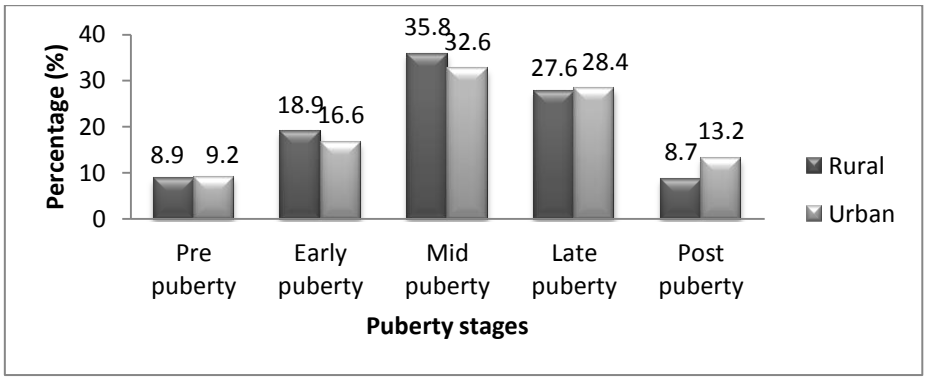

Figure I: Pubertal stages of respondents using PDS

When assessed using the MSMS method, the highest proportion of both urban (36.1%) and rural respondents (32.9%) were in the late puberty stage. (Figure II). The difference in the distribution of the rural and urban adolescents based on the MSMS was not statistically significant (p=0.748).

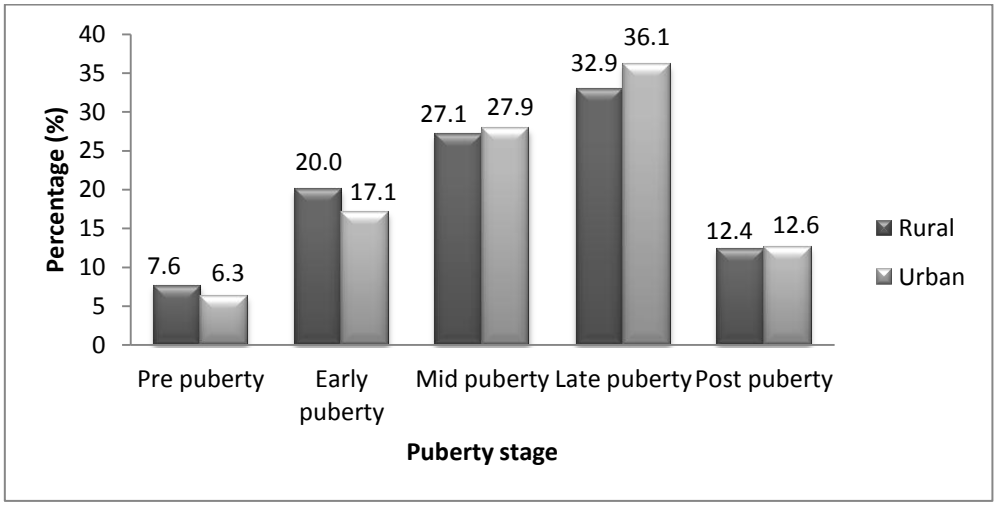

Figure II: Pubertal stages of respondents by location using MSMS

As Table 2 shows, there was poor level of agreement between PDS and MSMS in their pubertal of the adolescents (Kappa Statistic= 0.235, it was statistically significant (p<0.001).

Table 2: Agreement between PDS and SMS

Pubertal scales	PDS n (%)				Total N=760 n (%)
SMS	Pre puberty	Early Puberty	Mid puberty	Late/ Post puberty	
Pre puberty	26 (3.4)	18 (2.4)	7 (0.9%)	2 (0.2)	53 (7.0)
Early puberty	26 (3.4)	60 (7.9)	44 (5.8)	11 (1.5)	141 (28.6)
Mid puberty	10 (1.3)	41 (5.4)	95 (12.5)	63(8.3)	209 (27.5)
Late puberty	4 (0.5)	12 (1.6)	97 (12.8)	149 (19.0)	262 (34.5)
Post puberty	3 (0.4)	4 (0.5)	17 (2.2)	71 (9.4)	95 (12.5)

Table 1: Selected socio-demographic profile of respondents

Variable	Rural N= 380 n (%)	Urban N= 380 n (%)	Total N=760 n (%)	Chi square $\chi 2$	p value
Sex					
Male	194 (51.1)	195 (51.3)	389 (51.2)	0.005	0.942
Female	186 (48.9)	185 (48.7)	371 (48.8)		
Age groups (years)					
10-13	119 (31.3)	137 (36.1)	256 (33.7)	11.474	* 0.003
14-16	149 (39.2)	171 (45.0)	320 (42.1)		
17-19	112 (29.5)	72 (18.9)	184 (24.2)		
Type of school					
Public school	304 (80.0)	258 (67.9)	562 (73.9)	14.452	*< 0.001
Private school	76 (20.0)	122 (32.1)	198 (26.1)		
Class group					
Junior class(1-3)	194 (51.1)	168 (44.2)	362 (47.6)	3.566	0.059
Senior class (1-3)	186 (48.9)	212 (55.8)	398 (52.4)		

4. DISCUSSION

The development of various scales for assessing adolescent pubertal puberty provides researchers and clinicians with options to choose from. But how well do these instruments agree in their assessment? That questions remains relevant in adolescent health research and practice, and this article contributes towards addressing that question. On the other hand, research has noted significant disparity in many low and middle income countries in terms of rural-urban development, and this increasingly raises question about health equity. As a recent paper in Lancet using WHO database, the issue of social determinant of health has not focused well to adolescents, yet this is an important stage of life where the issue has much significance for health and development. In this context, this study compares the differences in pubertal development of Nigerian rural and urban adolescents in an exploratory sense.

In our comparison, we found no significant difference between rural- and urban-based adolescents Using the two assessment methods, majority of the respondents were in the mid and late puberty stages for both regions. The fact that majority of the respondents were in mid adolescent age group may account for this finding.

In this study, the urban girls were found to have attained puberty earlier than their counterparts in the rural areas; these rural-urban differences at pubertal maturity were not statistically significant using both assessment methods. Previous studies have also shown some rural-urban difference. Imobekhai in his study among rural and urban Nigerian adolescents found out that urban respondents were more matured than their rural ones(18), likewise was the finding by Tunua et al in Sokoto, northern Nigeria study (19). Unlike this study, assessment of puberty in Imobekhai's study was carried out using menarche and pubic hair development only, while Tunau et al assessed used menarche only. Adegoke in his study among African adolescents also reported similar rural-urban findings, urban respondents were found to be a year or two earlier in maturity than rural ones(10).

A major finding in this study is the agreement between the two scales using Kappa statistic; the agreement, although weak (0.235), was nevertheless statistically significant. Morris and Udry however demonstrated stronger correlations in their study(11).

In conclusion, there are differences in the pubertal development of rural and urban school adolescents in Osun state and the urban adolescents attained puberty earlier than their rural counterparts. Puberty can be measured using quantitative methods especially for research purposes. Researchers, policy makers and health programme officers need to consider this differential pubertal development when planning rural-urban adolescent health programmes.

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