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Assessment of Some Male Adolescent Anthropometric Parameters in Relation to Growth and Development in part of Lagos City, Nigeria

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Abstract
Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle, and adipose (fat) tissue. Adolescent merit special attention not only because they have special health and nutritional needs but because they are our future teachers, problem-solvers, and global leaders. The degree to which this generation responds to the challenges of tomorrow and promotes economic growth relies on optimal health and development throughout adolescence. From a biological perspective, the beginning of adolescence is marked by the onset of puberty. Cultural influences on puberty include nutrition, the quality of health care and living conditions. In the developed world the biological age of adolescence has declined over the past centuries. Data on boys also, suggest that they may be beginning maturation earlier as well. This present study assessed the association between actual stature, weight, sitting height and body measurements of some selected skeletal morphological parameters of adolescent male Nigerians in Lagos, for the purpose of assessing growth and provision of reference data from the (National health and nutrition examination survey) NHANES III study. A total of 222 male adolescent of Nigerian parentage from multiethnic groups with ages 11-17 years from two secondary schools in Lagos metropolis participated in the study. A weighing scale was used to take the body mass to the nearest 0.1 kg, Stadiometer, was used to measure standing and sitting heights to the nearest 0.l cm, Bone caliper was used for breadth estimations to the nearest 0.l cm, A customized wooden box of known height of 35.8cm was used to take the sitting heights and also a non-toxic white board markers were used to mark the anthropometric landmarks for easy identification. The result showed a direct relationship from all variables used in the study with an exception of few and also follows a similar pattern of growth in respect to that of the NHANES III study where by showing a normal growth pattern of the adolescent male Nigerians in Lagos. It may be established from this study that, besides skeletal length measurements, skeletal breadth estimates could also be used to assess the growth patterns among adolescents.

Key words: Adolescent, Growth, Lagos, Stature, Wellbeing

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INTRODUCTION

Adolescence is a difficult period to define in terms of age because of the variations in the time of its onset and termination. The World Health Organization (WHO) defines the age of adolescence as between 10 to 18 years (WHO, 1995) but certain authorities (Rolland-Cachera *et al.,* 1991; Suwa *et al.,* 1992; Roche and Guo, 2001; Malina *et al.,* 2004) regard the age ranges of 8 to 19 years in girls and 10 to 22 years in boys as more appropriate limits for normal variation in the onset and termination of adolescence. Adolescent merit special attention not only because they have special health and nutrition needs but because they are our future teachers, problem-solvers, nd global leaders. The degree to which this generation responds to the challenges of tomorrow and promotes economic growth relies on optimal health and development throughout adolescence (Christian and Smith, 2018).

Traditionally, stature (height) has been primarily set for growth assessment, but changes in body proportion and composition are also essential elements of growth especially of maturation. A child's growth can be compared with that of his or her peers by referring to norm on an appropriate growth chart. More importantly, the longitudinal measurements of a child's growth are a dynamic statement of his or her general condition or health (Alan *et al.,* 2000).

In a study conducted by Mbagwu *et al.* (2014) showed that growth in all the somatometric traits assessed in adolescent male Nigerians in Lagos was directly proportional to the age for that population. Thus, suggesting a normal growth pattern.

Given the concept that growth continues into the twenties, together with the delays in adopting adult roles, the idea has been proposed that adolescence might best be considered as ranging from 10 to 24 years (Sawyer *et al.,* 2018). From this perspective, adolescence occupies a greater proportion of the life course with greater relevance for human development than ever before (Skorikov and Patton, 2007).

Relative to other ages, the current generation of 10–24years old is the largest cohort seen (Gupta, 2014). Adolescent males in rural southwestern Nigeria continued to be shorter than African-American males up until the late teens and into their early twenties(20s) (Ayoola *et al.,* 2009).

Investing in adolescent nutrition has the potential to improve economic productivity, reproductive health, and chronic disease outcomes of populations. However, these investments are key to address the cycle of intergenerational growth failure and poverty in many low and middle income countries. Political will and funding to address these research and implementation knowledge gaps are urgently needed to ensure optimal investment in health and development of the largest generation in human history (Christian and Smith, 2018).

In a world of competing policy priorities, there is no doubt that providing the resources for healthy adolescent growth, education and emotional development will yield large benefits for current and future generations (Patton *et al.,* 2018).

International growth charts allow comparison between countries, but regional or national references are more useful in assessing local changes in growth patterns (Milani, 2012). It is recommended that growth references are updated regularly, as many countries have documented positive secular trend (Buckler, 1994). There have been several studies on the growth indices of children in Nigeria, but most of them are limited to either one ethnic group (Oninla, 2007; Ibekwe *et al.,* 2008; Ayoola *et al.,* 2009; Senbanjo, 2011 and Fetuga, 2011) or one

age band (Ibekwe *et al.,* 2008; Fetuga, 2011; Ebomoyi, 2012 and Adekanmbi, 2013). Many were carried out more than a decade ago (Jane, 1981; Didia, 1986 and Ukoli, 1993). Few studies have sought to compare the growth indices among the various ethnic groups (Elusiyan *et al.,* 2016).

Elusiyan *et al.* (2016) showed that the growth patterns of School age Nigerian children appear to be different from that of international references, with affluent Nigerian children being lighter in weight and having a similar height during childhood followed by a period of decelerating growth.

MATERIALS AND METHODS

Data for this study were obtained from secondary school students from Lagos metropolis, Lagos State, Nigeria. Number of participants were 222 with age range between 11-17 years old. The subjects were selected by systematic random sampling method from two Secondary schools in Lagos metropolis, namely; International School of the University of Lagos, Akoka and Oduduwa Secondary School, Ladipo Street, Mushin. In each of the schools, an informed written and verbal consent was sought from the school authority as well as the participating students in order to encourage more candidates and reliable responses. Equipment used are weighing machine **(**weighing scale**)** for measuring the weight to the nearest 0.1 kg, Stadiometer (height measure), calibrated in centimeter (cm) for measuring standing height (stature) and sitting heights to the nearest 0.1 cm, bone caliper was the instrument used for breadth estimation correct to the nearest 0.1 cm, a customized wooden anthropometric box of known height of 35.8cm was used to take the sitting heights, non-toxic white board markers were used to mark the anthropometric landmarks for easy identification. Physical examination was carried out to establish that each subject was in good health and if they are resident in Lagos. The Nigerian ethnic groups included Yoruba, Igbo, Edo, Urhobo, Ijaw, Ibibio, Efik and Hausa-Fulani. Acute illness and malformation were the exclusion criteria used. Generated data were analyzed using microsoft excel and Statistical Package for Social Sciences (SPSS 23). The relationships were established using the mean, standard deviation, coefficient of variation, Pearson's coefficient of correlation. Some variables from the generated data were compared with reference data from National Health and Nutrition Examination Survey (NHANES III) (1988-1994) by using the 50th percentile.

RESULT

TABLE 1: Measurement of mean anthropometric parameters of some male adolescent in part of Lagos city

Age (yrs)	n	Mean±SD Stature	Mean±SD Weight	Mean±SD Sitting height	Mean±SD Femur Breadth	Mean±SD Hand breadth	Mean ±SD Humerus Breadth
11	29	142.0±5.4	31.8±4.9	71.0±2.3	7.8±0.5	7.8±0.5	5.4±0 .4
12	30	149.0±7.1	37.4±6.5	71.3±8.2	8.5±0.7	8.6±1.1	5.7 ±0.6
13	22	151.1±7.6	37.6±6.2	74.2±3.5	8.2±0.6	8.2±0.8	5.8±0.5
14	23	158.6±7.3	41.9±5.5	77.0±3.6	8.6±0.6	8.5±0.8	5.8±0.4
15	35	164.3±9.2	49.8±11.6	78.7±6.0	9.2±1.0	9.6±1.1	6.4± 0.5
16	37	170.4±6.0	56.2±11.9	83.7±4.0	9.1±1.9	9.4±1.0	6.4±0 .7
17	46	171.0±5.8	54.7±7.2	83.9±3.4	9.1±0.5	9.5±0.8	6.4±0.4

n=Sample size, S D=Standard Deviation, yrs=years, significant at p< 0.05

TABLE 2: Comparative analyses of measurements obtained between present study and NHANES III studies

Age (yrs)	Stature(cm)				Sitting height(cm)				Weight(kg)			
	Present Study		NHANES III Study		Present Study		NHANES III Study		Present Study		NHANES III Study	
	CV	50TH Per	CV	50TH Per	CV	50TH Per	CV	50TH Per	CV	50TH Per	CV	50TH Per
11	**3.8**	**140.5**	**5.8**	**147.2**	**3.2**	**70.5**	**5.7**	**74.7**	**15.4**	**31.0**	**24.1**	**38.0**
12	**4.8**	**148.8**	**5.7**	**153.8**	**11.5**	**73.3**	**5.7**	**77.9**	**17.3**	**36.4**	**24.6**	**43.2**
13	**5.0**	**153.0**	**5.5**	**162.0**	**4.7**	**74.4**	**6.0**	**82.6**	**16.5**	**37.4**	**23.6**	**49.4**
14	**4.6**	**157.3**	**5.0**	**168.2**	**4.7**	**77.0**	**5.5**	**85.9**	**13.1**	**41.5**	**23.0**	**54.9**
15	**5.6**	**163.8**	**4.6**	**170.7**	**7.6**	**78.7**	**4.8**	**87.6**	**23.2**	**46.6**	**22.0**	**59.1**
16	**3.5**	**169.8**	**5.0**	**172.7**	**4.7**	**84.3**	**4.8**	**88.8**	**21.2**	**53.8**	**20.7**	**62.8**
17	**3.4**	**171.3**	**4.5**	**173.7**	**4.1**	**84.4**	**4.4**	**89.4**	**13.2**	**53.9**	**19.1**	**66.4**

NHANES III = National Health and Nutrition Examination Survey 111, CV= Coefficient of variation, yrs=year, significance at P< 0.05, Per= Percentiles

TABLE 3: Correlation of anthropometric measurement of some male adolescent in part of Lagos

Age (yrs)	n	Stature(cm) and Weight(kg)			Stature(cm) and Sitting height(cm)			Femur(cm) and Hand breadth(cm)		
		Mean±SD Stature	**Mean±SD Weight**	**r**	**Mean±SD Stature**	**Mean±SD sitting height**	**R**	**Mean±SD Femur**	**Mean±SD Hand**	**r**
11	29	142.0±5.4	31.8±4.9	0.62	142.0±5.4	71.0±2.3	0.71	7.8±0.5	7.8±0.5	0.67
12	30	149.0±7.1	37.4±6.5	0.69	149.0±7.1	71.3±8.2	0.11	8.5±0.7	8.6±1.1	0.78
13	22	151.1±7.6	37.6±6.2	0.78	151.1±7.6	74.2±3.5	0.85	8.2±0.6	8.2±0.8	0.82
14	23	158.6±7.3	41.9±5.5	0.71	158.6±7.3	77.0±3.6	0.80	8.6±0.6	8.5±0.8	0.84
15	35	164.3±9.2	49.8±11.6	0.85	164.3±9.2	78.7±6.0	0.86	9.2±1.0	9.6±1.1	0.80
16	37	170.4±6.0	56.2±11.9	0.40	170.4±6.0	83.7±4.0	0.54	9.1±1.9	9.4±1.0	0.39
17	46	171.0±5.8	54.7±7.2	0.50	171.0±5.8	83.9±3.4	0.86	9.1±0.5	9.5±0.8	0.63

n= Sample size, SD= Standard deviation, r= Pearson's product moment correlation, significant at P< 0.05

Table 1 showed mean stature increased consistently from 142.0cm at 11 years to 171.0cm at the age of 17years. The mean stature difference was greater around the ages of 11-12 years and 13-14 years with 7cm increment in either case. Furthermore, a reduced difference in mean stature between ages 16 and 17years. The mean sitting height increased from 71.0cm at 11 years to 83.9cm at 17 years of age. There were more difference in mean sitting height values from ages 12-13 years (71.3-74.2) cm and 14-15 years (77.0-78.7) cm. This difference was however minimal at 16-17 years. The mean weight increased from 31.8 kg at 11 years to 54.7 kg at 17 years. The difference in mean weight was however greater between ages 11 and 12 years (31.8-37.4) kg. It became less between 13-14 years and then increased again between 14-15 years (41.9-49.8) kg but became close between 16 and 17 years of age. The mean humerus breadth increased from 5.4cm at age l1 years to 5.8cm at 13 years. This value was maintained at 14 years and remained stable at 6.4cm from 15-17 years of age. The mean femur breadth fluctuated between ages 11 and 14 years and came to a peak value at 15 years but thereafter remained stable from age 15-17 years with a value of about 9.lcm. The mean hand breadth pattern is similar to that of femur breadth, having much difference from 7.8 cm at 11 years to 8.6 cm at 12 years. It declined to 8.2cm by age 13 years and then resumed a similar trend between 14-15 years. The values were close at about 9.4 cm and 9.5 cm for ages 16-17 years respectively

Table 2 showed stature measurement of the present study having lower coefficient of variation from age 11 to 14 years. The values were higher than those of NHANES III studies at about the age of 15 years but drop down from ages 15 to 16 years. The two studies have close 50^{TH} percentile values at ages 11 to 12 years and 16 to 17 years. Sitting height measurement of the present study shows higher coefficient of variation at the ages of 12 and 15years but has a lower value at age 11 years and from 13-14years. However, it has a similar coefficient of variation with NHANES III studies from ages 16 to 17 years. Weight measurement of the present study showed lower coefficients of variation from age 11 years until the age of 15-16 years when it had higher values but it came down again at age 17 years. The 50^{TH}percentile value showed a consistent lower value than that of NHANES III but the values appear to be close to it at age 11-12 years and 16 years.

Table 3 showed strong positive correlation existed between stature and sitting height (r=0.71-0.86). However, a moderate positive correlation was seen at age 16 years (r=0.54) and a low positive correlation was observed at age 12 years (r=0.11). There was a moderate correlations between stature and weight at 11- 12 years of age (r=0.62-0.69) while a strong correlation was observed for the next three age groups (r=0.79-0.85). A weak correlation was however observed at 16 years of age (r=0.40). There was a moderate positive correlations between Femur and hand at ages of 11 years (r=0.67) and 17 years (r=0.63) and a weak correlation(r=0.39) at age 16 years. Very strong positive correlations however existed between these variables in the remaining age groups (r=0.78-0.84).

DISCUSSION

The pattern of stature measurement of the present study is in agreement with the previous study by Tanner, (1975) that the timing of the onset of puberty correspond to the skeletal biological age of approximately 13years in boys and similar to the study by Kelch and Beitins, (1994) that boys attained a peak height velocity at 14years of age.

The mean weight showed a pattern similar to that of stature, with the greatest mean differences observed at 11-12 years and 14-15 years. A little difference was noticed between 16 and 17 years of age. This is in consonance with the finding by Cheek, (1974) that greater than 90% of peak

skeletal mass is present by age 18 years in adolescents who have undergone normal pubertal development at the usual time.

Mean differences for sitting height estimate were greatest between ages 12 and 13 years and 14 and 15 years while the lowest values were reported at 16-17 years. This observation supports the available evidence that adolescent growth spurt occurs disproportionately during growth in the trunk and it has been shown to produce a rise in cormic index in later adolescence (Gerver and De Bruin, 1995).

The mean Humerus breadth increased from 5.4cm at age 11years to 5.8cm at 13 and 14years and remained stable at 6.4cm from 15-17 years of age. This is corroborated by the findings that during adolescence, under the influence of testosterone, boys have a significant increase in growth of bone and muscles and a simultaneous loss of fat in the limbs (Tanner, 1989).

The growth pattern of hand breadth is similar to that of femur breadth with strong positive correlations existed between these two parameters. There were observed, decline in the mean femur breadth at age 13 and 16 years with stable value from 16 to 17 years of age which is explained by puberty onset and growth cessation.

The present study showed a lower coefficient of variation for most of the age groups and also gave lower values of the 50^{th} percentiles. This may imply that different levels of variability between the data used in the present study and that from NHANES III study might be due to the differences in sampling methods, sample sizes of the two studies, at different times and places. This conforms to the work of Jellife, (1966); Milani, (2012) and Elusiyan *et al.,* (2016). This present study is also in consonance with that of Ayoola *et al.,* (2009) which stated that, adolescent males in rural southwestern Nigeria continued to be shorter than African-American males up until the late teens and into their early twenties (20s)
The present study showed direct relationship between sitting height and stature. It may be important to note that the age group of 11-17years correspond to both the onset of puberty and the phase of deceleration of growth in stature. Previous study by Elise *et al.,* (2008) reported the pattern of growth between stature and sitting height with strong correlation between each other. Moderate to strong positive correlations existed between femur and hand breadths and this were significant ($p<0.05$) at 15 and 17 years of age showing a probable strong relationship exist between these two variables

CONCLUSSION

It can therefore be seen from this study that the growth pattern of Nigerian adolescent males in some part of Lagos follows the normal pattern as reported in literature. As a corollary, it may be established from this study that, besides length measurements, skeletal breadth estimates could also be used to assess the growth patterns among adolescents.

There is need for follow-up longitudinal studies in this regard in order to monitor the consistency of this pattern of growth among Nigerian adolescents. The result of this study should be documented so as to form part of the pool of normative data that could serve as a reference base for similar studies.

REFERENCES

Adekanmbi, V.T. and Uthman, O.A. (2013).Mudasiru OM. Exploring variations in childhood stunting in Nigeria using league table, control chart and spatial analysis. *BioMed Central,* Public Health;13:361.

Alan, D. R., Pamela, A. C., James, N. R., (2000). Growth and pubertal development in children and adolescents: Effects of diet and physical activity. *American Journal of Clinical Nutrition,* 72 , 2 .521S-528S.

Ayoola, O., Ebersole, K. and Omotade, O.O. (2009).Relative height and weight among children and adolescents of Rural Southwestern Nigeria. *Annals of Human Biology;*36: 388–99

Buckler, J.M.H. (1994).Growth Disorders in Children.1st edition. London: *British Medical Journal*, 1994, 1–107.

Cheek, D.B. (1974).Body composition, hormones, nutrition and adolescent growth. In: Grumbach M.M, Grave GD, Mayer FE, eds. Control of the onset of puberty. New York: *John Wiley and Sons*: 424-47.

Christian, P. and Smith, R E. (2018). Adolescent Under- nutrition: Global Burden, Physiology, and Nutritional Risks. *Annals of nutrition and metabolism.72: 316-328*

Didia, B.C and Ogunranti, J.O. (1986). Height and puberty in contemporary healthy Eastern Nigerian growing children: a clinical anthropological study. *Tropical Pediatrics;* 32:36–40.

Ebomoyi, E.W. (2012). Ethnic differences in the nutritional status of Nigerian Rural Fulani, Hausa and Yoruba School-Age Children and the role of bio-fortification to alleviate protein energy malnutition. *Journal of Basic and Applied. Sciences. Res*; 2, 7287–96.

Elise, W., Richard, M. M., George, D. S., Jeff M. P., Holly, D. G. (2008). Childhood circumstances and anthropometry. *The Boyd Orr Cohort,* 35, 518-534 (doi:10.1080/030 1446080294250).

Elusiyan, J.B., Ibekwe, M.U., Alkali, Y.S. and Agwu, J.C. (2016). Growth characteristics of contemporary school age Nigerian Children. *Journal of tropical paediatrics,* 62 (5), 345-351.

Fetuga, M.B, Ogunlesi, T.A and Adekanmbi, A.F. (2011).Growth pattern of school children in Sagamu, Nigeria using the CDC Standards and 2007 WHO standards. *Indian Pediatrics*, 48, 523–8.

Gerver, W.J and Debruin, R (1995). Relationship between height, sittinhg height and subischial leg length in Dutch children: presentation of normal values. Acta Paediatric. 84, 532-535

Gupta, M. D. (2014). The Power of 1.8 Billion: Adolescents, Youth and the transformation of the future (United Nations Population Fund).

Ibekwe MU., Okolo, A.A and Ibekwe, R.A. (2008). Community based study of the anthropometric indices of adolescent school girls in Oshimil local government area of Delta State Nigeria. *Nigerian Medical Journal,* 49:91–8.

Janes, M.D., Macfarlene, S.B and Moody, J.B. (1981).Height and weight growth standards for Nigerian children. *Annals of Tropical Paediatrics,* 1:27–37.

Jellife, D.B. (1966). The assessment of Nutritional Status of the community.W.H.O. Monograph Series No. 53, *Geneva.* P 27.S

Kelch, R.P. and Beitins, I.Z. (1994). Adolescent sexual development. In: Kappy M.S., Blizzard R.M., Migeon C.J., eds. The diagnosis and treatment of endocrine disorders in childhood and adolescence. 4th ed. *Springfield,* IL: 193-234.

Malina. R.M., Bouchard, C., and Bar-Or. (2004). Growth, malnutrition and physical activity, 2nd ed., *Human Kinetics publishers,* Leeds. 277-302; 509-522.

Mbagwu,S.I., Aniah, J.A., and Ezejindu, D.N. (2014). Anthropometric Study on the Growth Pattern of Adolescent Male Nigerian School Children in Urban Lagos. *American Journal of Medicine and Medical Sciences*, 4(2): 63-65.

Milani, S., Buckler, J.M and Kelnar, C.J, (2012). The use of local reference growth charts for clinical use or a universal standard: a balanced appraisal. *Journal of Endocrinology investigation;* 35:224–6.

Oninla, S.O., Owa, J.A and Onayade, A.A. (2007).Comparative study of nutritional status of urban and rural Nigerian school children. *Journal of Tropical Pediatrics*; 53:39–43.

Patton, G.C., Olsson, C.A., skirbekk, V., saffery R., Wlodek, ME., Azzopardi, P.S., stonawski, M., Rasmussen, B., Spry E., francis, K. Bhutta, Z.A., Kassebaum, N.J., Mokdad, A.H., Murray, C.J.L., Prentice, A.M., Reavley, N., Sheehan, P., Sweeny, Kim., Viner, R.M. and sawyer, S.M. (2018) . Adolescence and the next generationReferences.

Roche, A.F. and Guo, S.S. (2001). The new growth charts. *Paediatric Basic*, 94:2-13.

Roland-Cachera, M.F., Cole T.J., Sempe, M., Tichet J., Rossignol, C., and Charaud, A. (1991).Body Mass Index variations: centiles from birth to 87 years. *European Journal of Clinical Nutrition,* 45:13-21.

Sawyer, S.M., Azzopardi, P.S., Wickremarathne, D. and Patton, G.C., (2018). The age of adolescence. *The Lancet Child and Adolescent Health*, 2(3), 223-228.

Senbanjo, I.O., Oshikoya, K.A. and Odusanya, O.O. (2011). Prevalence of and risk factors for stunting among school children and adolescents in Abeokuta, Southwest Nigeria. *Journal of Health Population and Nutrition,* 29:364–70

Skorikov, V. and Patton, W.A. (2007). Career development in childhood and adolescence. Sence Publishers.

Suwa, S., Tchibana, K., Maesaka, H., Tanaka, T. and Yokoya, S. (1992).Longitudinal standards for height and weight velocity for Japanese children from birth to maturity. *Clinical peadiatrics and Endocrinology,* 1:5-13.

Tanner, J.M. (1989). Fetus into man: physical growth from conception to maturity. Cambridge, MA: Harvard University Press.

Tanner, J.M., Whitehouse, R.H., Marshall, W.A., Carter, B.S. (1975) Prediction of adult height, bone age, and occurrence of menarche, at age 4 to 16 with allowance for midparental height.*Archives and Disease in Childhood*; 50:14-26.

Ukoli F.A., Adams-Campbell L.L and Ononu, J. (1993).Nutritional status of urban Nigerian School children relative to the NCHS reference population. *East African Medical Journal;* 70:409–13.

WHO, 1995. Physical status: the use and interpretation of anthropometry. World health Organisation Technical Report Series, *Geneva.* No 854.