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Research Article
Anthropometric Indices as Determinants of Health Status among Primary School Children in the Delta South-Senatorial District, Delta State, Nigeria

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Abstract

Background and Objective: Anthropometric indices provide information on growth rates and body size. They reflect the status of nutrition and therefore of health status. The purpose of this study was to assess the health of primary school children between 6 and 12 years of age in the Delta South-Senatorial District through the use of anthropometric measures [weight, height, body mass index (BMI) and mid-upper-arm circumference (MUAC)]. **Materials and Methods:** An exploratory design was used for this study. The sample was 480 primary school children. One research question and one hypothesis were used to guide the study. The instruments used were a scale for weighing, a stadiometer and a handheld measuring tape. Participants had their weight, height and mid-upper-arm circumference assessed through weighing and measurement. BMI was calculated from weight and height (kg)/(wt)^2. The data analysis consisted of descriptive statistics and multiple regression with alpha at 0.05. **Results:** In this study, the mean weight of participants was 26.81±2.21 kg, height was 1.21±1.91 m, BMI was 18.36 2.86 and MUAC was 17.71.91; these values were compared with the reference or international standard values for weight (23.08±5.09 kg), height (1.22±0.11 m), BMI (15.08±0.76) and MUAC (19.8±2.82 cm), respectively. The anthropometric indices recorded in this study were significant with reference to WHO and UNICEF international standards. **Conclusion:** This study found that the anthropometric indices of participants compared favorably with those of their counterparts in other parts of the world. It is recommended that periodic surveillance be carried out to detect defeats and intervention applied if needed.

Key words: Anthropometric measures, body mass index, Nigeria, nutrition, physical health

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

One of the many ways by which physical health status can be determined is through measurement of the anthropometric indices of an individual; other ways include measurement of the levels of biochemical measures such as cholesterol, evaluation of physical appearance and assessment of the presence or absence of diseases or conditions. Anthropometrics provide information on body mass index (BMI), height (Ht) weight (Wt) and mid-upper-arm circumference (MUAC), among others. Anthropometrics is the scientific study of the measurement and proportions of human body parts or the whole body. It has also been stated that it is the science that defines the physical measurement of a person's size, form and functional capacities. Functional capacities are a function of wellness[1]. Anthropometrics provide indices of growth and development and therefore health status. Anthropometrics have a direct association with nutrition. Acute malnutrition contributes to over 50% of the 10-11 million deaths from preventable diseases that occur annually in children under five years worldwide. Severe malnutrition is a leading cause of morbidity and mortality in children under five years of age in developing countries[2]. Proper food and good nutrition are essential for physical growth, mental development, performance and productivity and health and well being[3,4].

Health is defined as a state of physical, mental and social and emotional well-being, not the absence of diseases or infirmity[5]. Health status therefore connotes the extent to which these variables are met by an individual. Children between 6 and 12 years of age were chosen for this study because children constitute the leaders of tomorrow and are more vulnerable to malnutrition and ill health because of their rapid growth rate. They need more attention and care for healthy physical and mental development. Chronic under nutrition is considered to be the primary cause of morbidity and premature mortality among children in developing countries such as Nigeria[6].

As one of the 36 states of Nigeria, the Delta State is not exceptional with regard to morbidity and premature mortality among children. However, health status determinants vis-a-vis anthropometric measures are not fully documented in the literature. This study is concerned with measuring the body mass index (BMI), height (ht), weight (wt) and mid-upper-arm circumference of primary school children between the ages of 6 and 12 years.

The aim of this study was to resolve challenges posed by inadequate information and data on anthropometrics to solve the problem of inadequate nutrition and growth and improve the health status of primary school children in South-Senatorial District, Delta State. Through this study and others of its kind, adequate planning can be achieved in nutrition, growth and the improved health of primary school children in the Delta South-Senatorial District, which could be extrapolated to other parts of the Delta State and Nigeria in general. This study assessed the BMI, ht, wt and MUAC of primary school children in the Delta South Senatorial District and compared them with international standards.

One research question and one hypothesis were postulated to guide the study. The question was "What are the range and mean anthropometric measures of primary school children ages 6-12 years in the Delta South Senatorial District compared to international reference standards?"

The hypothesis was "There is no significant relationship in the anthropometric indices among primary school children renaged 6-12 years in the Delta South Senatorial Districts, Delta State, Nigeria, compared to international reference standards".

Anthropometry is an important determinant of nutritional status and health; "poor nutritional status during the period of growth is an important determinant of health"[7]. Anthropometric indices can be divided into two types: body size and body composition[8]. In the hospital, anthropometric indices of body size (i.e., mid-upper-arm circumference, weight, height and body mass index) are used primarily to distinguish between under- and over-nutrition and to monitor changes after a nutrition intervention[9]. Weight and length/height are also critical as a basis for calculating dietary requirements[10]. The indices of height, weight, body mass index and mid-upper-arm circumference were used in this study. Other anthropometric parameters (though not used in this study) are mid-parental height, waist-hip ratio, skin fold measurement, head circumference and bioelectrical impendence analysis.

It has been stated that, "The measurement of ht. is important for calculating certain indices such as ht-for-age, wt-for-ht, BMI, the creatinine ht index and estimating basal energy expenditure. BMI can be used to determine nutritional status and widely accepted measures for body fat, although itis influenced by age, gender and race. MUAC is a simple, low cost, objective, accurate assessment of nutritional status. A decrease in MUAC may reflect either reduction in muscle subcutaneous tissue or both." p. 8[8].

Empirical evidence of anthropometric studies: In a previous study, the researchers found that "in Bauchi state, 12% of children aged 6-47 months were malnourished. In Cross River State, 5% of children aged 6-47 months were

malnourished in 2011"[11]. In this reported study, nutritional status among children 6 -47 months of age was assessed by measuring their mid-upper-arm circumference (MUAC). Another study of weight for age found that 82.13% of the children under age 5 were underweight; 33.52% were stunted while 85.15% were wasted[12]. The study reports the nutritional status of under-5 children in a location that was rural and where the children were quite poor; the study was conducted on low income earners in a southwestern Nigerian community.

A study in rural Bangang community in Cameroon found that the prevalence of stunting was 42.22%, of underweight was 6.67% and of wasting was 3.33%. An anthropometric measure, taken at 3 months, was used for this assessment[13].

MATERIALS AND METHODS

This study was carried out in the South Senatorial District of Delta State, Nigeria. Delta State lies roughly between longitudes 5.00° and 6.45° east and latitudes 5.00° and 6.30° north. The Delta South Senatorial Districts are riverine; three-quarters of the area is swampy and waterlogged[14]. Delta South lies in the extreme south of Delta State and is bounded by the Atlantic Ocean.

The study adopted an exploratory design. The population comprised all the primary school pupils in the Delta South Senatorial Districts estimated to be 130,387[15]. The sample was 480. The sample was derived using the formula: $n = 4 \times P \times (100\text{-}P)/25$[16]. This size was considered adequate for this study, as a sample of 384 for a population of 10,000 and above is reported to be adequate[17]. A simple ballot method was used to sample 34(10.75%) schools out of 315 schools in the sampling frame. Two arms of a class were sampled using this simple ballot technique. Between 10 and 15 children were obtained from each sampled school depending on the population of each class. A total of 480 children participated in the study. The children were persuaded to participate through the headmasters and class teachers. Those willing to participate were encouraged; those not willing to participate were dropped and replaced on a random basis.

The instrument used was the Human Measuring Scale manufactured by the Hana production company (Hanna's Pharmaceutical is a National Company with personalized customer service, headquartered in Wilmington, Delaware), a graduated metric linear measurement system that measures weight in pounds. This was used for weight, while a stadiometer calibrated in the metric linear measurement system from 0-5 m was used. A handheld measuring tape with a metric linear system of measurement was used for the mid-upper-arm circumference. To obtain the weight measurement, participants stood on the scale while wearing light clothing of known weight with both hands at their sides and with the face prone forward. Weight was obtained by subtracting the weight of the light clothing from the reading of the scale and recording the result. A stadiometer calibrated in metric and linear measurement systems from 0-5 m was the instrument for obtaining height. Participants stood on the base with the occipital part of the head touching the stadiometer, which was read to the nearest millimeter and recorded. The mid-upper-arm circumference on the left side was taken with a metric handheld tape measure. The body mass index (BMI) was calculated with the known formula of $wt/(ht)^2$. The validity of the instrument was obtained by a double check of all measures by a second person. Reliability was calculated using 60 children between the age range of 6-12 years in Abraka outside of the study area. Data were obtained for the parameters by the same person on two different occasions to calculate the technical error of measurement (TEM). The TEM was 0.09. From the TEM, reliability was calculated using the formula and was recorded as 0.96.

Data were obtained from children in the school at various times with the assistance of the headmaster, teachers and the study research assistants. Participants were weighed, their height was taken and their mid-upper-arm circumference was taken by turns during the short and long breaks. The study took place between February and April 2014. Data were analyzed using descriptive and multiple regression analysis.

RESULTS

Two-hundred sixty (59.98%) females and two-hundred fifty (40.12%) males took part in the study.

Table 1 presents the means and standard deviations for the weight, height, body mass index and mid-upper-arm

Table 1: Descriptive statistics: means for weight (wt) height (ht), body mass index (BMI), standard deviation (SD) and mid-upper- arm circumference (MUAC) compared to international standards (as an indicator of health status) among primary school children (age range 6-12 years)

	Mean weight	SD	Mean height	SD	Mean BMI	SD	Mean MUAC	SD	N = 510
Range	20-35		1.00-1.44		13.97-23.10		14.0-14.5		
Mean	26.81	2.21	1.21	0.121	18.36	2.86	17.7	1.91	
Inter-national ref. std	23.08	5.09	1.22	0.110	15.08	0.76	19.08	2.82	

Table 2: Regression analysis of weight, height, body mass index and mid-upper-arm circumference compared to the reference or international standard (as an indicator of health status) among primary school children in the Delta South-Senatorial Districts, Delta State

Weight	Sum of square	DF	Mean square	F	Sign
Regression	3014.423	3	1004.808		0.000
Residual	10207.781	506	20.173	49.808	0.000
Total	13222.204	509			
Height					
Regression	4.438	3	1.479000		0.000
Residual	1.829	506	004	409.38	0.000
Total	6.269	509			
BMI					
Regression	44.784	3	14.928		0.000
Residual	249.456	506	4.93	30.280	
Total	294.240	509			
MUAC					
Regression	103.924	3	34.641		0.004
Residual	3949.095	506	7.805	4.439	
Total	294.240	509			
Model	R	R^2	Adjusted R^2		
A = Wt	0.477	0.228	0.223		
B = Ht	0.842	0.708	0.706		
C = BMI	0.390	0.152	0.147		
D = MUAC	0.160	0.026	0.020		

circumference of participants in this study compared to the international standard or reference, which connotes their state of health. In this study, the mean weight of participants was 26.81±2.21 kg, height was 1.21±1.91 m, BMI was 18.36±2.86 and MUAC was 17.7±1.91; these were compared with the corresponding reference or international standards for which weight was 23.08 kg ±5.09, height was 1.22 m ± 0.11, BMI was 15.08±0.76 and MUAC was 19.8±2.82 cm, respectively.

Regression analysis of weight, height, body mass index and mid-upper-arm circumference compared to the reference or international standard (as an indicator of health status) is presented in Table 2 which reveals that there was a significant difference between weight, height, BMI and mid-upper-arm circumference.

DISCUSSION

Anthropometry varies from person to person and is different across ethnic groups. In this study, the results showed that primary school children in the Delta South District, Delta State, compared favorably with their counterparts when compared with the reference or international standards. Primary school children in this study had an advantage of 26.8±2.21 kg in weight over the international or reference standard of 23.08±5.09 kg. Height in both compared most favorably. An advantage was observed in BMI among primary school children in this study compared to the reference standard, 18.36±2.86 and 15.08±0.76, respectively. When these findings were compared in statistical analyses with the reference or international standards as the dependent variables, the result was found to be significant. There was a significant relationship in anthropometric measures of primary school children in the Delta South Senatorial District, Delta State, compared to the reference standard. This finding was consistent with the findings of a previous study conducted by Akinola *et al.*[18]. These researchers obtained the same results in their study in Ilorin, Nigeria-Central Senatorial District, Nigeria. This region falls within the same climatic belt and has the same diet pattern and the same level of social-economic development, which could account for the similarity.

Anthropometry is a function of nutritional status and is a determinant of health status[19,20]. The study results also agree with the findings of Ogechi *et al.*[21]. who reported a BMI of 19.99 kg m^{-1} for boys and 20.50 kg $m^{-1\ 2}$ for girls in Umuahia, Nigeria. This study has shown that Nigerian primary school children between the ages of 6-12 years in the Delta-South Senatorial District of Delta State, Nigeria, were healthy and compared favorably with their counterparts in other parts of the world. There is growing evidence from this study and that of other studies[19,21] which reported that Nigerian children are well-nourished and are not malnourished, as is claimed by some studies. The good health status of the primary school children in this study could be due to the fact that Delta State, Nigeria, is a rich oil-producing state with good soil for farming and fishing. Thus, most persons in Delta State are literate and are said to be "out of ignorance"[14].

CONCLUSION

In this study, the mean weight of participants was 26.81±2.21 kg, height was 1.21±1.91 m, BMI was 18.36±2.86 and MUAC was 17.71.91; these results were compared with the reference or international standards: wt was 23.08±5.09 kg, ht was 1.22±0.11 m, BMI, 15.08±0.76 and MUAC was 19.8±2.82 cm, respectively. The results show that primary school children compared favorably in anthropometric measurements with children in other parts of the world.

SIGNIFICANCE STATEMENT

This study found that there are no significant differences in the anthropometric indices of African primary school children in Nigeria and their counterparts in other parts of the world. This information is beneficial to nutritionists, health educators, pediatricians and others who might use these findings. This study supports policy formation and implementation and the results could help guide promotion of a school midday meal. This study will help researchers reveal areas of anthropometrics and the health of children that many researchers previously were not able to explore. Thus, a new theory of the nutritional status of the African child may be developed.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

- The socioeconomic status of Nigerian families in the Delta South-Senatorial District should continuously be promoted to maintain children's good and accepted health status
- An anthropometric survey should be carried out routinely as surveillance to monitor the health of children and to detect deficits and introduce intervention when needed
- There is a need to carry out more up-to-date national surveys and studies of anthropometrics and to report them in the literature, as a national nutrition and anthropometric survey is long overdue

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