

Physical growth and nutritional status assessment of school children in Enugu, Nigeria

JN Eze, T Oguonu, NC Ojinnaka, BC Ibe

Department of Paediatrics, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria

Abstract

Background: Physical growth of a child is a reflection of its state of nutrition. In some developing countries such as Nigeria with changing economy and rapidly growing population, the nutritional status of the children is a reflection of the general well-being of the society.

Materials and Methods: This was a descriptive cross-sectional study in which participants were selected using a multistage sampling method. Heights and weights of randomly selected school children aged 6–12 years were measured using standard protocols. Weight-for-age, height-for-age, and body mass index (BMI)-for-age expressed as Z-scores were used to characterize the nutritional status. Descriptive statistics was used to determine the frequency and standard deviations (SDs) of the anthropometric measurements. Age and gender differences in the mean body weight, height, and BMI were evaluated using an independent samples *t*-test. Significant levels were set at $P < 0.05$.

Results: A total of 1305 males and 1311 females were enrolled in the study. The mean age was 8.9 ± 1.9 years. Their mean height, weight, and BMI were 136.6 ± 10.2 cm, 29.7 ± 7.7 kg, 15.7 ± 2.4 kg/m², respectively. Their mean \pm SD scores of the WAZ, HAZ, and BAZ were 0.33 ± 1.20 , 0.78 ± 1.17 , and -0.51 ± 1.27 , respectively. A majority (78.9%, 2090/2616) were in the normal growth category. Wasting, overweight, obesity, underweight, and stunting were noted in 9.3% (243/2616), 6.3% (166/2616), 4.4% (117/2616), 0.9% (26/2616), and 0.4% (13/2616) of the children, respectively. Wasting was more in males ($P = 0.069$), and overweight was more in females ($P = 0.138$).

Conclusion: A majority of the children have normal growth with the remainder in both extremes of malnutrition. Institution of school-feeding programs in all Nigerian schools as well as nutrition education/campaign directed at parents and their children will help forestall the double burden of under- and over-nutrition among our children.

Key words: Children, obesity, stunting, underweight, wasting

Date of Acceptance: 02-Mar-2016

Introduction

Nutritional status is one of the indicators of the quality of physical and mental development of the school-aged child.

Address for correspondence:

Dr. JN Eze,
Department of Paediatrics, University of Nigeria Teaching Hospital,
Ituku-Ozalla, Enugu, Nigeria.
E-mail: joyezedr@yahoo.com

Physical growth assessment is one of the acceptable tools for assessing the child's state of nutrition.^[1] Physical growth not only illustrates the individual's nutritional status but also directly reflects the socioeconomic status of the family, social well-being of the community as well as the efficiency of the healthcare system, and the influence of the surrounding environment.^[2] Over 70% of under-five mortality arise from preventable infective causes, with malnutrition being

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Eze JN, Oguonu T, Ojinnaka NC, Ibe BC. Physical growth and nutritional status assessment of school children in Enugu, Nigeria. *Niger J Clin Pract* 2017;20:64-70.

Access this article online	
Quick Response Code: 	Website: www.njcponline.com
	DOI: 10.4103/1119-3077.180067

a contributory factor to more than 45% of such deaths.^[3] Chronic undernutrition in older children is linked to slower cognitive development, poor school attendance, high school withdrawal rate, and serious health impairments later in life that reduce the quality of life of individuals.^[2,4] Overweight and obesity have also been linked to increased risk of cardiovascular and pulmonary diseases.^[5]

Secular and geographical trends have been noted in the prevalence of malnutrition. Increasing prevalence of childhood overweight and obesity has been observed in both high- and low-income countries.^[6,7] With nutrition transition from intake of well-balanced meal to energy dense snacks and pastries and change in lifestyles and culture among the population in medium- and low-income countries, a rising prevalence of childhood obesity and overweight and decreasing rates of undernutrition have been reported in these countries.^[6,8]

Double burden of wasting and obesity has been noted among Nigerian children.^[9,10] A previous study in Enugu showed a low prevalence of obesity and overweight among the school age population.^[11] However, the prevalence rates for wasting, underweight, and stunting were not assessed in the study. Overtime notable changes have occurred in the socioeconomic indices in Nigeria.^[12,13] What will be the effect of these changes in the physical growth pattern in this population considering the geographical and secular trend? The study was to determine the pattern of physical growth among school-aged children in our community and relate it to their nutritional status and to assess age-sex trends in the level of the various categories of nutrition.

Materials and Methods

Ethics

Approval for the study was obtained from the Health Research and Ethics Committee of the University of Nigeria Teaching Hospital, Ituku-Ozalla. Before enrollment, written consent was obtained from the supervising State Ministry of Education and the local school authorities.

The objective and details of the present study were explained to the school heads and teachers. For participation of the subjects in the study, parents/guardians/caregivers were informed about the study objectives and gave informed written consent before inclusion into the study. As the participants were minors, verbal assent was obtained after due explanation in a language that is well understood by each of them. All participants' data were entered in a case file and stored securely in a protected format accessible only to the investigators.

Study site

Enugu is a cosmopolitan city with inhabitants from different socioeconomic background and with a population

predominantly (90%) from the Igbo ethnic group. The city has a population estimate of 722,664 people (2006 population census)^[14] and is a major administrative, educational, and trading center of the State. Coal is the most abundant natural resource. There are 298 primary schools in Enugu metropolis distributed among the three local government areas, namely, Enugu East, Enugu North, and Enugu South.

Study design

This was an observational cross-sectional study whereby the schools and school-aged children were selected by multistage sampling method.

Selection of participants

Participants were selected using multistage sampling method as follows:

Thirteen schools were selected from a sample frame made up of 298 primary schools in Enugu metropolis. A total of 298 (public and private) primary schools were grouped according to their location into 13 strata which correspond to the existing 13 officially allocated layouts in Enugu metropolis. The schools in each stratum were further stratified into public and private. The name of each school was written on a piece of paper, wrapped, and put into the corresponding ballot bags representing its stratum. A total of 13 schools, one school from each of the 13 strata were selected by simple random method. A coin was used to determine the school to be selected first either public or private. A public school was selected from the first stratum and a private school from the next stratum. Subsequently, the selection was done alternately until the 13th school was selected. This required the assistance of an individual who was not part of the study to avoid bias. These schools consisted of 7 public and 6 private schools.

Two-hundred four pupils (minimum sample size studied) were selected by systematic random sampling from each of the 13 schools.

In each school, the arms of the various classes were combined and stratified into six classes (one to six). The figure (204 pupils) was divided among the six classes. Thus, 34 pupils were recruited from each class. The average number of pupils in each class was about 150.

In each class, the pupils were further stratified into boys and girls using the class register. A total of 34 subjects (equal number of boys and girls) were selected by systematic sampling method from each class. A total of 2616 pupils (1305 males and 1311 females) were enrolled in this study.

School record of birth certificate of each enrolled child was used to establish age.

Children with history and examination findings suggestive of chronic disease conditions such as sickle cell disease, asthma, and congenital heart disease known to affect nutritional status were excluded from the study.

Demographic characteristics of each participant such as age, gender, and place of domicile were obtained. Relevant physical examination was conducted on each of the study participants.

The data of each of the study participants were recorded using a semi-structured questionnaire.

Measurement of anthropometric parameters

The protocol for measurement of height and weight was as described by the World Health Organization (WHO).^[11] Height was determined with portable height measure (Seca®, Leicester Birmingham, United Kingdom) to the nearest 0.1 cm. The children's height was measured with each child standing upright, the head in Frankfort plane, without shoes, with both feet flat on the platform and apposed at the medial malleoli; the heels, buttocks, and occiput placed against the scale with arms hanging freely by the sides. The instrument was checked before each measurement ensuring that both headboard and footboard were at 90° to the vertical rule.

Weight was measured in kilograms (kg) with an electronic weighing scale (Camry®, Model EB8571, Camry Electronic Co. Ltd., China) to the nearest 0.1 kg. The pupils stood on the scale without shoes wearing light cotton material. The scale automatically adjusted to zero before each measurement. It was also checked daily using an object of known weight as a quality control measure to ensure validity and reliability. Body mass index (BMI) was calculated as weight in kilograms divided by height in meter squared (kg/m²).^[15]

Height-for-age, weight-for-age, and BMI-for-age indices were calculated with WHO AnthroPlus® (v1.0.4, World Health Organization, Geneva 2009)^[16] and expressed in Z-scores. The children were classified into the following categories: “underweight” (low weight-for-age < -2 Z-scores for children ≤ 10 years old); “stunting” (low height-for-age < -2 Z-scores), “wasting” (low BMI-for-age < -2 Z-scores), “overweight” (BMI-for-age Z-score > +1 and ≤ +2), “obese” (BMI-for-age Z-score > +2), and “normal weight” (BMI-for-age Z-score - 2 to + 1). Children with height-for-age Z-scores < -3.00 were defined as severely stunted. Those with BMI-for-age < -3 Z-scores were defined as severely wasted. Children with BMI-for-age Z-score > 3 were severely obese. The values were set from the median values of the WHO international growth reference 2007 for 5–19-year-old children.^[15,16]

Statistical analysis

The data were analyzed using IBM Statistical Package for Social Sciences 20.0 (version 20, IBM Corp., Chicago, IL, USA); quantitative data such as weight, height, and BMI were presented as mean with standard deviations (SDs); and qualitative data such as sex and nutritional status were presented as proportions and percentages. Differences in the mean body weight, height, and BMI were evaluated for boys and girls according to age, using an independent samples *t*-test to a confidence interval of 95%. Chi-square test was used to test for statistical significance of the differences in proportion between males and females in the different nutritional categories. The significant level was set at a probability level of $P \leq 0.05$.

Results

Study population characteristics

A total of 2616 children (1305 males, 1311 females), male: female ratio 1:1, who were aged 6–12 years old (mean

Table 1: Mean weight, height, and body mass index of subjects

Age	Sex	Number of subjects	Mean weight (SD) in kg	P	Mean height (SD) in cm	P	Mean BMI (SD) in kg/m ²	P
6	Male	178	22.7 (3.1)	0.305	123.5 (5.3)	0.260	14.8 (1.4)	0.696
	Female	196	23.1 (4.8)		124.2 (5.6)		14.9 (2.3)	
7	Male	163	25.4 (6.3)	0.729	128.6 (6.7)	0.299	15.2 (2.5)	0.311
	Female	152	25.7 (6.3)		127.8 (6.1)		15.6 (2.9)	
8	Male	210	27.6 (5.6)	0.479	133.0 (6.4)	0.252	15.4 (2.3)	0.881
	Female	204	27.1 (6.7)		132.3 (6.0)		15.4 (2.7)	
9	Male	248	29.8 (6.5)	0.482	136.9 (6.0)	0.257	15.8 (2.5)	0.746
	Female	232	30.2 (7.0)		137.5 (6.2)		15.9 (2.7)	
10	Male	211	32.0 (5.7)	0.010*	141.3 (6.3)	0.023*	15.9 (2.1)	0.041*
	Female	216	33.6 (8.0)		142.7 (7.4)		16.4 (2.6)	
11	Male	158	33.7 (7.0)	0.007*	145.4 (6.6)	0.022*	15.9 (2.3)	0.018*
	Female	184	35.8 (7.2)		147.0 (6.3)		16.5 (2.5)	
12	Male	137	34.4 (5.8)	0.001*	147.3 (5.9)	0.001*	15.8 (1.9)	0.001*
	Female	127	38.0 (7.6)		150.1 (6.5)		16.8 (2.5)	

*Significant values. BMI=Body mass index; SD=Standard deviation

Table 2: Mean height-for-age, weight-for-age, and body mass index-for-age Z-scores of subjects

Age (years)	Mean (SD)					
	Height-for-age Z-score		Weight-for-age Z-score		BMI-for-age Z-score	
	Boys	Girls	Boys	Girls	Boys	Girls
6	1.50 (1.07)	1.72 (1.08)	0.63 (0.96)	0.70 (1.19)	-0.47 (1.06)	-0.45 (1.44)
7	1.26 (1.27)	1.25 (1.12)	0.52 (1.47)	0.63 (1.26)	-0.43 (1.49)	-0.16 (1.36)
8	0.99 (1.13)	0.95 (1.04)	0.36 (1.20)	0.25 (1.26)	-0.39 (1.29)	-0.47 (1.40)
9	0.69 (0.99)	0.79 (1.02)	0.18 (1.18)	0.19 (1.13)	-0.40 (1.27)	-0.37 (1.20)
10	0.53 (0.99)	0.59 (1.16)	0.01 (0.96)	0.10 (1.17)	-0.53 (1.16)	-0.36 (1.17)
11	0.31 (0.97)	0.26 (0.95)	N/A	N/A	-0.87 (1.15)	-0.60 (1.19)
12	-0.29 (0.83)	-0.19 (0.95)	N/A	N/A	-1.18 (1.09)	-0.77 (1.16)

BMI=Body mass index; SD=Standard deviation; N/A=Not available

Table 3: Comparison of nutritional status of subjects by gender (n=2616)

Nutritional status	Number of subjects, n (%)		Total (n=2616)	χ^2	P
	Male	Female			
Wasting (thinness)	139 (57.2)	104 (42.8)	243	11.688	0.069
Stunting	5 (38.5)	8 (61.5)	13	2.297	0.317
Underweight \leq 10 years	12 (46.2)	14 (53.8)	26	4.324	0.364
Normal weight	1046 (50)	1044 (50)	2090	2.928	0.818
Overweight	70 (42.2)	96 (57.8)	166	9.690	0.138
Obesity	50 (42.7)	67 (57.3)	117	4.777	0.573

Table 4: Nutritional status categories of school children by age and gender

Age (years)	Sex	Number of subjects (n)	n (%)					
			Normal	Wasted	Stunted	Underweight	Overweight	Obese
6	Male	178	150 (84.3)	13 (7.3)	0	0	12 (6.7)	3 (1.7)
	Female	196	149 (76.0)	19 (9.6)	0	1 (0.5)	17 (8.6)	11 (5.6)
7	Male	163	123 (75.4)	20 (12.2)	0	3 (1.8)	11 (6.7)	9 (5.5)
	Female	152	125 (82.2)	5 (3.2)	0	1 (0.6)	7 (4.6)	15 (9.8)
8	Male	210	168 (80.0)	16 (7.6)	0	2 (0.9)	12 (5.7)	14 (6.6)
	Female	204	150 (73.5)	18 (8.8)	0	4 (1.9)	25 (12.2)	11 (5.3)
9	Male	248	202 (81.4)	17 (6.8)	0	5 (2.0)	19 (7.6)	10 (4.0)
	Female	232	192 (82.7)	12 (5.1)	0	3 (1.2)	16 (6.8)	12 (5.1)
10	Male	211	173 (81.9)	19 (9.0)	1 (0.4)	2 (0.9)	11 (5.2)	8 (3.7)
	Female	216	177 (81.9)	14 (6.4)	1 (0.4)	5 (2.3)	15 (6.9)	10 (4.6)
11	Male	158	128 (81.0)	24 (15.1)	1 (0.6)	N/A	2 (1.2)	4 (2.5)
	Female	184	149 (80.9)	20 (10.8)	5 (2.7)	N/A	10 (5.4)	5 (2.7)
12	Male	137	102 (74.4)	30 (21.8)	3 (2.1)	N/A	3 (2.1)	2 (1.4)
	Female	127	102 (80.3)	16 (12.5)	2 (1.5)	N/A	6 (4.7)	3 (2.3)

No significant gender differences, $P > 0.05$; N/A=Not available

age 8.9 ± 1.9 years), were enrolled in the study. The mean height, weight, and BMI of the participants were 136.6 ± 10.2 cm, 29.7 ± 7.7 kg, and 15.7 ± 2.4 kg/m², respectively. Table 1 shows the anthropometric measurements among the various ages and sex. For males, the overall anthropometric values were as follows: Mean height was 136.2 ± 9.8 cm, the weight 29.2 ± 7.0 kg, and BMI 15.6 ± 2.2 kg/m². The corresponding measurements for females were 137.0 ± 10.7 cm, 30.2 ± 8.4 kg, and 15.9 ± 2.7 kg/m².

In relation to age trends, children who were <9 years of age had comparable height, weight, and BMI in the different

gender categories. Significant differences in height, weight, and BMI were noted at the ages of 10, 11, and 12 years with females having higher values than their male counterparts.

Anthropometric indices and nutritional status categories

The overall average height-for-age Z-score was 0.77 ± 1.17 while similar indices for males and females were 0.74 ± 1.16 and 0.80 ± 1.18 , respectively. The average weight-for-age was 0.33 ± 1.19 . The mean weight-for-age for males and females were 0.31 ± 1.17 and 0.35 ± 1.21 , respectively. The mean BMI-for-age Z-score was -0.50 ± 1.27 ; similar indices for males and females were -0.57 ± 1.25

and -0.44 ± 1.28 , respectively [Table 2]. There were variations in BMI-for-age in older children from age 10 years and above. The BMI-for-age Z-scores for the 10-year-old males and females were -0.52 ± 1.16 and -0.36 ± 1.17 , respectively, and for the 11-year-old males and females were -0.86 ± 1.14 and -0.60 ± 1.19 , respectively. Similar indices for 12-year-old males and females were -1.17 ± 1.08 and -0.77 ± 1.15 , respectively.

With the Z-scores assessment for the nutritional status, the indices showed that 78.9% (2090/2616) were of normal nutritional status, 9.3% (243/2616) wasted, 6.3% (166/2616) overweight, 0.9% (26/2616) underweight, and 4.4% (117/2616) obese whereas 0.4% (13/2616) were stunted [Table 3]. Severe obesity was noted in 23.9% (28/117) of the obese children.

Table 4 shows that stunting was noted more among the 11-year-old females. Wasting was more in those older than 10 years. More males (10.6%) than females (7.9%) were wasted, $P = 0.069$. Overweight and obesity were more prevalent among the females; 7.3% of females compared with 5.4% of males were overweight, $P = 0.138$; and 5.1% of females compared with 3.8% of males were obese, $P = 0.573$.

Discussion

The majority (78.9%) of the school children studied had normal nutritional status, but the prevalence of the various forms of malnutrition was also remarkable. The prevalence rates for wasting, underweight, and stunting were comparatively lower than the rates reported in some studies in Nigeria^[17-19] and other parts of Africa.^[20,21] Akor *et al.*^[17] reported 11.1% and 10.3% for stunting and underweight, respectively, but lower rate (2.4%) for wasting. The 9.3% prevalence rate for wasting obtained in the current study is lower than 19.4% and 14% prevalence rates reported among school children in Ghana^[20] and Ethiopia,^[21] respectively. The prevalence rates for underweight and stunting are comparatively lower than the rates reported in the African studies as well in studies done in some parts of the world.^[20-23] The observed differences may be related to study instruments such as the reference indices used, secular/time trends, and sociocultural factors. For instance, Akor *et al.*^[17] used the National Center for Health Statistics/WHO reference values. Kovalskys *et al.*^[7] documented different rates 3.5%, 2.1%, and 2.1% for wasting using 3 different methods (Center for Disease Control centile charts, International Obesity Task Force charts, and WHO AnthroPlus based on Z-scores), respectively, in the same population. Wang and Chen^[22] in their review of the use of percentile and Z-score in anthropometry for the assessment of nutritional status found variances related to the different measurement tools. Whereas the WHO AnthroPlus^[16] was used in this study, this is in compliance

with the recent WHO recommendation on the use of Z-score-related indices in the assessment of physical growth and nutritional status. These variances in assessment tools underscore the need for a guided application of international growth references and standards in different populations, especially in developing countries. To harmonize the tool for assessment of nutritional status, the WHO launched the new growth standards for children irrespective of ethnicity, socioeconomic status, and feeding mode.^[23] The new standards make use of multiple indicators based on Z-scores (height-for-age and BMI-for-age instead of only weight-for-age to better characterize growth patterns such as stunting, wasting, overweight, and obesity). The Z-scores are preferred because they permit clinical tracking of patients whose anthropometric classification lies beyond the measurable limits of the percentile range such as those with severe undernutrition and severe obesity.

Irrespective of the different methods of assessment, the nutritional indices obtained in the present study are better than those obtained from urban and rural India.^[2,24] Srivastava *et al.*^[2] and Fazili *et al.*,^[24] respectively, documented higher rates of 33.3% and 12.3% for wasting as well as 18.5% and 9.2% for stunting. The differences may be due to sociocultural influence. The factor of societal influence is most likely to influence the nutrition of the school-aged child. Srivastava *et al.*^[2] in their study noted that ignorance and difficult conditions of life (overcrowding, poor quality drinking water, and sanitation) obtainable in the slums were likely to result in improper food habits, low healthcare use, and hygiene awareness. Thus, children living under such conditions are at especially high risk for health and nutritional problems. High burden of malnutrition in Sub-Saharan Africa has also been attributed to poverty, poor environmental conditions, and overpopulation which predispose children to inadequate food intake or intake of foods of poor nutritional quality and quantity.^[25] Our study was done in an urban setting with better living conditions than may be found in slums or rural areas. This is further buttressed by the low prevalence of stunting among our children which may also be attributable to the stable economic growth within the region and the consequent impact on child growth.

There were gender variations in height in different age groups; the younger males (6–9 years old) were generally taller than their female counterparts but at older age 10 years and above the trend changed with females being taller and heavier than the males. Similarly, Akor *et al.*^[17] noted among the children studied that males were heavier and taller than their female counterparts till the age of 9–10 years after which the trend reversed with females being heavier and taller than males. This may be linked to the prepubertal growth spurt which occurs earlier in females than males.^[26] Under hormonal influence, females experience earlier and more rapid increase in body size and shape than boys just before puberty.

There were notable differences in the nutritional status with different age and gender categories. For instance, older children were more wasted notably among older males. Consistent with other studies,^[17,19,27] boys were more wasted than girls. El Hioui *et al.*^[28] also noted higher prevalence of underweight and wasting in older males. In contrast, Srivastava *et al.*^[2] reported significantly higher prevalence of underweight, wasting, and stunting in girls than boys and attributed the disparities in findings to differences in study frame, family setups, and gender bias due to parental preferences for male children in the Indian society. This implied that males received better care and possibly fed better than the girls. These contrasts seem to suggest the influence of society on the nutrition and consequent physical growth of children. In the African setting, gender bias against females does not seem to be a major determinant of malnutrition in children since most African studies showed that males are more nutritionally disadvantaged than their female counterpart.^[29,30] Increasing attention on female children has been suggested as a possible explanation for the improved nutritional status in females.^[31]

Different studies in Nigeria^[10,18,32] have shown variations in the prevalence of overweight and obesity. Although the peculiarities of the different population studied may explain the differences in the figures reported by these authors, the disparities may also be attributable to the varying methods of assessment of nutritional status used by the authors. The finding in the current study in comparison to a previous one^[11] in the same environment showed a higher rate of obesity, which may suggest a rising trend in Enugu. However, this variation comparing rate of 4.4% obtained in the current study with 1.7% obtained in the previous study^[11] (based on Cole's BMI cutoff points for children and adolescents) may be taken with caution considering the different methods used in assessment. Therefore, it will be difficult to draw conclusions based on these findings. Although the prevalence rates for overweight and obesity in the current study are considerably lower than the reports from high-income countries as well as other lower-income countries like India,^[33,34] a high proportion (23.9%) of the obese children in our study were severely obese. This is quite alarming considering that childhood obesity is a risk factor for adult obesity with associated risk of cardiovascular and pulmonary diseases.^[4,34]

Consistent with other workers,^[8,18] younger children in our cohort were more overweight/obese than older children. In contrast, Senbanjo *et al.*^[32] and Ene-Obong *et al.*,^[35] respectively, documented higher prevalence of overweight and obesity in older children. Females were more overweight and obese than males. The gender differences observed in our study and other studies^[8,35] may be attributed to natural gender propensities. Male children are arguably more adventurous and indulge in more physical activities than females, thus are likely to shed excess weight during such activities.

Conclusions

A majority of the children have normal growth and nutritional status. Both extremes of malnutrition were found to be coexisting in the remaining few. We recommend urgent preventive measures such as institution school feeding programs in all Nigerian schools as well as nutritional education to parents and their children to forestall the double burden of under- and over-nutrition in our setting.

Limitations of this study

The sample was drawn from an urban population and may not be representative of the sample obtained in the rural area. The lack of assessment of food intake as a nutritional status assessment is a limitation.

Acknowledgments

We would like to express our deep gratitude to the head teachers of the various schools used for the study for their cooperation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser 1995;854:1-452.
2. Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP, Kumar B. Nutritional status of school-age children – A scenario of urban slums in India. Arch Public Health 2012;70:8.
3. You D, Bastian P, Wu J, Wardlaw T. Levels and Trends in Child Mortality. United Nations Inter-agency Group for Child Mortality Estimation, Report; 2013.
4. Olusanya JO. Assessment of the food habits and school feeding programme of pupils in a rural community in Odogbolu local government area of Ogun state, Nigeria. Pak J Nutr 2010;9:198-204.
5. Tauman R, Gozal D. Obesity and obstructive sleep apnea in children. Paediatr Respir Rev 2006;7:247-59.
6. Popkin BM, Richards MK, Montiero CA. Stunting is associated with overweight in children of four nations that are undergoing the nutrition transition. J Nutr 1996;126:3009-16.
7. Kovalskys I, Rausch Herscovici C, De Gregorio MJ. Nutritional status of school-aged children of Buenos Aires, Argentina: Data using three references. J Public Health (Oxf) 2011;33:403-11.
8. Popkin BM. The nutrition transition and obesity in the developing world. J Nutr 2001;131:871S-3S.
9. Opara DC, Ikpeme EE, Ekanem US. Prevalence of stunting, underweight and obesity in school aged children in Uyo, Nigeria. Pak J Nutr 2010;9:457-66.
10. Fetuga MB, Ogunlesi TA, Adekanmbi AF, Alabi AD. Growth pattern of schoolchildren in Sagamu, Nigeria using the CDC standards and 2007 WHO standards. Indian Pediatr 2011;48:523-8.
11. Nwaiwu O, Ibe BC. Body mass index of children aged 2 to 15 years in Enugu, Nigeria. Niger J Paediatr 2014;41:194-8.
12. Sede PI, Ohemeng W. Socio-economic determinants of life expectancy in Nigeria (1980-2011). Health Econ Rev 2015;5:2.
13. Ighodalo A. Poverty and sustainable socioeconomic development in Africa: The Nigerian experience. Eur Sci J 2012;8:26.

14. Federal Republic of Nigeria. 2006 Population Census. Vol. 94. Official Gazette; 2007. p. B180-5.
15. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* 2007;85:660-7.
16. WHO AnthroPlus for Personal Computers Manual: Software for Assessing Growth of the World's Children and Adolescents. Geneva: WHO; 2009. Available from: <http://www.who.int/growthref/tools/en/>. [Last accessed on 2015 Aug 15].
17. Akor F, Okolo S, Okolo A. Nutritional status of newly enrolled primary school children in Jos Plateau, Nigeria. *Pak J Nutr* 2010;9:1166-70.
18. Fetuga MB, Ogunlesi TA, Adekanmbi AF, Alabi AD. Nutritional status of semi-urban Nigerian school children using the 2007 WHO reference population. *West Afr J Med* 2011;30:331-6.
19. Goon DT, Toriola AL, Shaw BS, Amusa LO, Monyeki MA, Akinyemi O, *et al.* Anthropometrically determined nutritional status of urban primary schoolchildren in Makurdi, Nigeria. *BMC Public Health* 2011;11:769.
20. Prince AK, Laar A. Nutritional status of school age children in the Nkwanta south district – Volta region of Ghana. *Eur Sci J* 2014;10:310-27.
21. Wolde M, Berhan Y, Chala A. Determinants of underweight, stunting and wasting among schoolchildren. *BMC Public Health* 2015;15:8.
22. Wang Y, Chen HJ. Use of percentile and Z scores in anthropometry. In: Preedy VR, editor. *Handbook of Anthropometry: Physical Measures of Human form in Health and Disease*. New York: Springer Science + Business Media, LLC; 2012. Available from: <http://www.springer.com/978-1-4419-1787-4>. [Last accessed on 2014 May 15].
23. de Onis M, Onyango A, Borghi E, Siyam A, Blössner M, Lutter C; WHO Multicentre Growth Reference Study Group. Worldwide implementation of the WHO Child Growth Standards. *Public Health Nutr* 2012;15:1603-10.
24. Fazili A, Pandit MI, Mir AA, Bhat IA. Z score and CIAF – A comprehensive measure of magnitude of under nutrition in a rural school going population of Kashmir, India. *Glob J Med Public Health* 2012;1:46-9.
25. Bain LE, Awah PK, Geraldine N, Kindong NP, Sigal Y, Bernard N, *et al.* Malnutrition in sub-Saharan Africa: Burden, causes and prospects. *Pan Afr Med J* 2013;15:120.
26. Njokanma OF, Nkanginieme KE. Growth and development. In: Azubuike JC, Nkanginieme KE, editors. *Paediatrics and Child Health in a Tropical Region*. Owerri: African Educational Publishers Ltd.; 2007. p. 56-69.
27. Mwaniki EW, Makokha AN. Nutrition status and associated factors among children in public primary schools in Dagoretti, Nairobi, Kenya. *Afr Health Sci* 2013;13:39-46.
28. El Hioui M, Azzaroui F, Ahami A, Aboussaleh Y. Nutritional status and school achievements in a rural area of Anti-Atlas, Morocco. *Food Nutr Sci* 2011;2:878-83.
29. Garcia V. Children Malnutrition and Horizontal Inequalities in Sub-Saharan Africa: A Focus on Contrasting Domestic Trajectories. UNDP United Nations Development Programme. W/P; 2012-2019. p. 1-42.
30. Wamani H, Astrøm AN, Peterson S, Tumwine JK, Tylleskär T. Boys are more stunted than girls in sub-Saharan Africa: A meta-analysis of 16 demographic and health surveys. *BMC Pediatr* 2007;7:17.
31. Babatunde RO, Olagunju FI, Fakayode SB, Sola-Ojo FE. Prevalence and determinants of malnutrition among under-five children of farming households in Kwara state, Nigeria. *J Agric Sci* 2011;3:173-81.
32. Senbanjo IO, Adeodu OO, Adejuyigbe EA. Low prevalence of malnutrition in a rural Nigerian community. *Trop Doct* 2007;37:214-6.
33. Siddiqui NI. Prevalence and trends of obesity in Indian school children of different socioeconomic class. *Indian J Basic Appl Med Res* 2012;2:393-8.
34. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA* 2002;288:1728-32.
35. Ene-Obong H, Ibeanu V, Onuoha N, Ejekwu A. Prevalence of overweight, obesity, and thinness among urban school-aged children and adolescents in Southern Nigeria. *Food Nutr Bull* 2012;33:242-50.

