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Research Article
Nutritional Status of Adolescent Schoolchildren In South East Nigeria

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Abstract

Background and Objective: Adolescent malnutrition is still prevalent worldwide. The scanty information in this area, especially in developing countries, hinders the development of appropriate nutrition programs for the adolescents. Therefore, this study was conducted to assess the nutritional status of adolescents in South East Nigeria. **Materials and Methods:** Six public and six private schools were selected and a sample of 647 adolescents aged 10-19 years was examined. Anthropometric, hemoglobin and serum retinol measurements were determined on a sub-sample (n = 174). A questionnaire was used to collect demographic data. Chi-square and independent t-test were used to compare means. **Results:** The mean age of the adolescents was 14.2±1.2 years. About 40% of the adolescents were both anemic and vitamin A deficient, 39.6% had vitamin A deficiency while 40.3% were anemic and 57% had multiple malnutrition indicators. The prevalence of stunting was 9.1% and that of thinness, 14.4%. The prevalence of anemia and vitamin A deficiency was significantly ($p<0.05$) higher in public than private schools. Overweight/obesity was low (3.1%) in private schools. Conversely, urban schools had significantly ($p<0.05$) higher overweight/obesity than rural communities. Thinness and stunting were significantly ($p<0.05$ higher in rural than urban schools. About 13.6% of the adolescents had one or two nutritional indicators. **Conclusion:** The study revealed that malnutrition was prevalent in South East Nigeria amongst adolescents. This makes nutrition education and intervention imperative in the region.

Key words: Anemia, children, malnutrition, nutrition education, obesity

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Competing Interest: The authors have declared that no competing interest exists.

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

INTRODUCTION

Malnutrition and overweight/obesity in adolescents are of great concern, especially in the developing countries[1-2]. Overweight/obesity is a form of malnutrition and has been the major cause of nutrition related diseases afflicting people in different epidemic proportions worldwide[3-6]. This rising epidemic, together with under nutrition and over nutrition, is now referred to as 'Triple Burden of Malnutrition' (TBM) which is becoming of great concern for developing countries, particularly, African countries[7-12]. The TBM is currently a real threat in underdeveloped economies and adolescents are the most vulnerable at the population, household and even individual levels[13-14].

Obesity is on the increase among schoolchildren even in developed countries. For instance, in America, the percentage is as high as 50[6,10]. In African countries and particularly, Nigeria, the percentage is higher than this figure. Rural communities in developing countries are mostly affected by obesity. This is because malnutrition and its related chronic diseases are more widespread in rural areas than that of the urban areas[15-16]. An obese person is defined as someone having a body weight that is 20% above the ideal value (or +2SD of the median value) based on population statistics, considering age and sex. An obese person has a higher risk for chronic and degenerative diseases[17-20]. The most important consequence of childhood obesity is its persistence into adulthood with all the associated health risks. Although most obese infants will not remain so, they have the likelihood of becoming obese children.

"Hidden hunger" (micronutrients deficiency) is becoming a serious threat among adolescents in developing countries[17]. Due to their physiological needs, adolescents are seriously affected by anemia, vitamin A deficiency[18] and parasitic infections with the adverse effect on their nutritional status[21], cognitive development and academic performance[18,22,23].

Due to lack of adequate nutritional information about this vulnerable group, it would be very hard to ascertain appropriate intervention strategies. WHO[24] has shown that overweight and obesity are consequences of a global shift towards increased consumption of energy rich food that are high in fat and sugars but deficient in proteins, vitamins and minerals. In underdeveloped countries such as Nigeria, obesity is as a result of globalization which leads to nutrition transition. Due to the nutritional transition economic, demographic, cultural and environmental changes occur in the society; it affects the nutritional status of the population[24]. Overweight and obesity are usually linked with high morbidity and mortality[12]. Despite the obvious health implications of overweight and obesity, routine screening is not usually practiced in our schools where these adolescents are. Recent nutrition surveys in Nigeria showed high prevalence of overweight and obesity amongst adolescent schoolchildren in both urban and rural communities[8].

The present study was conducted to ascertain the nutritional status of adolescent schoolchildren in both public and private schools in poor-rural settings of the South East Nigeria. We hypothesized: (1) That under-nutrition and micronutrient malnutrition as well as parasitic infections would be widespread, (2) That boys would be more stunted than girls and (3) that school children, particularly in rural areas would be most affected.

MATERIALS AND METHODS

Location: Uzo-Uwani is situated in the northern part of Enugu State, in the South East Nigeria. The vegetation is Sahel savanna. The temperature ranges from 21-35°C. The local government headquarters is Umulokpa which lies on latitude 6^0 35^1 North and longitude $7°42^1$ East and about 86km away from Enugu, the State capital.

Methods

Experimental design: A cross-sectional descriptive study was conducted between December 2016 and April 2017 to assess the prevalence of overweight and obesity and nutrition-related diseases among adolescents aged 10-19 years in secondary schools in Uzo-Uwani Local Government Area of Enugu State. Twelve schools, made up of both public and private schools, were studied. The schools from both the urban and rural communities were covered to ascertain if the proposed hypotheses are justifiable.

Ethical clearance: The approval for the study was sought through the Research Ethics Committee of the Faculty of Medicine, University of Nigeria Teaching Hospital, Enugu and the Ethics Committee of the Ministry of Health, Enugu State (Approval Number: NHREC/05/01/2008B-FWA0002458-IRB00002323). The study objective and procedures were explained during meetings held in each school. Informed consent forms were given to the children for their parents to sign and were collected one week later. Some children whose parents refused to give their consent were excluded. All the children who participated in the study were required to give their own full consent.

Population and sample: Based on an estimated global prevalence of 40% for anemia and 27% for overweight/obesity

in adolescent schoolchildren[15], about 840 subjects were recruited for the study. The schoolchildren aged 10-19 years were selected using multi-stage sampling technique. The selection of schoolchildren was purposive since some were below 10 years and others above 19 years. The total number of adolescent schoolchildren that were recruited in each school was 70 and a total of 12 schools were studied. The respondents filled out a self-administered questionnaire. The schools were 6 public schools (three in poor-rural and three in urban areas) and 6 private schools (three in poor-rural and three in urban areas), all located in different parts of Uzo-Uwani Local Government Area in South East Nigeria.

Anthropometric measurements: Anthropometric measurements were carried out using standard procedures[20]. Weight was measured to the nearest 0.1 kg using electronic scale (SECA 803). Children were asked to wear light clothes and without shoes. Weight was recorded twice and the mean value taken. Where the difference between the two measures exceeded 0.2 kg, the child was re-weighed to ensure accuracy of the results. Individual height was measured with a wooden stadiometer placed on a flat surface. The subject was made to stand on the basal part of the device with feet together. The shoulders, the buttocks and the heels had to touch the vertical measuring board. The children were asked to stand with their eyes in the Frankfort horizontal plane. The height was measured to the nearest 0.1 cm and in duplicate. Computed Z-scores of Body Mass Index for age (BMIAZ) and height for age (HAZ) were then used to assess thinness/overweight/obesity and stunting, respectively, using the WHO new reference values for school boys and girls[25,26]. Stunting is defined by WHO[27] as HAZ <-2.0, thinness as BMIAZ <-2.0, overweight as BMIAZ >1.0 and obesity as BMIAZ >2.0. Hemoglobin (Hb) concentration was determined using the HemoCue® system (HemoCue, Angelholm, Sweden)[26]. One drop of capillary blood is carefully collected at the tip of the middle finger with a lancet. The first two drops were discarded and the third one is used to fill the microcuvette, which is then placed in the cuvette holder of the device (HemoCue Hb 201$^+$). The displayed Hb value is then recorded. WHO age-specific criteria were used to identify anemic children (Hb <11.5 g dL^{-1} for children between 7 and 11 years of age and Hb < 12 g dL^{-1} for those aged 12 years and above)[26].

Vitamin A status was determined only in the subsample because of high cost of the assay. A certain volume (10 mL) of venous blood was collected. After centrifugation, the serum samples were analyzed in duplicate for retinol. Low serum retinol (<0.7 μmol L^{-1}) indicates vitamin A deficiency (VAD)[27]. Thyroid palpation was performed on the subjects to assess iodine status in order to detect goiter (if any)[28]. Palpation technique was employed by trained personnel in order to grade the goiter (if any) according to standard procedures[29,30].

Statistical analyses: Data were processed and analyzed using Statistical Product for Service Solutions software (SPSS 2.1, Inc., Chicago IL). Chi-square and independent t-test were used to compare means between groups. Significance was accepted at $p<0.05$.

RESULTS

About 840 children were recruited to participate in the study and 804 parents (95.7%) gave their consent. Twenty four subjects were missing at the time of data collection, 780 children were finally included (97.01% response rate). Data were retained only for the subjects aged between 10 and 19 years (713 subjects) as some were either below or above this age range. Children whose date of birth was not known (66 subjects) were also excluded from the analyses. Hence 647 subjects in the total sample and 174 subjects in the subsample with complete data were retained for the analyses.

The mean age was 14.2±1.2 years. A total of 434 adolescent children (67.1%) were in public schools while 213 (32.9%) were in private schools. The 28.1% of the total came from the rural schools. The sex ratio was the same in the subsample and in the whole sample. Similarly, the proportion of pupils attending public/private (67/33%) and urban/poor-rural (72/28%) schools was roughly the same in the overall and the subsample.

The overall malnutrition indicators in the total and subsample are depicted in Fig. 1. Anemia and vitamin A deficiency was evident and the prevalence was 40 and 38%,

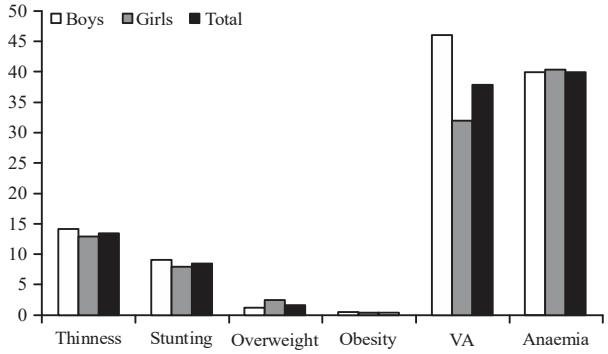

Fig. 1: Prevalence (%) of overall and specific malnutrition signs in adolescent schoolchildren in South East Nigeria (n = 647), p = 0.048 between boys and girls (χ^2 test). Subsample: 174. VA: Vitamin A status

Table 1: Malnutrition signs in adolescent school children

	Boys		Girls		Total		
No. of signs (N = 647)	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	p-value*
Zero (0)	120	39.1	157	46.2	277	42.8	
One (1) or more	167	54.4	204	60.0	371	57.3	0.652
Two (2)	46	15.1	42	12.4	88	13.6	0.411
Stunting+thinness	8	2.6	3	0.8	11	1.7	0.042
Stunting+anemia	10	3.2	13	3.8	23	3.6	0.837
Thinness+anemia	22	7.2	18	5.3	40	6.2	0.523
Stunting+VAD	3	1.0	5	1.5	8	1.2	0.544
Thinness+VAD	4	1.3	3	1.0	7	1.1	0.585
Anemia+VAD	23	7.5	17	5.0	40	6.2	0.224

VAD: Vitamin A deficiency, *χ^2 test

Table 2: Nutritional status of adolescent schoolchildren in South East Nigeria according to age

		Frequency (%)				
Age (years)	N	Overweight/obesity	Thinness	Stunting	Anemia	VAD
10-12	68	6 (8.8)	11 (16.2)	0 (0.0)	21 (30.9)	5 (17.4)
13-16	502	14 (2.8)	66 (13.1)	44 (8.8)	205 (40.8)	56 (43.6)
17-19	77	0 (0.0)	16 (20.8)	15 (19.5)	35 (45.5)	8 (31.2)
p-value*	0.039	0.184	<0.001	0.160	0.280	0.081
Total	647	20 (3.1)	93 (14.4)	59 (9.1)	261 (40.3)	69 (39.6)

VAD was on sub-sample only (N = 174), *χ^2 test

Table 3: Nutritional status of adolescent school children in South East Nigeria according to school characteristics

		Frequency (%)				
School characteristics	N	Overweight/obesity	Thinness	Stunting	Anemia	VAD
School type						
Public schools	445	6 (1.3)	63 (14.2)	43 (9.7)	203 (45.6)	62 (51.3)
Private schools	202	10 (4.4)	24 (11.9)	12 (5.9)	60 (29.7)	6 (6.2)
p-value*		0.007	0.880	0.236	0.001	<0.001
School location						
Urban schools	523	16 (3.1)	65 (12.4)	42 (8.0)	220 (42.1)	50 (36.2)
Poor-rural schools	124	0 (0.0)	22 (18.0)	13 (10.5)	43 (35.0)	18 (52.2)
p-value*		0.073	0.036	0.003	0.798	0.088
Total	647	16 (2.5)	87 (13.4)	55 (8.5)	263 (41.0)	68 (40.2)

VAD was on sub-sample only (N = 174) *χ^2- test

respectively. Stratifying by gender, anemia affected both sexes equally (p>0.05). There was no goiter detected in the entire sample. Stunting rate was 8.2% for girls and 9.2% for boys (p>0.05). Thinness affected 13.6% of adolescent schoolchildren and there was no significant difference between the boys (14.2%) and girls (13.2%). Only six cases of obesity (two boys and four girls) were observed, however, the difference in overweight between boys (0.6%) and girls (2.8%) was high (p<0.05)

Considering the extent of the malnutrition indicators in the entire sample (Table 1), 42% of the children was within acceptable levels of nutritional well-being, while 58% of the children had at least one sign of malnutrition, including 14% who presented with two or three signs of malnutrition indicators. Copious evidence was also observed in the concurrent deficiencies affecting children according to sex, as seen in the combination of VAD and anemia (24.6%).

The malnutrition rate by age is shown in Table 2. The prevalence of thinness and anemia in the 17-19 year-old group was the highest with 20.8 and 45.5% respectively, followed by those of 13-16 year age range with anemia (40.8%). The youngest adolescents (10-12 years) did not present with stunting while the older ones were the most affected with 19.5% prevalence. On the other hand, while older adolescents did not present with overweight/obesity, their younger ones (10-12 years) were more affected (8.8%) followed by 13-16 years old group with 2.8% prevalence. The differences were found to be significant (p<0.05). The 13-16 years age group was the most affected with VAD (45%) followed by the 17-19 years old group (29%). Nevertheless, the age differences in proportions of micronutrient malnutrition were not significantly different (p>0.05).

Table 3 shows the comparison of the nutritional status of the adolescent school children according to school type.

Children in public schools were more affected by anemia and VAD than those in private schools and the difference was significant ($p<0.05$). Stunting was also more in public schools (9.7%) than private schools (5.9%) (Table 3). Overweight/obesity was more prevalent in private schools (4.4%) than public schools (1.6%) ($p<0.05$), while the prevalence of thinness was more in public schools (14.2%) than in private schools (11.9%), however, the difference was not significant ($p>0.05$). The study also revealed that stunting (10.5%) and thinness (18%) were significantly higher in poor-rural communities than in urban areas (8 and 12.4%, respectively) ($p<0.05$). VAD tended to be more widespread and overweight/obesity was lower in the poor-rural schools than in the urban schools though the result was not statistically significant ($p>0.05$).

DISCUSSION

The study revealed that adolescents malnutrition was prevalent at school age in the study area. About 55% of the school children examined had at least one indicator of malnutrition and about 16% had at least two such malnutrition signs. The findings accord with those of other previous studies Omuemu and Oguche[8,] Dabone *et al.*[25] and Yahya *et al.*[28]. A high prevalence of micronutrient malnutrition at school age is not uncommon in developing countries. Hall *et al.*[7] had reported that in six African and two Asian countries, 40.2% of children aged 7-11 years and 54.4% of those aged 12-14 years were anemic. The study also showed that about 14% of the subjects were thin, which is higher (10.8%) than the prevalence previously reported for adolescent children in Nigeria[8]. Acute malnutrition, defined by thinness, or wasting could be as a result of current economic and food crisis exacerbated by climate change and this would reduce access to food, especially among vulnerable groups[28-31]. We noted that many schoolchildren, neither came to school with snacks nor had money to buy them during break periods. We also observed that even those that had the snacks did not provide an adequate meal. This may have contributed to the observed prevalence of thinness in schoolchildren in the present study. Nevertheless, the present prevalence is far lower than those previously reported by PCD[32].

The prevalence of stunting (9.1%) in this study was lower than those obtained in other sub-Saharan African countries such as Burkina Faso[25]. It has been shown that stunting is an indicator of chronic malnutrition and at school age, it may reflect malnutrition during the first years of life[1]. Some studies have shown that growth deficit tends to track with age, especially in boys as was observed in the present study PCD[32] and Begin *et al.*[33]. We observed that except for overweight/obesity and anemia, a higher proportion of boys than girls exhibited signs of malnutrition and this was in agreement with those reported for stunting, wasting and VAD[32]. A meta analysis of data from 16 demographic and health surveys conducted in 10 sub-Saharan African countries revealed that boys were more stunted than girls. This could be attributed to cultural factors or natural selection[25,34-36]. The present study (Fig. 1) revealed that girls had higher prevalence of overweight than boys and this accords with the report of other studies[25]. It was apparent from the study that private schoolchildren enjoyed a better nutritional status than those attending public schools, with anemia and VAD was significantly higher in the latter.

We also observed that overweight/obesity was significantly higher in private than public schools and this is in agreement with the findings of previous studies conducted in other underdeveloped economies[15,16]. It is obvious that socio-economic disparities were the likely cause of this variance[15,16]. Private schools pay as high as ₦6,000 to ₦40,000 as against public schools that do not pay fees at all. Nevertheless, present study showed that thinness was as common in private as in public schools (11.9 and 14.2%, respectively). This could be due to poor food choices and cultural beliefs by mothers. It could also be due to poor management by private school managers.

We observed that stunting and thinness were significantly higher in poor-rural than urban schools and VAD also tended to be higher in the former than the latter (Table 3). Poverty and low maternal education are among the determinants of child malnutrition[13]. It is also known that the prevalence of malnutrition is higher in rural than urban areas, particularly stunting[15], which reflects poor socio-economic status at the community level. It is, therefore, not surprising to find a higher percentage of malnourished children in poor-rural communities, where people are poorer. Anemia was observed in the same proportion for both urban and poor-rural schoolchildren (about 42% vs. 35%). It is therefore, obvious that this pandemic mostly affects schoolchildren in less developed countries like Nigeria[14,17].

It is observed that a concurrent incidence of anemia and infections caused by nematodes, notably hookworms in adolescent children and this accords with the results of previous studies Brooker *et al.*[19,] WHO[20] and Pollitt[22]. It has been reported that the prevalence of malaria (41.1%) was highest in children aged 5-14 years in Ouagadougou while in Nigeria the prevalence was 40% in children aged 10-15 years[25,37]. Other micronutrient deficiencies may

also be involved in the etiology of anemia[37,38]. The "top three" micronutrient deficiencies are iron deficiency, VAD and Iodine Deficiency Disorders (IDD)[31]. The high prevalence of anemia could be a great threat for school-children, since it was combined with VAD in one out of five children (20%) in the present study. Apparently, iron deficiency and VAD are interrelated[29]. In contrast, we detected no goiter using the palpation method recommended by WHO[30], which most likely was due to the effectiveness of the salt iodization[30]. The urgent need to address nutritional problems among adolescents cannot be overemphasized due to their implications in the cognitive and academic performance of these schoolchildren[23,36].

CONCLUSION

The present study copiously depicted overweight and malnutrition in adolescent school children in both urban and rural communities in South East Nigeria. They also co-exist in both private and public schools particularly, among younger children. This could be attributed to nutrition transition. The observed high prevalence of VAD and anemia and their frequent coexistence should be of great concern and could be as a result of other factors such as parasitic infections. Moreover, the prevalence of stunting, thinness and overweight/obesity was also high. The findings are unique in their nature because if properly addressed will help to resolve some adolescent malnutrition problems in South East Nigeria. This makes nutrition education and intervention imperative in these areas.

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