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Original Article

Dietary Intake and Nutritional Status of Secondary School Adolescent Girls in Nnewi, South East Nigeria

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ABSTRACT

Context: Dietary intake largely influences the nutritional status of the adolescents. Assessment of nutritional status enables early detection and correction of malnutrition in the adolescents. ***Objective:*** To assess the dietary intake and nutritional status of secondary school adolescent girls in Nnewi, Southeastern Nigeria. **Methodology:** Cross-sectional study involving 311 adolescent girls from a boarding, and a day secondary school. Anthropometric measurements, hemoglobin estimation, 24-hour dietary recall, and quantitative food frequency estimation were carried out on the subjects and recorded along with demographic data in a pre-tested proforma. Data analysis was performed using computer-based softwares. P-value =0.05 was considered significant. **Result:** The mean age of the adolescents was 14.46±3.0 years. The mean weight, height, and body mass index (BMI) were 51.79±10.35kg, 1.58±0.08m and 20.77±3.45kg/m2 respectively and all showed significant difference with increasing age (p =0.001). Up to 27.7% of the adolescents were underweight; 62.1%, normal weight; 9.0%, overweight; while 1.3%, obese. Cumulative three-day caloric-intake was generally low but significantly increased with increasing BMI (P=0.002). The basal metabolic rate (BMR) and the total resting energy expenditure (TREE) significantly increased for the day students compared to the boarding students, p= 0.001, and 0.001 respectively. **Conclusion:** The nutritional status of the adolescent girls in this study is poor, and the caloric intake generally low. Daily BMR and TREE were significantly higher for the day students compared to the boarders. Information from the study will be useful in the development of appropriate policies and dietary guidelines on adolescent nutrition.

Keywords: adolescent-girls, assessment, dietary-intake, nutritional-status.

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Introduction

The term 'adolescent' as defined by the World Health Organization (WHO) includes persons aged 10-19 years. According to UNICEF 2016 report, there was about 1.2 billion adolescent in the world, accounting for 16% of the world's population.

The adolescence age group is a transition from childhood to adulthood, and as such, the adolescent may no longer benefit from the attention and care normally given to children, neither would they obtain the protection associated with adulthood. Adolescence is a period of rapid growth, being next to (in terms of rapidity of growth) the rate seen in the first 1000 days of life, as up to 45% of skeletal growth takes place during this period to achieve 15 to 25% of the adult height. In addition to the increased nutritional requirement during adolescence, poor dietary diversity and inadequate intake are threats to adolescents due to eating behaviours and some psychosocial factors. Nutrition influences growth and development throughout infancy, childhood and adolescence periods. The effects of malnutrition continues from generation to generation, because adolescent girls that enter reproductive period with poor nutritional status are more likely to give birth to low birth weight, small for gestational age and intrauterine growth restricted (IUGR) babies that are more vulnerable to metabolic disorders later in life.

The adolescence period, therefore, is a unique opportunity to break this vicious cycle of structural and metabolic derangements that are passed from one generation to the next.[5] Many children in low and middle income countries enter adolescence thin, stunted, anaemic, and often display some micronutrients deficiencies. This period is therefore a window of opportunity to address poor nutritional status. However, delivery of these interventions to girls may be challenging in settings where they do not attend school or participate in community programmes. For examples, in Asia and sub-Saharan Africa, 30-40% of girls do not attend lower secondary school. Keeping adolescent girls in school will discourage early marriage and improve their nutritional status, and by extension, that of their children. The health, wealth and wellbeing of any generation depend directly on the health status of adolescents. Therefore, improving the nutritional status of adolescent girls is vital to the wellbeing of future generation. In order to disrupt the intergenerational cycle of malnutrition, targeting nutritional interventions to adolescent girls offers a window of opportunity to improve their health and that of the future generation. Yet data on the nutritional status of this vital group are limited and evidence for nutrition-specific interventions is scarce.

Schools can provide a good entry point to reach adolescents and educate them on dietary choices and the need for consumption of adequate and healthy nutrition. Adequate nutrition consists of balanced diet that provides all the essential nutrients in their right quantities and proportions.,,, Malnutrition, which is a form of poor nutrition, includes Protein-Energy Malnutrition (PEM) and micronutrient deficiencies and is a significant contributor to mortality and morbidity of mothers and children.[11,12]

As a result of the importance of nutrition, many international policies touch on nutrition in one way or the other such as the Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs) and the International Federation of Gynaecology & Obstetrics (FIGO) conference of 2015. The National Committee on Food and Nutrition in 1995 developed the National Food and Nutrition Policy (NFNP) which was launched in 2002. Unfortunately in the NFNP document, there was no policy directive on adolescent, pre-pregnancy and maternal nutrition.[9] Adinma[12] in his review highlighted the importance of adolescent, pre-pregnancy and maternal nutrition. In another analysis of the status of nutrition in adolescence, pre-pregnancy, and pregnancy period in Nigeria Adinma et al[9,10,11] observed that Adolescent, Pre-pregnancy and Maternal nutrition were poorly developed and that there is urgent need to develop a national guideline and IEC (information, education and communication) materials relevant to the adolescence, pre-pregnancy, pregnancy and

postpartum periods.

In 2012, the World Health Organization (WHO) member states endorsed a global target for improving maternal, infant and young child nutrition by 2025 This is as a result of the critical role nutrition plays in health and diseases. The importance of nutrition in adolescent girls and women were captured directly or indirectly in five of the 8 goals of the United Nations Millennium Development Goals (MDGs): Goals 1, 3, 4, 5 and 6. The International Federation of Gynaecology and Obstetrics (FIGO), furthermore at her 21st World Congress held in Vancouver, Canada in 2015, launched the Report of its Expert Committee on Adolescent, Pre-pregnancy and Maternal Nutrition, under the theme- "Think Nutrition First"16. In addition to the FIGO recommendation, adolescents, pre-pregnancy and maternal nutrition was highlighted under the second goal of the UN SDG-the 2030 Agenda. All these unequivocally buttress the importance of nutrition in these various categories of women.

This study has been undertaken amongst secondary school adolescent girls in southeastern Nigeria to elicit their dietary intake and nutritional status. The study will help in providing baseline data which can be used by policy makers in the formulation of the necessary policies and appropriate dietary guidelines to optimize the nutritional status of this vital segment of the Nigerian population, the future Nigerian mothers.

Subjects, Materials and Method

This was a cross sectional study conducted among 311 secondary school adolescent girls aged 10-19 years from two randomly selected secondary (one day and one boarding) schools in Nnewi north LGA of Anambra state, southeastern Nigeria.

Stratified random sampling with proportional allocation of sample size between the boarding and day schools was used to select the samples. The number of secondary schools in Nnewi North LGA was obtained from the Ministry of Education. They were stratified into 2: boarding schools and day schools. One school was selected from each strata using simple random sampling technique. After selection, preliminary visits were made to the Principals of these schools and the study explained to them for their consent and co-operation. Each of the selected school was further stratified into 6 groups: 3 groups for Junior Secondary (JSS) and 3 for Senior Secondary (SS). From each class, a sample frame was created and proportional selection of the research subjects who met the inclusion criteria was done.

Ethical approval for this study was sought and obtained from the Ethics Committee of Nnamdi Azikiwe University Teaching Hospital, Nnewi (No: NAUTH/CS/66/VOL.10/226/2017/140). Consent for the study was obtained from research subjects, as well as their school authorities and the parents/guardians following proper explanation to enable their understanding of the study.

The sample size 311 was determined as per standard method recommended by the WHO Expert Committee for studies involving nutritional status. The sample size was calculated using a power calculation:

(Cole 1997)n=[Z2P(100-P)]/X2

Where, Z= z value
(example 1.96 for 95% confidence interval),

P=percentage adolescent girls assumed to have poor nutritional status. P was taken to be 23% since the National Demographic and Health Survey of 2013[17] showed that 23% of adolescent girls were undernourished, 100-P= Percentage of adolescent girls assumed to have good nutritional status. X= Width of Confidence interval or required precision level taken to be 5%. This gives a power of 80%.

The field workers, recruited from among the technicians in the Dietetics and Nutrition department of Nnamdi Azikiwe University Teaching Hospital, Nnewi, were appropriately updated on the aim of the study by the researchers and the qualified dietician and nutritionist engaged for this research. The adapted validated assessment tools employed in this research were: socio-demographic questionnaires (S-DQ), food frequency questionnaire (QFFQ), and 24 hour dietary reference. The S-DQ questionnaire elicited

information with respect to participant's socio-demographic characteristics age, ethnicity, religion, occupation of the father and mother's educational qualification; while their food consumption was assessed with the 24-hour dietary recall and QFFQ.

During the interview, samples of local household dishes and utensils (different sizes of bowls, plates, cup, glasses and spoons) were displayed to the participants to help them in portion size estimation. Food models were also used simultaneously to explain food items and to obtain the nearest possible approximation of serving sizes of the food the participants consume.

A quantified food method required participants to recall average amount of food consumed on daily, weekly or monthly basis and was used as a reference measure to the 24-hour recall questionnaire. The questionnaire was adapted from that developed and validated in African populations by Oldewage-Theron and Kruger.All the participants completed the QFFQs in an individual interview with the assistance of a fieldworker. The participants were asked to provide detailed information regarding the types and amounts of the foods, beverages and nutritional supplements consumed over the period, the cooking method used (where applicable), the brand name of food (where appropriate) and details of recipes and any leftover. All related foods were grouped together and listed accordingly with preparation methods. Participants were asked to indicate their frequency of consumption of items per day, per week or per month and the questionnaire has a specific column in which the participant can indicate that a food item is eaten less frequently than once a month. The quantity of food consumed and the amount of nutrients obtained were compared using food composition table for use in Nigeria by Oguntona & Akinyele. [27]

Measurement of Weight

The weight and height were determined with a hospital medical body weight and height scale (Yongkng Zhezhong Weighing Apparatus Factory, China).

- **Procedure for weight measurement:** Participants were weighed using a calibrated scale placed on an even uncarpeted floor. The scale was first calibrated with standard weight and checked on daily basis (as a quality control measure). The participant was asked to remove socks and shoes as well as any additional clotting that could contribute extra weight. The participant was asked to stand in the middle of the scale with the body weight equally distributed on both feet and with hand at their sides; standing flat footed, feet slightly apart in relaxed position facing the researcher and looking straight ahead. The participant stood still until the measurements were recorded and then stepped aside from the scale and waited for zero reading to appear on the scale for second confirmatory measurement. The weight which flashed on the screen at the end of the measurement process was taken as the final weight. The average value was determined and recorded in two decimal places (in kilogramme) to the nearest 0.5kg.

Height Measurement

The height was measured using a stadiometer with a sliding headpiece. The measurement was obtained in 2 decimal places. The procedure: The stadiometer was placed on an even surface. The participant was asked to remove socks and shoes, and then stood with heels together, arms to the side, legs straight, shoulders relaxed and the head in the Frankfort horizontal plane. The shoulder blade, buttocks and the heels were touching the measuring rod. The sliding headpiece was then lowered upon the height with adequate pressure to compress the hairs. The sliding headpiece was then held in place and the reading taken. The reading was recorded in 2 decimal places in metres.

BMI was calculated from the anthropometric measurements. The BMI was expressed as ratio of weight (kg) to height (m2). In this study, the BMI was used in relation to the age of the adolescent to indicate wasting, normal weight, overweight and obesity.

Estimation of Haemoglobin Using Sahli's Haemoglobinometer

The haemoglobin was estimated using the Sahli's Haemoglobinometric Method at the Haematology Department of Nnamdi Azikiwe University Teaching Hospital, Nnewi by the researcher.

- **Collection of blood sample for Haemoglobin estimation:** About 2 ml of blood was collected from each of the research subjects. The subject was allowed to sit comfortably and the cubital fossa was cleaned with methylated spirit soaked cotton wool. A tourniquet was tied proximal to the cubital fossa to expose the ante cubital veins. Using a 2ml sterile syringe, about 2ml of blood was collected and emptied into a sample bottle containing ethylenediaminetetraacetic acid (EDTA) and gently mixed together. Little pressure was applied at the punctured site to prevent bleeding.

- **Principle:** When anticoaglulated blood is added to 0.1N HCl (hydrochloric acid) and kept for 5-7 minutes, it forms acid haematin. The colour of this acid haematin should be matched with the solution, present in the calibrated tube. Distilled water is then added to the acid haematin until the colour matches and the final reading is directly noted from the graduation in the calibrated tube. (Note: 100% of the scale corresponds to 14.5g% to 15g %.)

- **Procedure:** 0.1 N of HCl was placed in diluting test tube to a mark of 20. About 20cm3 mark of blood was taken with pipette and added into diluting tube and rinse very well. After 10mins, distilled water was added drop by drop and the tube was mixed until it has exactly the same colour as the comparison standard. The reading indicated the percentage of the haemoglobin in g/ml of blood.

The obtained data were checked for completeness and then entered into the computer excel spreadsheet and further imported into the SPSS software version 23 (IBM Corporation, Atlanta, GA, USA) for analysis. Descriptive statistics were determined where applicable such as the mean age and mean nutrient intake as well as inferential statistics like the f- test. P-values of less than 0.05 at 95% confidence interval, was statistically significant. The results were presented in tables, as frequencies and percentages.

The dietary intake and food consumption data from 24-hour recall and QFFQ was analyzed by a nutritionist using the food version 3 computer software programme that is based on Medical Research Council (MRC) food consumption tables. Mean, standard deviation and nutrient intake were calculated and compared with the daily recommended intake (DRIs) using the tables of representative values of food commonly used by Platt in the tropical countries; and nutrient composition of commonly eaten foods in Nigeria- raw, processed and prepared developed by Oguntona & Akinyele as a guide.

Results

The distribution by age of the adolescents frequency, mean ± SD, Minimum, maximum ages; F-value and P-values, as seen on table 1: The mean age of the participants was 14.46±3.0years. One hundred and twenty two students (39.23%) were in early adolescence (11 -13 years); 134 (43.09%) were in mid adolescence (14 -16 years); and 55 (17.68%) were in the late adolescence period (17 - 19 years).

Table 2 shows the distribution by age of the adolescent for anthropometric measurements (Height, weight, and BMI).The mean height of the adolescent girls with respect to age was 1.58 ±0.08m with a range of 1.30m - 1.96m; mean weight was 51.79±10.35kg with a range of 29 - 80kg; while mean BMI was 20.77±3.45kg/m2 with a range of 11.9 kg/m2 to 37.0kg/m2. Anthropometric measurement showed a statistically significant increase with increasing age of the adolescent girls (p-value = 0.001).

The distribution by body mass index percentile for nutritional status of the respondent as shown in figure 1 indicates that as high as 193 (62.1%) of the

respondents had normal weight (BMI percentile range=5.00 -84.99; BMI range 18.5 -24.9kg/m2); 86(27.7%) were underweight (BMI percentile range=0.00-4.99; BMI range =18.5kg/m2); 28(9.0%) were overweight (BMI percentile range =85.00-94.99; BMI range=25.0-29.9kg/m2); while only 4(1.3%) were obese (BMI percentile range=95.00-100.00; BMI range=30.0-34.9kg/m2).

Table 3 shows the distribution by the nutritional status of the respondents for their haemoglobin levels. Haemoglobin values increased with increasing nutritional status (from 11.89±0.93 for underweight; to 11.99±0.92 for normal; to 12.06±0.82 for overweight; and up to 12.50±0.57 for obesity). The increase was however not statistically significant (P value= 0.495).

Table 4 shows the distribution by nutritional status of adolescents for their calorie intake: Cumulative consumption of calories over three days, and average daily consumption showed an increase with increasing BMI of the adolescents, and the relationship was statistically significant (p =0.002). Adolescents who were underweight cumulatively consumed 1962.62±314.33 calories in three days (with an average of 654.20± 104.77calories per day). Those with normal body mass index cumulatively consumed 2090.77± 313.82 calories in three days (with an average of 696.92±104.60 calories per day). While those who were overweight and obese cumulatively consumed 2120.28±242.90 calories and 2355. 50±576.26 calories in three days respectively with an average of 706.76±80.96 calories and 785.16± 192.08 calories consumed per day respectively.

The distribution by a comparison of cumulative calories consumed per day, BMR, and total resting energy expenditure per day for boarding and day students as shown in table 5 indicates that the mean cumulative calories consumed per day for boarding students (675.92± 100.89) was not significantly different from that consumed by the day students (689.27 ± 110) (p=0.063). The mean BMR per day of the day students (1340.91± 112.70) was however significantly higher than that of the boarding students (1205.58±116.77) (p=0.001). Similarly, the mean total resting energy expenditure per day of the day students (2051.60±172.43) was also significantly higher than that of the boarding students (1844.55± 178.66), (p =0.001).

Table 1: Distribution by age of the adolescents frequency, mean ± SD, Minimum, Maximum ages, F-value and P-values

Stages of adolescence by age	Freq (%)	Mean±Std (AGES)(Yrs)	Min	Max	F-value	P-value
11-13(Yrs)	122 (39.23)	12.30±0.67	11.00	13.00		
14-16(Yrs)	134 (43.09)	15.26±0.77	14.00	16.00	1104.372	0.001
17-19(Yrs)	55 (17.68)	17.30±0.57	17.00	19.00		
Total	311 (100)	14.46±3.0	11.00	19.00		

Table 2: Distribution by age of the adolescents for anthropometric measurements (Height, weight, and BMI)

Stages of adolescence by age	Freq (%)	Height Mean±Std	Min	Max	F-value	P-value
11-13(Yrs)	122 (39.23)	1.54±0.08	1.30	1.96		
14-16(Yrs)	134 (43.09)	1.60±0.07	1.46	1.87	25.380	<0.001
17-19(Yrs)	55 (17.68)	1.60±0.06	1.49	1.76		
Total	311 (100)	1.58±0.08	1.30	1.96		
Stages of adolescence by age	**Freq (%)**	**Weight Mean±Std**	**Min**	**Max**	**F-value**	**P-value**
11-13(Yrs)	122 (39.23)	44.51±8.27	29.00	71.00		
14-16(Yrs)	134 (43.09)	55.61±8.54	36.00	80.00	76.137	<0.001
17-19(Yrs)	55 (17.68)	58.64±8.86	43.00	79.00		
Total	311 (100)	51.79±10.35	29.00	80.00		
Stages of adolescence by age	**Freq (%)**	**BMI Mean±Std**	**Min**	**Max**	**F-value**	**P-value**
11-13(Yrs)	122 (39.23)	19.05±3.31	11.90	37.00		
14-16(Yrs)	134 (43.09)	21.54±2.91	16.00	32.50	32.982	0.001
17-19(Yrs)	55 (17.68)	22.75±3.34	16.70	30.10		
Total	311 (100)	20.78±3.46	11.90	37.00		

Table 3: Distribution by BMI-for-age percentile for Nutritional status (BMI) classification

BMI for Age in percentile	Classification	Frequency	Percentage (%)
0.00-4.99	Underweight (18.5 (kg/M^2) & below)	86	27.7
5.00-84.99	Normal (18.5-24.9kg/M^2)	193	62.1
85.00-94.99	Overweight (25.0-29.9kg/M^2)	28	9.0
95.00-100.00	Obesity (30.0-34.9kg/M^2)	4	1.3
Total		311	100

Table 4: Distribution of Nutritional status of the student for Haemoglobin Concentration levels of the Participants

BMI-for-Haemoglobin Conc.		Girls Haemoglobin Conc. (G/dl)				
Nutritional Status	**Freq. (%)**	**(Mean±SD) Haemoglobin conc. (G/dl)**	**Min**	**Max**	**f-value**	**p-value**
Underweight	86(27.7)	11.89±0.93	10.00	14.00		
Normal	193(62.1)	11.99±0.92	10.00	14.00		
Overweight	28(9.0)	12.06±0.82	10.50	14.00	0.800	0.495
Obesity	4(1.3)	12.50±0.57	12.00	13.00		
Total	311					

Table 5: Distribution by nutritional status of the adolescents (BMI) for their caloric intake

BMI for Calories Consumed		Cumulative Calories Consumed in 3 Days				
BMI Classification	**Freq. (%)**	**(Mean±SD)**	**Min**	**Max**	**f-value**	**p-value**
Underweight (18.5 (kg/M^2)	86(27.7)	1962.62±314.33	1286.00	2853.00		
Normal (18.5-24.9kg/M^2)	193(62.1)	2090.77±313.82	1053.00	3010.00		
Overweight (25.0-29.9kg/M^2)	28(9.0)	2120.28±242.90	1769.00	2811.00	4.959	0.002
Obesity (30.0-34.9kg/M^2)	4(1.3)	2355.50±576.26	1560.00	2852.00		
	311(100)					
BMI Classification	**Freq. (%)**	**Cumulative Calories Consumed Per Day**				
Underweight (18.5 (kg/M^2)	86(27.7)	654.20±104.77	428.67	951.00		
Normal (18.5-24.9kg/M^2)	193(62.1)	696.92±104.60	351.00	1003.33		
Overweight (25.0-29.9kg/M^2)	28(9.0)	706.76±80.96	589.67	937.00	4.959	0.002
Obesity (30.0-34.9kg/M^2)	4(1.3)	785.16±192.08	520.00	950.67		
Total	311(100)					

Table 6 shows the distribution by a comparison of cumulative calories consumed per day, BMR, and Total resting energy expenditure per day for boarding and day students.

Calories intake and nutritional status of adolescent girls	Type of student	(Mean±Std)	p-value	t-value
Cumulative Calories Consumed Per Day	Boarding Student	675.92±100.89		
	Day Student	698.27±110.02	0.063	1.867
BMR per day (WHO, 1985)	Boarding Student	1205.58±116.77		
	Day Student	1340.91±112.70	0.001	10.397
Total resting Energy Expenditure per day (WHO, 1985)	Boarding Student	1844.55±178.66		
	Day Student	2051.60±172.43	0.001	10.397

Discussion

This study has been undertaken amongst in-school adolescent girls in secondary institutions in Anambra state of southeastern Nigeria, to elicit their dietary intake and nutritional status. The study showed that 256 (82%) of the adolescent girls were aged=16years while the remaining 55(18%) were aged >16years. This distribution agrees with UNESCO's observation which reported that greater proportion of adolescent girls is within the early-and mid-adolescent age bracket of 11-16 years.

The nutritional anthropometric indices of the participants in this study showed prevalence of underweight, overweight and obesity of27.7%; 9.0%and 1.3% respectively using body mass index for age (BMI-for-age) considered being the most reliable method for assessing nutritional status of adolescents. The finding of 27.7% of underweight adolescent girls was higher than the prevalence of 23.4% of under-nutrition among adolescent girls reported in Ibadan Nigeria by Omobuwa et al and also with the 23% under-nutrition rate reported for adolescent girls in the 2013 Nigerian National Demography Health Survey (NDHS).[17] Furthermore, it was also much higher than the global prevalence of 8.4% reported for children and adolescents by the Non-Communicable Disease Risk Factor Collaboration Study. The finding was however, surprisingly much lower than the 57.8% reported by Ukaegbu et al for adolescent girls from Abia state of the same south eastern Nigeria. The reason for this gross disparity is not clear, however, Ukaegbu et al's study had been conducted amongst adolescent undergraduates whose dietary habits may be considered to be more irregular and oftentimes inadequate compared to that of the in-school secondary adolescents whose food intake may be regulated and influenced both by the school authorities in the case of the boarding students, and the parents in the case of the day students.

The relatively high value of adolescent under-nutrition of 27.7% observed in this study, compared to the 2013 NDHS value of 23% may not be unrelated to regional variations, Nigeria being a relatively large country with diverse ethnic and socio-cultural variations, or the effect of increasing poverty, overtime, affecting a sizeable number of a Nigerian population. Irrespective of whatever reasons however, it is important that due attention be paid to meeting the nutritional needs of adolescent girls in Nigeria so as to reduce the likelihood of their ultimately giving birth to underweight children, thereby promoting inter-generational under-nutrition.

This study has reported a prevalence of overweight and obesity of 9.0% and 1.3% respectively, which though lower than the global prevalence of 20% and >5% for overweight and obesity respectively, is nonetheless important in that it represent a nutritional direction often discouraged because of the predisposition to dietary related non-communicable diseases like diabetes and hypertension.[11]

The mean hemoglobin levels of the participants were 11.89±0.93g/dl, 11.99± 0.92g/dl, 12.06±0.82g/dl and 12.50±0.57g/dl respectively for underweight, normal, overweight and obese groups. This did not show any statistical significance (P=0.495). However, these values when compared with the WHO recommended normal mean hemoglobin concentration for the adolescent girls (that is 12.0g/dl), the underweight and normal weight group fall below the mean recommended value. The hemoglobin levels of the school girls that had normal BMI were still below the average mean recommended by the WHO. The finding of this study was comparable with other studies that documented anaemia as a common occurrence among adolescent girls. Available evidence has attributed the aetiology of anaemia in adolescence to be of nutritional origin especially iron deficiency. This study however did not investigate the causes of anaemia amongst these students.

The intake of calories was inadequate for all the adolescents that participated in the study (boarding and day students) when compared with the recommended calorie intake for teenage girls (that is 1600calories per day). This is in agreement with other African studies. Mwanikin et al in

Nairobi, Kenya reported that only 17.3% of school children and adolescents cumulated adequate calorie. Findings from a study in Accra, Ghana, that compared the nutritional status of children in boarding school with non-boarding school revealed that 11-27% of the children attained the recommended daily allowance (RDA) based on age and sex 37 In contrast to this however, 76% of school children in Libya attained the RDA for calorie, while in Brazzaville, Congo, the mean intake of energy for adolescent girls (1998.9± 448kcal) was very close to the RDA. Furthermore, in Mexico, 88.0% of the school children had adequate amount of calories. The poor calorie intake observed among adolescent girls in our study portends a great nutritional danger for these potential mothers.

The average adolescent secondary school girl in this study was stunted (lower height-for age) and had a low weight for age. This observation is similar to the finding from other studies in Nigeria. Ayola et al documented low relative height and weight (height-for-age Z-score) in a larger proportion of children and adolescents in rural Nigeria. In the same vein, Akinpelu et al reported lower height and weight for age across all the ages in adolescent girls in Ogun state, Nigeria, when compared with their counterparts from the USA and Cyprus.

This study did not show any significant difference in the calorie intake of the boarding students and the day students (P=0.06). This agrees with the finding in Accra Metropolis by Intiful et al,[40] which showed no difference in the nutritional intake of boarding and non-boarding students. However, it differs from the report by Akinyemi & Ibraheem which revealed that students in boarding school are likely to be malnourished than non-boarding students. He suggested that the probable reason may be due to inadequate funding for the running of boarding facilities. On the other hand, Owusu et al[37] reported that the nutritional intake of boarding school adolescent girls in Ghana was adequate. In spite of the fact that the cumulative caloric intake per day was not significantly different for boarding and day students, the BMR and the total resting energy expenditure were significantly higher for the day students compared to the boarding students. This is presumably on account of the relatively higher energy expended by the day students that on daily basis have to trek sometimes over long distance from their homes to school.

This study undertaken amongst in-school adolescents from southeastern Nigeria showed that their dietary intake and nutritional status were poor being characterized by relatively low daily cumulative caloric intake, relatively lower than normal hemoglobin status, underweight status of 27.7% and overweight and obesity status of 9.0% and 1.3% respectively. Although the daily calorie intake was not significantly different for both the boarding and day student, BMR and daily total resting energy expenditure was significantly higher for the day students compared to the boarding students.

This study has a limitation of being restricted to the assessment of the caloric intake of the adolescents, which is a measure of the macro-nutrient. Due assessment of the micro-nutrient status had not been conducted for this adolescents. A knowledge of their micro-nutrient status will inform appropriate micronutrient supplementation in the form drugs, food fortification, and other supplementation considered to enable the optimization of the overall nutrient needs of the adolescent girl to prepare her for pregnancy, labour, and delivery.

It is recommended that a more comprehensive study encompassing both macro and micronutrient assessment should be conducted not just for the in-school girls, but also for the adolescent girls that are out-of-school in Nigeria, to provide a more comprehensive information on their overall dietary intake and nutritional status. The findings from this study is significant in that it will assist in the formulation of appropriate nutritional policies and guidelines in relation to the adolescence, which is silent in the present Nigerian national nutritional policy. Such policy and guideline when developed and appropriately disseminated for use in educational institutions and primary healthcare

centers would go a long way towards improving the overall nutritional status of the adolescence - the future mothers, and thereby breaking the cycle of transmission of malnutrition to the future generation. There should be nutritional interventions targeted at mothers, children and adolescents. Education of the mothers on the danger of nutritional deficiencies and how to prevent nutritional related diseases should be undertaken as a matter of urgency, at every opportunity and every convenient advocacy platforms. The school health division of the ministry of education should institute periodic monitoring of boarding schools to assess the quality of foods served to the students and ensure the appropriate nutritional content.

References

1. UNFPA, April 2015. Office of the UN Secretary General Envoy on Youth.
2. Delisle H. Nutrition in Adolescence Issues and Challenges for the Health Sector. Issues in Adolescent Health and Development. Geneva, Switzerland: World Health Organization; 2005.
3. Delisle H, Chandra-Mouli V, de Benoist B. Should Adolescents be specifically Targeted for Nutrition in Developing Countries: To Address Which Problems, and How? World Health Organization/International Nutrition Foundation for Developing Countries. 2014
4. Stang J, Story M. Adolescent growth and development. In: Stang J., Story M., editors. Guidelines for Adolescent Nutrition Services. Chapter 1. Minneapolis, Minn, USA: Center for Leadership, Education and Training in Maternal and Child Nutrition, Division of Epidemiology and Community Health, School of Public Health, University of Minnesota; 2005. pp. 18.
5. Literature review prepared for message and material workshop, USAID, IYCN, Addis Ababa, January 2011
6. Samba RD, Moench-Pfanner R, Sun K. Consumption of micronutrient fortified milk and noodles are associated with reduced risk of stunting in preschool aged children in Indonesia. Food Nutrition Bull. 2011; 32:347-353
7. UNESCO Institution for Statistics (UIS) and UNICEF. Fixing the Broken Promise of Education for all. Findings from the Global Initiation on Out-of-School children. 2015. Mantreal: UIS.
8. Save the Children. Adolescent Nutrition, Policy and Programme in SUN Countries 2015. The Children Fund.
9. Adinma J, Adinma E, Umeononihu O. Nutrition policy and practice landscape on adolescent, pre pregnancy and maternal nutrition in Nigeria. JOJ nurse health care. 2017; 1(2): 555560.
10. Adinma JI, Umeononihu OS, Umeh MN. Adolescent and pre-pregnancy nutrition in Nigeria. Trop J obstet gynaecol 2017;34:1-5.
11. Adinma JI, umeononihu OS, Umeh MN. Maternal nutrition in Nigeria. Trop J obstet gynaecol; 2017;34(2):79-84.
12. Adinma JIB. Adolescent, pre-pregnancy and maternal nutrition, in: The Total Woman and Her Man: Diseases, Disorders, and other conditions perculiar to women. Lagos: Mindex pubihing Company Ltd. 2018; Vol. 3: p 81-96.
13. WHO. Food and Agricultural Organization. World Health Organization. Second International Conference on Nutrition, WHO Geneva, Switzerland, 2014.
14. United Nations Children Fund: Milleninium Development Goals (MDGS).
15. Sustainable Development Knowledge Platform.
16. Hanson MA, Bardsley A, De-Regil LM, Moore SE, Oken E, Pastor L. The International Federation of Gynaecology & Obstetrics (FIGO) recommendation on adolescent, preconception and maternal nutrition: "Think Nutrition First". Int. J. Gynecol Obstet. 2015; 131 Sup 4: S213-53.
17. National Population Commission (NPC) [Nigeria] and ICF International. 2014. Nigeria Demographic and Health Survey 2013. Abuja. Nigeria. Rockville, Maryland, USA: NPC and ICF International.
18. WHO. Global Target 2025. http//www.who.int/nutrition/global target 2025/en/.
19. Summing the two LGAs Nnewi North/South as per: Federal Republic of Nigeria Official Gazette (15 May 2007). "Legal notice on Publication Details of the Breakdown of the National and State provisional totals 2006 census. Archived from the original PDF on June 26, 2011. Retrieved March 04, 2017.
20. WHO 1995. Physical Status: The use and interpretation of anthropometry. Technical Report

Series no 854. World Health Organization, Geneva.
21. Cole TJ.1997. Sampling study size and power. In Margrets, BM; Nelson, M (eds); Design concept of nutritionally epidemiology. New York: Oxford University Press. 64-86.
22. Silangwe BN. Nutritional status and dietary intake of adolescent girls in Mandlenkosi High School-Lindelani. Dissertation submitted in fulfillment of requirement for the Degree Magister Technologie: Consumer Science; Food and Nutrition in the Department of Food and Nutrition Consumer Sciences, Faculty of Applied Sciences at the Durban University of Technology, 2012.
23. Oldewage-Theron WH, Kruger R. Food variety and dietary diversity as indicators of the dietary adequacy and health status of an elderly population in Sharpeville, South Africa. J Nutr Elder. 2008;27(1-2):101-133.
24. WHO 2008. Training course on child growth assessment. WHO Child Growth Standard. (B&C) Measuring a child growth.
25. Lanngenhoren M, Kruger M, Gouws E, Faber M. MRC food composition table. 3rd Edition. Parow SAMRC; 1991. 245.
26. Platt, BS. Tables of representative values of food commonly used in Tropical Countries. Medical Research Council. Special Report Series No 302, Rev. Edn of SRS 253 of Her Majesty's Stationary Office, London. 1975.
27. Oguntona, EB & Akinyele, IO. Nutrient composition of commonly eaten food in Nigeria - raw, processed and prepared. Food Basket Foundation Publication Series. Ibadan, Nigeria. 1995.
28. Early adolescents Girls: a global view of participation in lower secondary education. United Nations Educational, Scientific and Cultural Organization (UNESCO). Institute for Statistics. 2005.
29. Omobuwa O, Alebiosu CO, Olajide FO, Adebimpe WO. Assessment of nutritional status of in-school adolescents in Ibadan, Nigeria. South Afr Fam Pract. 2014; 56(4): 246-50.
30. Non-Communicable Disease Risk Factor Collaboration (NCD-RisC): Worldwide trends in body mass index, underweight, overweight and obesity from 1975-2016: a pooled analysis of 2416 population based measurement studies in 128.9 million children, adolescents and adult. Lancet. 2017; 390:2027-264.
31. Ukegbu PO, Uwaegbute A, Usonka V. Contribution of snacks to energy and micronutrient intake of undergraduates in Nigerian University. Malaysian Journal of Nutrition. 2015; 21(1):15-23.
32. Gorstein J. Assessment of nutritional status: effects of different methods to determine age on the classification of under nutrition. Bull WHO.1989; 67:143-50.
33. WHO. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin andMineral Nutrition Information System. Geneva, World Health Organization, 2011 (WHO/NMH/NHD/MNM/11.1) available from: http://www.who.int/vmnis/indicators/haemoglobin pdf, accessed [15th sept 2020]
34. Upadhye JV, Upadhye JJ. Assessment of anaemia in adolescent girls. Inter J of Reprod, Contr,Obstet and Gynaecol. 2017; 6(7):3113-3117.
35. Siva PM, Sobha A, Manjula VD. Prevalence of anemia and its associated risk factor among adolescent girls of Centra Kerala. Journal of Clinical and Diagnostic Research. 2016; 10(11):19-23.
36. Owusu A, O'Hara Murdock P, Weatherby NL. Measuring nutritional intake of adolescents in Ghana West Africa. International Electronic Journal of Education. 2007; 10:104-113.
37. Coleman E. Minimum calorie intake for a Teenage Girl. Healthy Eating SFGATE. Updated March 30, 2018
38. Nago ES, Lachat CK, Huybregts L, Roberfroid D, Dossa RA, Kolsteren PW. Food, energy and macronutrients contribution of out of home foods in school going adolescents in Cotonou, Benin. Br J Nutrition. 2010; 103:281-288.
39. Intiful FD, Ogyiri L, Asante M, Mensah AA, Steele-Dadzie RK, Boateng L. Nutritional status of boarding and non-boarding children in selected schools in the Accra Metropolis. J. Bio Agric Health C. 2013; 3:156-162.
40. Acham H, Kikafunda JK, Malde MK, Oldewage-Theron WH. Egul AA. Breakfast, midday meals and academic achievement in rural primary schools in Uganda: implication for education and school health policy. Food Nutr Res. 2012; 56:112-117.
41. Mwaniki EW, Makokha AN. Nutrition status and associated factors among children in public primary schools in Dagoretti, Nairobi, Kenya. Afr. Health Sci. 2013; 13:38-46.
42. Mbemba F, Mbabiala-Babela JR, Massamba A, Senga P. A nutrition survey among schoolchildren in Brazzaville, Congo. Arch Paediatr Organe Off Soc Francaise Paediatr. 2006; 13:1022-1028.
43. Flores M, Macias N, Rivera M, Barquera S, Hernandez L, Carcia-Guerra A. Energy and nutrient intake among Mexican school-aged children, Mexican National Health and Nutrition Survey 2006. Salud Publica Mexico. 2009; 51: S540-S550.
44. Ayola O, Ebersole K, Omotade OO, Tayo BO, Brieger

WR, Salami K, et al. Relative height and weight among children and adolescents of Rural South-western Nigeria. Anna Human Biology.2009; 36(4): 388-399.
45. Akinpelu AO, Oyewole OO, Oritogun KS. Reference Growth Values for Adolescents aged 12-18years in Nigeria community. African Journal of Biomedical Research. 2009; 12(1): 12-18.
46. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. International Journal of Paediatrics. 2006; 1:11-25.
47. Akinyemi O, Ibraheem AG. Assessment of nutritional status of Queen College students of Lagos state Nigeria. Pakistan journal of nutrition. 2009; 8(7): 937-939.
48. Adinma JIB, Ahaneku JE, Adinma ED, Ugboaja JO, Egeonu RO, Edet MM Vitamin D status and its influence on pregnancy outcomes amongst pregnant women in southeastern Nigeria. W J. Adv Res. Rev. 2020; 7(2), 89-98. https://doi.org/10.30574/wjarr.2020.7.2.0264
49. Adinma JIB, Nwankwo MC, Ahaneku JE, Ugboaja JO, Ibe CC, Edet MM. Vitamin D Status of pregnant women and the association between vitamin D Levels and Selected Pregnancy outcomes. IJSR. 2019 Aug; 8(8):1568-1571. Available from: https://www.ijsr.net/search_index_results_paperid.php?id=ART2020146
50. Adinma JIB, Oguaka VN, Okafor CI, Udigwe GO, Adinma Obiajulu-ND, Edet MM. Serum calcium levels, uterine contractility and labour in parturient Nigerian Igbo women. Br J Bio Med Res Oct 2019; 3 (5)1085-1093.
51. Adinma JIB, Oguaka VN, Okafor CI, Udigwe GO, Adinma Obiajulu-ND, Edet MM. Serum calcium levels, uterine contractility and labour in parturient Nigerian Igbo women. Br J Bio Med Res Oct 2019; 3 (5)1085-1093.
52. Adinma J, Adinma E, Umeononihu O. Nutrition policy and practice landscape on adolescent, pre pregnancy and maternal nutrition in Nigeria. JOJ nurse health care. 2017; 1(2): 555560.