Nutritional Status and Micronutrients Adequacy of Food Consumed by Adolescents in School in Abeokuta

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ABSTRACT

Background: Micronutrient and nutritional deficiencies remain a serious nutritional problem of significant importance in low-income countries especially Nigeria. Adolescents are vulnerable because they are at a stage of biological and psychological growth and nutrition inadequacy at this stage will have serious nutritional and health consequences.

Objectives: The study assessed the nutritional status and micronutrients adequacy of food consumed by adolescents in school in Abeokuta, Ogun state.

Materials and Methods: The study design was descriptive and cross-sectional involving multistage sampling for the selection of 200 respondents from public secondary schools in Abeokuta North and South. Data were obtained on socio-demographic, socioeconomic characteristics, nutritional knowledge, nutrients intake and anthropometry of the respondents using a structured self-administered questionnaire, repeated 24-hour dietary recall and standard procedures. Data were analyzed and presented using descriptive and inferential statistics. Statistical significance was established at $p \leq 0.05$.

Result and Discussion: Result revealed that majority (94%) of the respondents were within the age range of 14-19years, 42% of the respondents consumed breakfast in school, 57.5%, 37.5% and 5% had good, fair, and poor nutritional knowledge respectively. The nutritional status estimation revealed that 31% of the total respondents were stunted, while 50% were thin. There was significant micronutrient inadequacy of vitamin A, carotene, Vitamin B1, Vitamin B2, folate, vitamin C, potassium, calcium, iron, and zinc.

Conclusion: This study established substantial micronutrients inadequacy and increased prevalence of undernutrition among the study respondents

Keywords: Nutritional status, Micronutrients, Adequacy, Adolescents, Abeokuta.

INTRODUCTION

Adolescent malnutrition is still prevalent worldwide (1) especially in the developing countries (2). Micronutrient deficiencies and inadequacies is one of the global health issues accounting for 7% of the global disease burden which have been long reported as a major healthcare problem (3,4). Micronutrient deficiency has been known to result when there is decreased intake; impaired absorption and utilization of vitamins and minerals for health sustainability and development as well as normal physiological and cognitive functions (4). This deficiency's impact is often unnoticed until evident and irreversible body damages "hidden hunger". Adolescence has been referred to as the developmental period that commences at puberty and ends at adulthood (5,6). The World Health Organization (WHO) defined adolescents as persons between 10-19 years. Adolescence was further classified by Lancet commission on

adolescent health and well- being into; early adolescence (10–14 years), late adolescence (15–19 years) (5) constituting 16% of the global population (7) and in sub-Saharan Africa, 23% of the region's population (8). Epidemiologically, adolescent in any population is the healthiest of any age group and are at best in raising the economic productivity of the resident country (6). It was reported that there were 1.2 billion adolescents in the world, 90% of whom lived in low- and middle-income countries (LMICs) where access to health and social services, jobs, and livelihoods are strained (6,7,8) and as a result, more than 1.2 million adolescents globally die each year (7).

There is a close relationship between Nutrition and adolescent transition (6) since there are many factors that influence eating patterns such as peer influences, mass media influence, parental guidance, cultural, religious, and personal belief, food availability, food preferences, cost, convenience, among others. In Nigeria, Malnutrition is associated with increasing globalization and Nutrition transition (1,3). (1) reported that overweight and obesity are forms of malnutrition and risk factors of many nutrition and diet-related diseases affecting people globally in different epidemic proportions. In addition to these 'Triple Burden of Malnutrition' (TBM) which is the coexistence of micronutrients deficiencies, undernutrition and overnutrition is becoming of great concern for developing countries, particularly, African countries (1,4). Adolescents are a nutritionally vulnerable specially to Triple burden of Malnutrition because of their increased nutritional needs, eating patterns, lifestyles, and susceptibility to environmental influences (1).

Many research findings on adolescents (1, 3, 4, 6, 7 and 9) has reported low fruits and vegetables consumption, increasing snacks and carbonated drinks consumption in secondary schools, these were attributed to factors such as inability of parents to eat breakfast with their children and food transition that most less developed countries like Nigeria are currently experiencing (10, 11). Convenience foods that are mostly consumed by secondary school children have been reported to be high in salt, saturated fats and low in essential micronutrients for adolescent undergoing growth spurts (12, 13, 14).

Malnutrition including micronutrient deficiencies during adolescence can have lifelong consequences (15), such as impaired physical growth, poor cognitive function, low resistance to infection and high susceptibility to parasitic infections, degenerative and chronic diseases, and nutrition related diseases such as anemia, vitamin A deficiency at later age (1, 4). In addition, adolescent girls are at risk of dropping out of school, engaging in early marriage, and becoming pregnant all of which have adverse effect on their nutritional status, academic performance (1) and health as well as that of their children (15). This study therefore assessed the nutritional status and micronutrient adequacy of foods consumed by school adolescents in Abeokuta, Ogun State.

MATERIALS AND METHOD

Study Area
The study was carried out in Abeokuta. The city being the state capital of Ogun State in southwest Nigeria is situated in a wooded savanna near a group of rocky outcrops (16) on the east bank of the Ogun River. Abeokuta has two (2) Local Government Areas (Abeokuta South and Part of Abeokuta North) and with total population of 451,607 people (17, 18).

Study Design
A descriptive cross-sectional design was used in this study

Study Population
Adolescents from public secondary schools in Abeokuta North and South

Sample Size
The sample size was calculated using the formula (19):

$$N = \frac{Z^2\ P\ (1-P)}{D^2}$$

Where;

    N = Desired minimum sample size

    Z = confidence interval at 95% significance level (1.96).

    P = Prevalence= 15% (0.15)

    D = Margin error, (5%) set at +0.05

Substituting the values in the above formula, the sample size equals:

$$N = \frac{(1.96)2 \times 0.15 \times 0.850}{(0.05)2}$$

$$N = \frac{3.8416 \times 0.1275}{0.0025}$$

N = 195.9

The estimated Sample was increased to 216 (10%) to cater for attrition and possible drop out. Therefore, 210 respondents were recruited for the study

Sampling Techniques

A probability sampling technique involving multistage sampling method was used in selecting 216 respondents. The first stage involves a simple random sampling for the selection of two public secondary schools at Abeokuta south and north respectively. The second stage involves stratification by classes and sex. The third stage involves simple random sampling for the selection of 91 students in the two secondary schools of Abeokuta North and 125 students in the two public secondary schools in Abeokuta South. The class register list of the schools was used as the sampling frame.

Method of Data Collection

A semi-structured pre-tested interviewer administered questionnaire designed according to the objectives of the study and used to solicit data on sociodemographic and economic characteristics of the respondents. Data on general nutritional knowledge of the respondents were obtained using the Nutrition Knowledge Assessment questionnaire described by (4). The performance of each respondent was converted to percentage by dividing obtained scores by the total obtainable scores and multiplying by 100. The percentage scores were categorized as Excellent Knowledge (100–70%), Good knowledge (69–40%) and Poor knowledge (< 40%) (4).

The dietary intakes were assessed using repeated 24-hour dietary recalls (9, 20), comprising 1 weekday and 1 weekend day without festive and market days. The respondents were probed for in between meals and snacks and the quantities of food and drinks intake was estimated using household utensils and food models as described by (9). The average weight of each type of food recorded and their equivalent portion sizes determined using the household utensils were estimated to the nearest gram. Food sources of vitamins A, B6, C, B12, calcium, folate, and iron were analyzed because they were considered shortfall nutrients using the NutriSurvey for Windows, West African Food Composition Table (21) and Nigerian nutrient composition database. Micronutrient adequacy was estimated by calculating the percentage fulfilment of the recommended nutrient intake (RNI) (9).

Anthropometric data (height and weight) were taken using standard procedures (22, 23), by trained anthropometrists. Anthropometric measurements were taken twice, and average values were used for data analysis. The nutritional status of the respondent was established by estimating stunting, thinness, overweight and obesity using computed Z-scores of Body Mass Index for age (BMIAZ) and height for age (HAZ) of the WHO reference values for schoolboys and girls (1, 24).

Ethical Considerations

Prior the study, permission to embark on the study was obtained from the Department of Nutrition and Dietetics, Federal University of Agriculture, Abeokuta. Approvals were obtained from the concerned school authorities and written informed consent from the respondents.

Data Analysis

The obtained data was analyzed with descriptive statistics using statistical package software for analysis (SPSS version 20.0). Data from 24hour dietary recall was analyzed using the NutriSurvey for Windows. Chi-square test was used to test for statistically significant association between the dependent and independent variables at $P \leq 0.05$. The result was presented in the form of frequencies and percentages by using tables, charts, and text.

RESULT

Socio-demographic and socioeconomic characteristics of respondents

Table 1 shows the socio-economic and demographic of the respondents. Majority (94%) were in their late adolescence stage (15-19years), more than half (68.5%) were in SS2, 55.5% of the respondents were from Urban settlement, more than half (57.5%) were Christian and majority (96%) were Yoruba. More than half (71%) of the respondents were living with their parent, and majority (50.5%) go to school using motorcycle as their mode of transportation. The breakfast consumption distribution revealed that more than three quarter (80%) of the total respondents consumes breakfast, majority (58%) of those that consumes breakfast takes their breakfast at home. Furthermore, the parent and caregiver distribution revealed that only 21% had tertiary education, more than half (68.5%) of the parent/caregivers were self-employed, and the family average monthly income distribution revealed that 31% of the respondent family earned below #10,000 and 30% of the respondent's family spent 21-40% of their family income on foods.

Table 1: Socio-demographic and Socioeconomic Characteristics of the Respondent
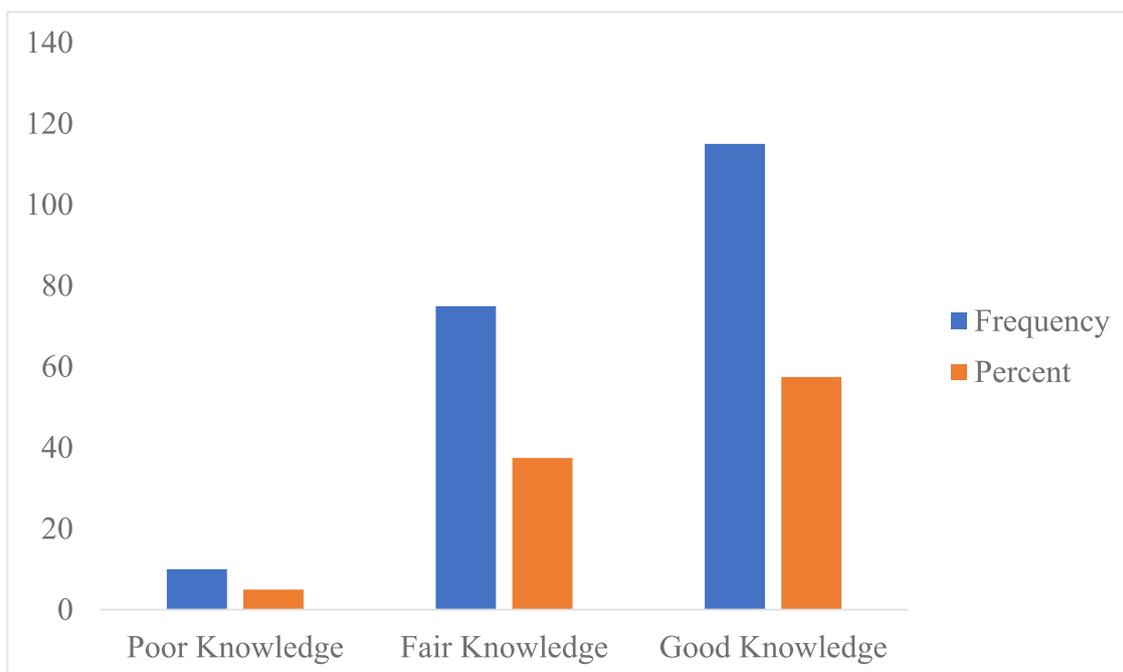
Variables	Frequency	Percent
Age of the Respondents		
Early Adolescence (10-14)	12	6.0
Late Adolescence (15-19)	188	94.0
Mean age of the respondent		16± 2.38
Class of respondents		
SS 1	47	23.5
SS 2	137	68.5
SS 3	16	8.0
Place of settlement		
Rural	45	22.5
Urban	111	55.5
Rural-urban	44	22.0
Religion of the respondent		
Islam	84	42.0
Christianity	115	57.5
Traditional	1	0.5
Ethnicity		
Yoruba	192	96.0
Igbo	8	4.0
Respondent living with		
Father	10	5.0
Mother	39	19.5
Parent	142	71.0
Caregiver	9	4.5
Respondent mode of transportation to school		
Trekking	52	26.0
Motorcycle	101	50.5
Public transport	24	12.0
Parent/caregiver's car	23	11.5
Breakfast Consumption		
Yes	160	80.0
No	40	20.0
Place of Breakfast Consumption		
At home	116	58.0
At school	84	42.0
Parent/ caregiver's educational qualification		
No formal education	10	5.0
Primary school not completed	15	7.5
Primary school completed	29	14.5
Secondary school not completed	18	9.0
Secondary School Completed	86	43.0
Tertiary	42	21.0
Parent/ caregiver's occupation		
Self-employed	137	68.5
Civil servant	52	26.0
Unemployed	11	5.5
Family average monthly income		
<10,000	62	31.0
10,001 - 30,000	25	12.5
30,001-50,000	51	25.5
50,001-100,000	31	15.5
>100,000	31	15.5
Percentage of the family income do you spend on foods		
0-20%	37	18.5
21-40%	60	30.0
41-60%	51	25.5
61% and above	52	26.0

The general nutrition knowledge of the respondents is presented on Figure 1. The result of the overall knowledge revealed that more than half of the respondents (57.5%) had good knowledge, 37.5% had fair knowledge and 5% had poor knowledge.

Nutritional Status of the respondents
Table 2 below describe the nutritional status of the respondent as assessed using height for age (measure of stunting), and Body mass Index (BMI) for Age. The result revealed that 2.0% of the total respondents were severely stunted, 4.5% are moderately stunted and 25% were mildly stunted. The severity of thinness among the respondents revealed that 4.5% of the total respondents were severely thin, 11.5% were moderately thin and 34% were mildly thin.

Figure 1: General Nutrition Knowledge of the respondents

Table 2: Nutritional Status of the respondents (n=200)

Variables	Frequency	Percent	Mean (SD)
Height for Age			3.6700± 0.76
Severe stunting	4	2.0	
Moderate stunting	9	4.5	
Mild stunting	50	25.0	
Normal	124	62.0	
Overweight	12	6.0	
Obesity	1	0.5	
BMI for Age			3.3150± 0.87
Severe thinness	9	4.5	
Moderate thinness	23	11.5	
Mild thinness	68	34.0	
Normal	96	48.0	
Overweight	4	2.0	

Micronutrient Adequacy of the food consumed by the Respondents in the last 24hours

Table 3 present information on the micronutrient adequacy of the food consumed by the respondent. Majority (71.5%, 63% and 81.5%) of the respondents had inadequate intake of Vitamin A, carotene, and vitamin B1 intake respectively. Nearly half (48%) of the respondents had inadequate Vitamin B2 intake, more than three-quarter (96.5%) had inadequate vitamin C intake. 98%, and 92% of the total respondents had inadequate folate and vitamin B12 intake respectively.

The adequacy of mineral consumed reveals that 50.5%of the respondents had excess intake of sodium. 99.5% and 100% of the total respondents had inadequate potassium and calcium intake and 37.5% had inadequate magnesium intake. The phosphorous, iron and zinc intake revealed that 28%, 5.5% and 14.5% had adequate intake of phosphorus, iron, and zinc respectively, whereas 27%, 93% and 79% had excess intake of phosphorus, iron, and zinc respectively.

Relationship between Nutritional status, age, and sex of the respondents

Table 4 described the nutritional status of the respondent in relation to their age and gender. The result revealed that stunting is highly prevalent in male (21.5%) compared to female (10%). Furthermore, the result also revealed the severity of thinness by age and sex of the respondents, the overall prevalence of thinness revealed a higher prevalence among male respondents (30.5%) than in female (19.5%).

There is significant difference between sex, stunting and thinness in late adolescence (P=≤0.05) whereas there is no significant difference between sex, stunting and thinness in early adolescence (P>0.05).

DISCUSSION

Previous studies have established that adequate and optimum nutrition is important for achieving full growth potential during adolescence (25, 26), and failure to achieve and maintain optimal nutrition may result in delayed and stunted linear growth and impaired organ function (6). However, Studies on the effect of malnutrition on adolescents and school children are limited (27) and little focus has been given to micronutrient deficiencies among adolescents despite their increased nutritional vulnerability (28).

Majority of the respondents in the study were between age 15-19years, this is similar to a study conducted by (4, 29) in which majority of school adolescent assessed falls between 15-18years. The mean age of the respondents was 16±2.3years, this is similar to research conducted by (9) where the mean age of the respondents was 16years. Majority of the respondents (55.5%) were living in urban settlement, and this is in line with the study reported by (30) in which 88% of the total respondents assessed were living in the urban settlement. Adolescents have been believed to generally have poor habits of breakfast skipping with reasons such as short time for meal preparation, illness, anorexia, or disliking the food served (31), however, majority of the respondents (80%) consumed breakfast regularly, a study conducted in India (32) result reported that 55% of adolescents in India have a good habit of taking regular meals supporting the claim that healthy breakfast consumption is an achievable phenomenon. Majority (43%) of the respondent's parent completed at least secondary school, this is similar to a study carried out by (27) where majority (42.1%) of participants' mothers and 45% of participants' fathers had secondary education. Good nutritional knowledge is essential because it has a positive and direct influence on healthy food choices and health outcomes (33). The result of this study showed that majority (57.5%) of the respondent had good knowledge of nutrition, this is higher than the value reported by (34) where 34.8% of the adolescents in Abuja Municipal had good knowledge of balanced diet, this might result from difference in the acquisition of knowledge related to nutrition and healthy eating in the school curriculum.

The study also showed that stunting and thinness were problems affecting school going children. The prevalence of stunting was 31%, the result is in respect with the prevalence reported by (29) where 33.3% of the respondents were stunted. In this study, higher prevalence of stunting was reported in male (21.5%) compared to female (10%) which correlates with result of the reported study (9). The prevalence of thinness in the study (50%) was higher than the prevalence reported by (35) where the prevalence of thinness was 12.4%. The prevalence of thinness was also higher in male (30.5%) compared to female (19.5%); this agrees with the global prevalence of stunting in which male were more stunted to female (36).

Many studies (6, 9, 20, 37) have reported significant micronutrient inadequacy among adolescents, this study also confirmed inadequate

Table 3: Micronutrient adequacy of the food consumed by the respondents (n=200)

Micronutrients	Adequacy	Frequency	Percent	Mean (S.D)
Vitamin A				1.4150± 0.71
	Inadequate	143	71.5	
	Adequate	31	15.5	
	Excess	26	13.0	
Carotene				1.7350± 0.96
	Inadequate	126	63.0	
	Adequate	1	0.5	
	Excess	73	36.5	
Vitamin B1				1.2500± 0.57
	Inadequate	163	81.5	
	Adequate	24	12.0	
	Excess	13	6.5	
Vitamin B2				1.8200± 0.87
	Inadequate	96	48.0	
	Adequate	44	22.0	
	Excess	60	30.0	
Total Folate				1.0150± 0.12
	Inadequate	197	98.5	
	Adequate	3	1.5	
Vitamin B12				1.1050± 0.38
	Inadequate	184	92.0	
	Adequate	11	5.5	
	Excess	5	2.5	
Vitamin C				1.0500± 0.28
	Inadequate	193	96.5	
	Adequate	4	2.0	
	Excess	3	1.5	
Sodium				2.1800± 0.90
	Inadequate	65	32.5	
	Adequate	34	17.0	
	Excess	101	50.5	
Potassium				1.0100± 0.14
	Inadequate	199	99.5	
	Excess	1	.5	
Calcium				1.0000± 0.00
	Inadequate	200	100.0	
Magnesium				1.9450± 0.83
	Inadequate	75	37.5	
	Adequate	61	30.5	
	Excess	64	32.0	
Phosphorus				1.8200± 0.83
	Inadequate	90	45.0	
	Adequate	56	28.0	
	Excess	54	27.0	
Iron				2.9150± 0.33
	Inadequate	3	1.5	
	Adequate	11	5.5	
	Excess	186	93.0	
Zinc				2.7250± 0.57
	Inadequate	13	6.5	
	Adequate	29	14.5	
	Excess	158	79.0	

Table 4: Relationship between Nutritional status, age, and sex of the respondents

Age of the respondent		Sex		Total	P-value
		Male	Female		
Height for Age					
Early Adolescence					0.753
	Mild stunting	0	2	2	
	Normal	2	6	8	
	Overweight	0	1	1	
	Obesity	0	1	1	
Total				**12**	
Late Adolescence					**0.003***
	Severe stunting	3	1	4	
	Moderate stunting	9	0	9	
	Mild stunting	31	17	48	
	Normal	51	65	116	
	Overweight	4	7	11	
Total				**188**	
BMI for Age					
Early Adolescence					0.494
	moderate thinness	1	1	2	
	mild thinness	0	3	3	
	Normal	1	5	6	
	Overweight	0	1	1	
Total				**12**	
Late Adolescence					**0.010***
	Severe thinness	5	4	9	
	moderate thinness	16	5	21	
	mild thinness	39	26	65	
	Normal	38	52	90	
	Overweight	0	3	3	
Total				**188**	

P-value >0.05 is not significant

*Statistically significant

intake of Vitamin A, Vitamin B1, Vitamin B2, Folate, Vitamin C, Calcium, Phosphorus, Potassium and Zinc among secondary school students in Abeokuta. This study also established that micronutrient inadequacy increases as adolescents moved from early to mid-adolescence and beyond as reported by (20) that by 14–18 years of age, there is significant micronutrient inadequacies and almost 90% of the studied population failed to meet the recommended nutrient intake of calcium, magnesium, potassium and vitamins D and Vitamin E. The study (20) also reported that female adolescents had the highest proportion of micronutrient inadequacies.

CONCLUSION

It is well known that adolescents are vulnerable and deserve special attention in nutrition because adult health can be affected by nutrition during adolescence, however, the result of the study revealed significant poor and fair nutritional knowledge, poor nutritional status and substantial micronutrients inadequacy which can be related to dietary transition with increased access to cheap food outlets selling mainly starchy foods and carbonated beverages which are low in micronutrients but dense in terms of energy and low intake of fruits and vegetables which are rich in micronutrients and antioxidants. All these factors are attributable to the higher prevalence

of malnutrition among the respondents. There is therefore a need for recognition of micronutrient deficiencies as a group of important public health issues and encouragement of national health systems to adopt a national intervention program targeting multiple micronutrient deficiencies in school adolescents.

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