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Original Article

Household Food Insecurity and Nutritional Status of Female Adolescents in Ikwuano South-East, Nigeria, Post COVID-19

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ABSTRACT

Background and Objectives: Malnutrition and other dietary-related complications are likely to increase in young people due to the worsening effects of COVID-19 control measures on food security. Adolescent girls are vulnerable to nutritional deficiencies due to menarche and other physiological developments. Therefore, the aim of this study was to assess the household food insecurity and nutritional status of adolescent girls in Ikwuano districts, Nigeria, Post COVID-19.

Materials and Methods: A cross-sectional study was carried out in 388 households having at least one female adolescent. Household food insecurity was assessed using interviewer-administered household food insecurity access scale. Anthropometric measurements were collected using standard procedures. Body mass index for age was considered in assessing nutritional status of the adolescent girls. Associations between the household food insecurity access scale and anthropometric measures of the nutritional status were investigated.

Results: Results indicated that more than half of the households (77.06%) experienced degrees of food insecurity (e.g. mild, 26.80%; moderate, 36.59% and severe, 13.66%). Underweight within the adolescent girls was 21.65%, whereas overweight and obesity were 15.96 and 10.05%, respectively. Although no strong associations (R = 0.053, p = 0.459) were recorded between the household food insecurity access scale and all the anthropometric measurements, most malnourished female adolescents (60.7%) where from moderately and severely food insecure households.

Conclusions: Increased food insecurity and emerging cases of nutritional abnormalities in this study could be true reflections of COVID-19 effects on food security. This study recommends to formulate appropriate intervention programs to improve food security and nutrition status of adolescent girls in the study area.

Keywords: Food insecurity, Nigeria, Nutritional status, Female adolescents, COVID-19

Introduction

Food is addressed as a universal human right which is different from other commodities because of its inevitability for survival and existence (1, 2). Food security means living in a household with financial means to access sufficient nutritious foods to sustain active healthy living for all members of the family (3, 4). Food insecurity has globally been concerned in recent decades, especially in low-middle income countries (LMICs) as well as Nigeria. Achieving sustainable food security in most LMICs has often been a major challenge for many low-income households (5). Moreover, measures for the control of COVID-19 virus spread have most likely contributed to unintended worsening effects of the pre-existing food crisis globally (6). Therefore, prices of foods and certain essential goods in local markets have uncontrollably increased at a time, when people have less money to feed themselves and fetch for their household due to loss of jobs. The entire situation has caused many individuals more vulnerable to acute food insecurity (3). Occurrence of food insecurity is affecting nearly 2 billion people globally (3, 7). Regional prevalence report for Africa shows that nearly 277 million people are experiencing severe forms of food insecurity (8). In Nigeria for example, estimates show that food insecurity is a persistent problem despite the presence of numerous

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natural and human resources (2, 8, 9). Acute food insecurity levels in the country before the pandemic included almost 5 million people of the entire population (10). Based on the reports from the United Nations (UN) on the State of Food Security and Nutrition, nearly 118 million more people are worldwide expected to suffer from chronic hunger due to COVID-19 disruptive effects on food systems after 2023 (11, 12). This can result in high levels of undernourishment and malnutrition (e.g. overweight and obesity), especially in most vulnerable groups such as children and adolescents (6).

Household food insecurity is a determinant factor of the nutritional status outcomes as it directly affects quantity and quality of the food consumption and nutrient intake within a household (4, 13). Poor nutrition during key developmental stages (e.g. adolescence) is indeed a crucial public health concern and an emerging global policy issue, especially in poor-resource settings (14). World Health Organization (WHO) defines adolescents as individuals between the age of 10–19 years (14, 15). It is a unique period of rapid growth and development of good health, which creates increased demands for energy and nutrition (16). While undernutrition is prevalent as a major challenge within children and adolescents in several LMICs including Nigeria, increasing prevalence of overweight and obesity in Nigeria has been reported (17, 18). Hence, several LMICs face double burden of malnutrition problem (18). Decreases in family incomes and changes in consumption patterns of nutritious foods possibly due to COVID-19 effects can increase risks of acute malnutrition during adolescence (19). In this study, focuses on female adolescents are because they are vulnerable to nutritional deficiencies due to menarche, growth spurt and other physiological developments (20). Moreover, various studies have suggested that female adolescents are at higher risk of food insecurity effects on nutritional outcome than males (4, 21, 22). According to Roy *et al.* (23), food insecurity at household level can result in low dietary diversity within young women, which may directly be linked to the quality of life of the next generation as young women are addressed as mothers of tomorrow.

In Nigeria, household food security and nutritional status of adolescents are not well understood even before the onset of COVID-19 pandemic. This can pose as a serious barrier in addressing malnutrition and its associated risks for such a vulnerable group. Moreover, studies are yet to fully establish whether food insecurity during adolescence leads to increases in body mass index (BMI)/obesity or not as various findings show complicated results (24–26). Therefore, the aim of the present study was to assess the current food security level (as it links to the nutritional status of female adolescents) in Ikwuano District, Nigeria, since the ease of COVID-19 control measures. Monitoring and exploring such evidence can generate helpful information to design effective nutrition and public health policies for young girls and the future generation to ensure their wellbeing.

Materials and Methods

Study area

The study was carried out in Ikwuano local government area (5º27’44” N, 7º26’24”E) in Abia State, Southeastern Nigeria (Figure 1). It is a low-income district which covers 281 km^2 with a population of nearly 137,993 (27). It is the home of Michael Okpara University of Agriculture Umudike, National Root Crops Research Institute and the prestigious government college in Umuahia. The vegetation of the area is predominantly lowland rainforest with an annual temperature of 26 ºC. It is known for agricultural activities with farming as the major occupation of people in the various communities within the district. The major crop is cassava with much attention on palm oil, kernel and broom; on which, people largely depend as a source of livelihood. Population typifies the average Nigerian experience and hence the area was purposively selected as the study area. The entire study was carried out between April and August, 2022, during planting season.

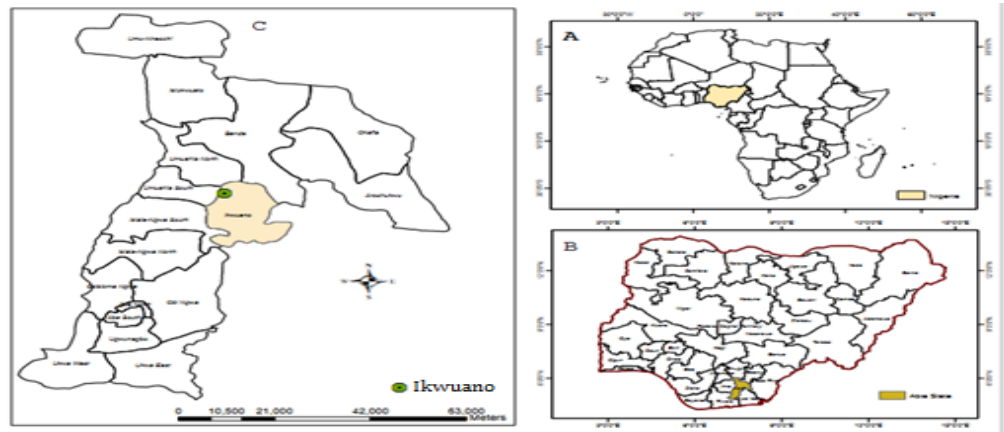

Figure 1. Map of Abia showing the study area

Subjects and inclusion criteria

Female adolescents (10–19 years old) from various households of Ikwuano District were potentially eligible for participation in this study. Households without at least one female adolescent between 10–19 years old were excluded from the study design. Furthermore, those not willing to participate in the study, refusal from the family or demand for money to participate were excluded. Other inclusion criteria for the study were absence of signs of overt illness, non-use of prescription drugs by the female adolescents and residency within the study area. All the interviews were made with strict privacy; therefore, names and addresses of the participants were not recorded in the questionnaires.

Sample size

Sample size was calculated using a formula described by Anyika *et al.* (28) (Eq. 1)

$$n = [Z^2P(100 - P)] / x^2 \quad \text{Eq. 1}$$

Where, Z represented the acceptable margin error of 1.96 (~2) for a sample size (*n*) greater than 30 at 95% confidence interval, P represented the assumed prevalence (65% or 0.65) of food insecurity (29), (100 - P) represented the percentage of female adolescents assumed to have good nutritional status, X was width of confidence interval of 5% and *n* was the sample size. Moreover, 10% extra sample were added to compensate for the uncertainties of loss of the sample due to unpredictable reasons. Totally, 400 households in Ikwuano who had at least one female adolescent of 10–19 years old and lived within the study area were included in the study. When there was more than one female adolescent in the selected households, only the youngest female adolescent was participated in the study. No incentives were provided to participants.

Study design/sampling approach

This study was a descriptive cross-sectional study with use of a multi stage sampling technique to select 400 households that met the inclusion criteria within the study area. Study included two stages. In the first stage, five wards were randomly selected out of ten wards that made up Ikwuano District using random sampling technique. In the second stage, four communities were randomly selected from each of the sampled five wards, making up a total of 20 communities. These 20 households were randomly selected from each community, which resulted in a total number of 400 households as respondents. Information on socioeconomic and demographic characteristics were collected as continuous qualitative data using semi-structured questionnaires.

Assessment of household food insecurity

Household food insecurity was assessed using household food insecurity access scale (HFIAS) guideline version 3 (30). HFIAS is a continuous measurement of the extent of food insecurity majorly associated with the household access to food within the past four weeks (19). The HFIAS consists of nine (9) questions divided into three domains of food insecurity, including (i) concern and uncertainty about the family's food supply; (ii) a change in diet quality; and (iii) an insufficient quantity of the food consumed. The nine (9) "frequency-of-occurrence" questions were asked as a follow-up to each phenomenon question to investigate how often the situation occurred. Each reply was then scored on a range of 0–3; where, 0 represented ‘no occurrence’, 1 represented 'rarely', 2 represented 'sometimes' and 3 represented ‘often’. The total frequency of occurrence over the previous 30 d was calculated and the household scores ranged 0–27. Based on the scores, households were categorized into food secure (HFIAS = 0–1), mildly food insecure (HFIAS = 2–7), moderately food insecure (HFIAS = 8–11) and severely food insecure (HFIAS > 11).

Anthropometric measurements of female adolescents

Anthropometric measurements such as height and weight were carried out using standard procedures (17). Height was measured using inelastic measuring tape fastened to a vertical rod to the nearest 0.1 cm with the subject standing on bare feet. Weight was measured using portable digital-display electronic scale (BF 214, OMRON, Japan) with an accuracy of 0.1 kg with participants removing shoes and wearing light clothes. The BMI was calculated by dividing weight by the square of height (kg/m^2). The WHO AnthroPlus Software v.1.0.4 was used to compute the nutrition indices of Z-scores for BMI-for-age (31). Adolescents were classified as underweight if their BMI-for-age scores $\leq 5^{th}$ percentile and overweight or obesity if their BMI-for-age $> 85^{th}$ but $\leq 95^{th}$ percentile, and $\geq$ 95th percentile, respectively (15, 31). Waist circumference (WC) was measured midway between the lower hip margin and the iliac crest. Hip circumference (HC) was measured at the largest circumference and waist-to-hip ratio (WHR) was calculated as the ratio of waist-to-hip circumferences.

Ethical consideration

This study was carried out based on the guidelines suggested by the Declaration of Helsinki and the study protocol was reviewed and approved by the College of Natural Science, Michael Okpara University of Agriculture Umudike Ethics Committee (ref. no. MOU/CREC/001/22). Informed consents were signed by the participants of the study after the purpose of the study was explained to them. All the interviews were carried out with sufficient privacy; therefore, names and addresses of the respondents were not included in the questionnaires.

Statistical analysis

Data analysis was carried out using SPSS for windows v.16 (IBM, USA). Continuous and categorical data were reported as means ±SD (standard deviation) and percentages, respectively. Differences between the means (for continuous data) were tested for statistical significance using one-way ANOVA with post-hoc multiple comparisons. For categorical data, Fisher's exact test was used to test for significant differences. Relationships between the HFIAS scores and anthropometric measures of nutritional statuses were assessed using Pearson's correlation coefficients analysis. For all analyses, significant threshold included $p \leq 0.05$.

Results

Sociodemographic and socioeconomic characteristics of the parents

Data for 12 households out of 400 interviewees were incomplete; hence, the final analysis was based on 388 households and their female adolescents of 10–19 years old. More than half of the adolescents (57.9%) were in the age group of 10–14 years old (Table 1). Out of 388 households, 342 households (88.14%) were male headed and 53.6% households had larger family size greater than seven with the mean size of 6.2 ±2.01. Distribution on educational status indicated that only 17.26% of the respondents' household heads achieved tertiary education while 8.50% had no formal education and 27.8% were farmers while 16.49 % were civil servants.

Household food security statuses after COVID-19 control measures

Nearly half of the total households (42.01%) were reported to worry often about food shortage during the last 30 d and 17.5 % reported going to sleep without eating any food several times (Table 2). Within these 388 households, only 89 households (22.9 %) were food secure. Furthermore, 104 households (26.80%) were mildly food insecure and 142 households (36.59 %) and 53 households (13.66%) were respectively moderately and severely food insecure (Figure 2). Overall, 77.05 % of all households experienced degrees of food insecurity (e.g. mild, moderate or severe) in the month prior the study, claiming serious food insecurity situations (moderate or severe) in the region.

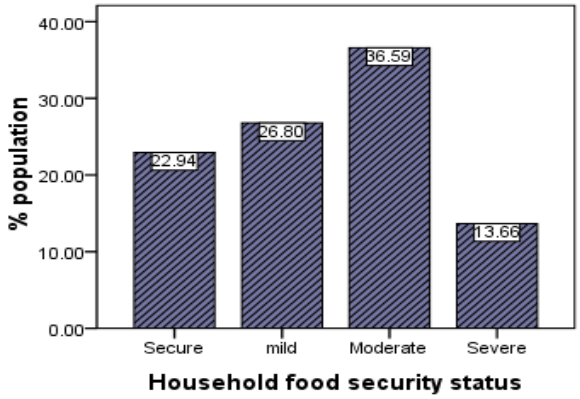

Figure 2. Household food insecurity statuses in Ikwuano, Nigeria, post COVID-19 (Study duration of April–August, 2022)

Table 1. Sociodemographic characteristics of the household heads

Variable	Category	Frequency	Percentage (%)
Head of Household	Male	342	88.14
	Female	46	11.86
Age range of adolescents	10-14	225	57.99
	15-19	163	42.01
Education level of household head	No formal education	33	8.50
	Primary	96	24.74
	Secondary	192	49.48
	Tertiary	67	17.26
Occupation of household head	Farming	108	27.83
	Trading	88	22.68
	Civil servant	64	16.49
	Artisan	128	32.98
Household size	Small (1-3)	68	17.53
	Medium (4-6)	112	28.86
	Large (>7)	208	53.60

All data is shown as number and percentage (%)

Table 2. Participants' responses to household food insecurity access scale questionnaires

Variable	Category	Frequency	Percentage
Worry about enough food	No	66	17.01
	Rare	50	12.88
	Sometimes	109	28.09
	Often	163	42.01
Unable to eat preferred food due to lack of resources	No	33	8.51
	Rare	69	17.78
	Sometimes	99	25.52
	Often	187	48.19
Eat limited variety of foods due to lack of resources	No	24	6.18
	Rare	46	11.85
	Sometimes	175	45.10
	Often	143	36.85
Eat foods they really do not want to eat	No	82	21.13
	Rare	76	19.58
	Sometimes	132	34.02
	Often	98	25.26
Eat smaller meals in a day due to insufficient food	No	31	7.99
	Rare	48	12.37
	Sometimes	73	18.81
	Often	236	60.82
Eat a small meal portion	No	26	6.70
	Rare	59	15.21
	Sometimes	141	36.34
	Often	162	41.75
No food of any kind in the household	No	226	58.25
	Rare	72	18.56
	Sometimes	56	14.43
	Often	34	8.76
Go to sleep hungry	No	142	36.59
	Rare	101	26.03
	Sometimes	77	19.84
	Often	68	17.52
Go a whole day and night without eating	No	303	78.09
	Rare	39	10.05
	Sometimes	18	4.64
	Often	28	7.22

Study duration: April-August, 2022

Anthropometric measurements of the nutritional statuses

Anthropometric characteristics of the population are present in Table 3. For convenience purposes, values are stratified into two age ranges viz. 10–14 and 15–19 years old representing early and late adolescents, respectively. The mean age of the female adolescents was 16.4 y ±1.3 while BMI was 19.3 ±0.2 kg/m^2. The mean weight (47.82 kg ±2.6), height (1.58 m ±0.04) and BMI of the respondents increased with age of the adolescents. A majority of the female adolescents (52.32%) had healthy body weight and 15.98 and 10.05 % were respectively overweight and obese while 21.65% were undernourished (Figure 3). Significant differences ($p< 0.05$) were reported for undernutrition between the early (10–14 years old) and late (15-19 years old) adolescences when data were separated according to age range.

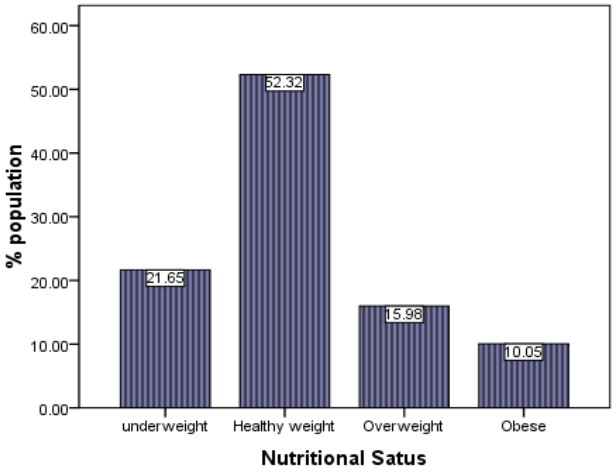

Figure 3. Nutritional statuses of the adolescent girls in Ikwuano, Nigeria, post COVID-19

Table 3. Anthropometric characteristics of the female adolescents within COVID-19 context

Variable	10-14 (mean ±SD)	15-19 (mean ±SD)	Total (N=388)
Age	11.41±4.20	17.55±3.3	16.4±5.10*
Weight (kg)	41.50± 0.3	53.81±3.3	47.82±2.6*
Height (m)	1.52±0.03	1.61±0.02	1.58±0.04
Waist Circumference (cm)	52.44±1.12	62.10±2.2	61.61±3.61*
Hip Circumference. (cm)	69.11±3.22	76.51±5.22	73.22±0.22*
Body mass Index (BMI)	17.56±0.2	20.91±0.3	19.54±0.16*
Waist-to-Hip ratio	0.71±5.33	0.75±2.11	0.73±5.01

*P values <0.05 were considered statistically significant by gender for BMI classification

Distribution of the nutritional statuses of the female adolescents and food insecurity

Results in Table 4 show that a majority of the undernourished female adolescents (60.7%) are from food insecure households (moderate and severe) while only 21.4% were from food secure households. Furthermore, 25.8 and 35.9% of overweight and obese female adolescents respectively were from food secure households. Prevalences of obesity were almost similar ($p > 0.05$) in food secure (35.5%) and severely insecure (30.7%) households.

Associations of HFIAS scores with anthropometric measures of the female adolescents

Associations of the HFIAS with nutritional outcomes of the female adolescent are shown in Table 5. Positive associations were recorded between the HFIAS scores and all anthropometric measurements of the nutritional statuses. However, associations were weak and not statistically significant ($p > 0.05$) when data were pulled together irrespective of age categories.

Discussion

This study was one of the few studies to assess food security and nutritional statuses of female girls in Nigeria since the COVID-19 pandemic. Socioeconomic characteristics of the individual households such as education, occupation, income and family size have been identified as the major predictors of food security statuses of the households (32, 33). In the present study, only 17.2% of the household heads had tertiary education while 8.5% had no formal education. Several literatures reported that education levels positively contributed to the food security of households (13, 34). This was attributed to the fact that educated household heads were aware of various food constituents and adopted correct principles of nutrition for their families despite economic situations (34).

Table 4. Distributions of the nutritional statuses of the female adolescents and household food insecurity

Variable	Underweight: N=84	Healthy weight N=203	Overweight N=62	Obese N=39	Total N=388 (100%)
Food secure	16 (21.4)^{a}	43 (21.2)^{a}	16 (25.8)^{b}	14 (35.9)^{c}	89 (22.94)^{a}
Mild insecure	15 (17.8)^{a}	73(35.9)^{b}	13 (20.9)^{b}	3 (7.7)^{a}	104 (26.80)^{c}
Moderate insecurity	31 (36.9)^{c}	78 (38.4)^{b}	23 (37.1)^{c}	10 (25.6)^{b}	142 (36.59)^{d}
Severe food insecurity	22 (23.8)^{b}	9 (4.4)^{c}	10 (16.1)^{a}	12 (30.7)^{c}	53 (13.66)^{b}

Values with different superscripts (a-b-c) along each column were considered statistically significant at the 0.05 level

Table 5. Correlations of the anthropometric measurements of the adolescents with HFIAS scores

	Household Food Insecurity Access Scale (HFIAS) Score	
Anthropometrics	Pearson's correlation coefficient (r)	Level of significance (P)
Body mass index (kg/m^2)	0.053	0.435
Waist circumference (cm)	0.068	0.592
Waist-to-Hip ratio	0.020	0.857

*P-values <0.05 were considered statistically significant

For the family size, the mean family size of 6.2 ±2.01 in this study could be regarded as a large family size. Previous studies have shown that increasing the size of a family makes additional pressure on household expenditure in contrast to households with small family sizes (19, 35). This is logic because per-capita availability of foods decreases as the family size increases due to rapid increases in the population. Increases in food prices with losses in buying power since COVID-19 emergence might lead to food shortages within the study area. Families with limited budgets or losses in incomes might be unable to afford sufficient and nutritious meals and might not consume foods from multiple food groups regularly (19). Therefore, it is noteworthy that poor nutritional statuses of the female adolescents in the present study might be driven by these sociodemographic factors in addition to poor dietary intakes due to the shortage of foods.

Most of the households during the study reported adjustments from the foods usually provided to their households due to decreased household incomes and/or high costs of foods to enable them pay for their other needs such as medications, school fees and house rents. In general, a majority of the households (77.06%) within the study area experienced degrees of food insecurity (mild, moderate or severe). These values were higher than the 63.3% value previously reported by Okpokiri *et al.* (29) within South-East Nigeria before the emergence of COVID-19 and that of 57% reported from Iran within the context of the pandemic (36) but lower than the 93.2% value reported by Karim and Tasim (19) in Bangladesh since the ease of Covid-19 control measures in the country. The present results are significantly similar to those of 73.5% food insecurity prevalence in adolescent girls from six schools in Maiduguri, Northern Nigeria, within COVID-19 context reported by Shapu *et al.* (37). When only moderate and severe food insecurities are addressed, the current report (50.25%) was similar (43.7%) to the report of Adeomi *et al.* (38) within adolescent girls in Gombe and Osun States, Nigeria. Similarly, reports from some other countries since the emergence of the pandemic were similar as well, including the 75.8% value reported by Betebo *et al.* (13) in East Badawacho District, South Ethiopia and 72 and 78.6% respectively reported by Alam *et al.* (39) and Roy *et al.* (23) in urban slums, Bangladesh. Additional increases in food insecurity by 30 and 44% were reported in Kenya and Uganda by Kansiime *et al.* (40), which were attributed to COVID-19 effects on food systems in these countries. This could be an indication of worsening effects of COVID-19 on household food security. Moreover, the incidence linked factors such as worries over foods, changes in diet qualities and consumptions of insufficient foods were similar to those by Shapu *et al.* (37) as seen in the present study. This was disturbing because such a poor nutrition was linked to acute and chronic malnutrition in young people (17, 41).

Adolescents' food quantity and quality have been shown to be linked to their nutritional statuses (42, 43), especially in the form of BMI-for-age. Out of the 388 female adolescents from the current study, 21.65% had BMI-for-age < 5th percentile (e.g. underweight) while 15.98 and 10.05% were overweight and obese, respectively, indicating nutritional abnormalities. The WHO defined BMI values less than 5th percentile (underweight) as the cutoff value for adolescents, indicating chronic energy protein malnutrition (31). Results from the present study showed that the overall prevalence of undernutrition and overweight/obesity were high, indicating double burden of malnutrition within the study population. However, more undernourished female adolescents (21.65%) were detected than those with overweight/obesity who were at risk of obesity in the population. Earlier cross-sectional studies in the same area before the pandemic reported a lower prevalence of underweight and overweight/obesity using similar measuring tools (44). Similar to the present study, a recent study in Nigeria within adolescents (6–19 years old) from various parts of Nigeria reported prevalence rates of overweight/obesity from 10.4 to 15.4% (18, 45, 46). In contrast, reported prevalence of overweight/obesity in this study (10.5%) was higher than that of the United Nations International Children's Emergency Fund (UNICEF) for Nigeria and sub-Saharan Africa before the pandemic (46). This might be a true reflection of the current economic situation during COVID-19. Results might not be unexpected because the lack of money due to loss of jobs and other resources during the pandemic decreased the household ability to maintain consisted access to nutritious foods, which often resulted in a higher prevalence of food insecurity and nutritional abnormality. The value suggested needs to decrease overdependence on high-calorie and low-nutrient foods and improve quality of diets served to the female adolescents in these households. However, this shift is almost an illusion as poverty is involved in assessing quality of foods consumed at households due to the low prices of such 'unhealthy' foods. Thus, these findings are worrisome because malnutrition during key developmental stages is prone to health problems and later complications of the life stages (41). Several other reports are found in literatures on the nutritional statuses of adolescents within the same study area as well as other regions of Nigeria before the onset of COVID-19. However, variations in sample characteristics and methodological differences make their appropriate comparisons with the current reports quite difficult.

In this study, lack of positive statistically significant associations between the household food insecurity and anthropometric indicators of the nutritional statuses (BMI, WC and WHR) is consistent with a broader literature,

showing no positive associations between the anthropometric measures of obesity (especially BMI) and food insecurity (26, 48). In addition, Maehara *et al*. (49) showed that associations between food insecurity and obesity sifted to insignificance ($p > 0.05$) after incorporating socioeconomic variables into the analysis. This signified that the household socioeconomic conditions could affect associations between the food insecurity and nutritional statuses in adolescents. In contrast to the present study, Mohammadi *et al*. (24); Pan *et al*. (50) and Lohman *et al*. (4) reported significant positive associations between the food insecurity and obesity within females only but not in males, while inverse (negative) relationships were reported by Cordeiro *et al.* (25). Although the present study reported lack of strong significant associations ($p > 0.05$) between the household food insecurity and anthropometric indicators of the nutritional statuses of female adolescents, most malnourished female adolescents (under and overweight/obese) in the study belonged to food insecure households, typifying double burden of malnutrition. This was similar to studies by Adeomi *et al*. (18) in Gombe and Osun States, Nigeria, Dirghayu *et al.* (51) in Nepal and Ajao *et al. (*32) in Ile-Ife, Nigeria, where a majority of malnourished adolescents belonged to food insecure households. This implied that female adolescents living in food insecure households had higher risks of being underweight as well as overweight/obese as a result of malnutrition. These findings were not surprising at all since these adolescents might face decreased dietary varieties or nutrient intakes due to decreased household budgets and high costs of healthy foods in recent years. The current findings demonstrated that household food insecurity affected nutritional outcomes of female adolescents by possible compromising quantity and quality of their dietary intakes. Thus, additional economic strains by the COVID-19 pandemic on the available resource-constrained households should be considered to avoid dietary disruption and its subsequent consequences, especially on young girls from poor resource neighborhoods.

limitation of the study

This study included limitations that should be addressed in assessing its findings. First, as design of the study was cross-sectional, its ability to draw cause-effect relationships was limited. Second, the entire analysis was based on data that were collected during planting season of the year (April–August, 2022). However, the magnitude of household food insecurity might vary within seasons of the year. Moreover, recall and reporting bias in food security was possible since variables were based on a recall to situations happening a few weeks back from the actual data collection time. Despite these limitations, results of this study importantly contributed to the limited data available and allowed important insight into the current situation of food security and its distribution with nutritional status within a vulnerable population at high risks since the ease of COVID-19 measures. Further elaborated studies are necessary using further diverse samples.

Conclusion

In conclusion, this study reported that a substantial proportion of households (77.06%) within the study population were food insecure (mild, moderate or severe), which could be due to the lasting effects of COVID-19 pandemic on food security. The study showed high prevalence of double burden of malnutrition (undernutrition and overweight/obesity) in adolescent girls from food insecure households in Ikwuano District, Nigeria. Although no significant associations were observed between the household food insecurity scores and anthropometric measures of the nutritional statuses of the adolescents in this study, a majority of malnourished female adolescents belonged to food insecure households. These results argue for increasing access to foods, especially during key developmental periods of rapid growth to tackle malnutrition (under and over-nutrition). This could help improve optimal nutrition and health status of adolescent girls and as well decreasing long-term adverse effects on their health.

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References

1. Otaha IJ. Food Insecurity in Nigeria: Way Forward. *An International Multidisciplinary Journal Ethiopia*. 2013; 7 (4):26–35.
2. Mikkonen J, Raphael D. Social Determinants of Health: The Canadian Facts. Toronto, ON: York University School of Health Policy and Management; 2010; Available at: https://thecanadianfacts.org/the_canadian_facts.pdf
3. Food and Agriculture Organization (FAO). The state of food security and nutrition in the world. The world is at a critical juncture. Rome, Italy. 2021; Available at; https://www.fao.org/state-of-food-security-nutrition
4. Lohman BJ, Neppl Tk, Lee Y, Diggs ON, Russel D. The association between household food insecurity and Body mass index: A prospective growth curve analysis. *The journal of pediatrics.* 2018; 202:115-120
5. Sanusi RA, Samuel FO, Ariyo O, Eyinla TE. Achieving food security in Nigeria by 2050. *Afr. J Med. Med Sci*. 2019; 4, suppl. 23-27.

6. Anyiam PN, Ikwuegbu EC. Concerns on child malnutrition and mortality increases during the food crisis in Nigeria post COVID-19 pandemic. *Nutrition and food sciences Research*. 2022; 9(3): 1-4.
7. Food Security Information Network (FSIN). Global Report on Food Crises. 2020. https://www.fsinplatform.org/global-report-food-crises 2020
8. Yahaya SP, Sanusi RA, Eyinla TE, Samuel FO. Household food insecurity and nutrient adequacy of under-five children in selected urban areas of Ibadan, South Western, Nigeria. *African Journal of Biochemistry research*. 2021; 24; 41-46
9. Akinyele IO. Ensuring food and nutrition security in rural Nigeria: An assessment of the challenges information needs, and analytical capacity'.NSSP Brief 18. Abuja, Nigeria: *International Food Policy Research Institute (IFPRI)* 2010.
10. Global Network Against Food Crisis. In Global Report on Food Crises; FAO: Rome, Italy, 2020
11. United Nations (UN). Policy Brief: the Impact of COVID-19 on Food Security and Nutrition. 2020; https://www.un.org/sites/un2.un.or/file/sg
12. World Bank. Food Security and COVID-19. 2021; https://www.worldbank.org/en/topic/agriculture/brief/food-security-and-covid-19
13. Betebo B, Ejajo T, Alemseged F, Massa D. Household food insecurity and its association with nutritional status of children 6-59 months of age in East Badawacho district, South Ethiopia. *Journal of environmental and public health*. 2017; 1-17
14. World Health Organisation (WHO). Maternal, newborn, child and adolescent health. 2016; http://www.who.int/maternal_child_adolescent/en/
15. Onis DM, 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(9):660-7.
16. Dick B, Ferguson BJ. Health for the world's adolescents: A second chance in the second decade'. *J. Adolesc Health*. 2015; 56(1):3-6.
17. Karim KMR, Tasnim T. Impact of lockdown due to COVID-19 on nutritional and food security of the selected low-income households in Bangladesh'. *Heliyon*. 2022; 8:e09368
18. Adeomi AA, Fatusi A, Klipstein-Grobusch K. Food Security, Dietary Diversity, Dietary Patterns and the Double Burden of Malnutrition among School-Aged Children and Adolescents in Two Nigerian States. *Nutrients.* 2022, 14, 789.
19. Onabanjo OO, Balogun OL. Anthropometric and iron status of adolescents from selected secondary schools in Ogun state, Nigeria. *Adolescents.* 2014*;* 6(2) 109-118:
20. Hadley C, Lindstrom D, Tessema F, Belachew T. Gender bias in food insecurity experiences of adolescents in Jimma zone'. *Soc Sci Med*. 2008; 66(2):427–438
21. Belachew T, Hadley C, Lindstrom D, Gebremariam A, Michael KW, *et al*. Gender differences in food insecurity and morbidity among adolescents in southwest Ethiopia. *Pediatrics.*2011; 127(2):e398-405.
22. Roy D, Zulfiqar F, Tsusaka TW, Datta A. Household food insecurity and dietary diversity of women of reproductive age among smallholder farming households in northwest Bangladesh. *Ecol Food Nutr*. 2022*;* 13:1-24.
23. Mohammadi F, Omidvar N, Harrison GG, Ghazi-Tabatabaei M *et al*. Is household food insecurity associated with overweight/obesity in women? *Iran J Public Health*. 2013; 42:380-90.
24. Cordeiro LS, Wilde PE, Semu H, Levinson FJ. 'Household food security is inversely associated with undernutrition among adolescents from Kilosa, Tanzania. *J. Nutr*. 2012; 142(9):1741-7.
25. Gundersen C, Lohman BJ, Eisenmann JC, Garasky S, Stewart SD. Child-specific food insecurity and overweight are not associated in a sample of 10- to 15- year old low-income youth. *J Nutr*; 2008; 138:371-8.
26. National Population Commission (NPC). The Population Census of the Federal Republic of Nigeria Analytical report at the National Population Commission. 2006; -Abuja
27. Anyika JU, Uwaegbute AC, Olojede AO, Nwamarah JU. Nutrient intakes of adolescent girls in secondary schools and universities in Abia State of Nigeria. *Pakistan Journal of Nutrition*. 2009; 8(10):1596-1602.
28. Okpokiri CI, Agwu NM, Onwukwe FO. Assessment of food security status of farming households in Abia state, Nigeria. *The Nigerian agriculture journal.* 2017*;* 48(2) 93-9
29. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3). Washington, D.C.: *FHI 360*/FANTA. 2007; 1-29
30. Anyiam PN, Nwuke CP, Adimuko GC, Uche PC, Ukpai EA & Ononogbu EC. Dietary intake and nutritional status of school children in umudike, South-East Nigeria during COVID-19 context'. *International Journal of nutrition sciences*. 2022; *7*(2): 2-10
31. World Health Organisation (WHO). WHO Anthro Plus for Personal Computers Manual: Software for Assessing Growth of the World's Children and Adolescents, 2009. WHO, Geneva. http://www.who.int/growthref/tools/en/
32. Ajao KO, Ojofeitimi EO, Adebayo AA, Fatusi AO, Afolabi OT. Influence of family size, household food security status and child care practices on the nutritional status of under-five children in Ile-ife, Nigeria. *African journal of reproductive health*. 2010; 14(4):123-130.
33. Babatunde RO, Omotesho OA, Sholotan OS. Socio-economics characteristics and food security status of farming households in kwara state, North-central Nigeria. *Pakistan journal of nutrition*. 2007; 6 (1): 49-58
34. Mohammed A, Wassie SB, Teferi ET. Determinants of smallholders' food security status in Kalu district, Northern Ethiopia. *Challenges*. 2021; 12:17.
35. Olayemi AO. Effects of family size on household food security in Osun State Nigeria. *Asian journal of agriculture and rural development.* 2012*;* 2(2):136-141
36. Pakravan-Charvadeh M, Mohammadi-Nasrabadi F, Gholamrezai S, Vatanparast H, Flora C Nabavi-Pelesaraei A. The short-term effects of COVID-19 outbreak on dietary diversity and food security status of Iranian households (A case study in Tehran province). *J. Clean. Prod*. 2021 281, 124537
37. Shapu CR, Ismail S, Ahmad N, Lim PY, Abubakar Njodi I. Food Security and Hygiene Practice among Adolescent Girls

in Maiduguri Metropolitan Council, Borno State, Nigeria. *Foods*. 2020, 9, 1265.

38. Adeomi A, Fatusi A, Klipstein-Grobusch K. Double burden of malnutrition among school-aged children and adolescents: Evidence from a community-based cross-sectional survey in two Nigerian States. AAS Open Research. 2021. 4:38: 1-14
39. Alam SS, Rahman MN, Lima LS, Haque MM, Islam K. Food security status of adolescent girls in selected Urban Slum. *MOJ Public Health*. 2018; 7(5): 247-250
40. Kansiime M, Tambo J, Mugambi I, Bundi M, Kara A, Owuor C. COVID-19 implications on household income and food security in Kenya and Uganda: findings from a rapid assessment. *World Dev*. 2021; 137, 105199.
41. Kindblom JM, Lorentzon M, Hellqvist A, *et al*. BMI changes during childhood and adolescence as predictors of amount of adult subcutaneous and visceral adipose tissue in men: the GOOD study. *Diabetes*. 2009; 58:867–74.
42. Doustmohammadian A. Nutritional status and dietary intake among adolescent girls. *J Paramed Sci*. 2013; 4:72-7
43. Dewi NU, Nurulfuadi Aiman U, Hartini DA, Pradana F, Bohari B. Food Insecurity and Anthropometry in Adolescents: A Literature Review. *Open Access Maced J Med Sci*. 2020; 26(8):1-7.
44. Ukegbu PO, Onimawo IA, Ukegbu AU. Nutritional status and energy intake of adolescents in Umuahia urban Nigeria. *Pakistan journal of nutrition*. 2007; 6 (6):641-646
45. Otuneye AT, Ahmed PA, Abdulkarim AA, Aluko OO, Shatima DR. Relationship between dietary habits and nutritional status among adolescents in Abuja municipal area council of Nigeria. *Nigerian Journal of Paediatrics.* 2017; 44(3): 128–35
46. Omisore AG, Omisore B, Abioye-Kuteyi EA, Bello IS, Olowookere SA. In-school adolescents' weight status and blood pressure profile in South-western Nigeria: urban-rural comparison. *BMC Obesity*. 2018; 5: 2
47. UNICEF. Food Systems for Children and Adolescents; UNICEF: New York, NY, USA, 2018
48. Manyanga T, El-Sayed H, Doku DT, Randall JR. The prevalence of underweight, overweight, obesity and associated risk factors among school-going adolescents in seven African countries. *BMC Public Health*. 2014;14:887.
49. Maehara M, Rah JH, Roshita A, Suryantan J, Rachmadewi A, Izwardy D. Patterns and risk factors of double burden of malnutrition among adolescent girls and boys in Indonesia. *PLoS One*. 2019; 14(8):e0221273.
50. Pan L, Sherry B, Njai R, Blanck HM. Food insecurity is associated with obesity among US adults in 12 states. *J. Acad Nutr Diet*. 2012. 112:1403-9
51. Dirghayu KC, Ulak N, Poudyal Anil, Shrestha N, Gautam N *et al*. Household food security access and nutritional status among early adolescents in a poor neighborhood of Sinamangal Nepal. *Current Developments in Nutrition*: 2021; 5(11): 1-7