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Research

Region, location, and age-specific comparison of nutritional status of in-school adolescent girls (10-19 years) in Nigeria

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Background
Nutritional status among female adolescents in Nigeria is becoming a major concern because it determines health outcomes and productivity in their adult years. There is a growing recognition of the potential to promote a healthy start to life for the next generation by addressing health and nutritional risks in adolescents.

Objective
This study assessed the nutritional status of in-school adolescent girls in Nigeria and made comparisons across regions, locations, and age groups.

Methods
A multistage stratified random sampling procedure was used to select participants from three geopolitical zones in Nigeria for this descriptive cross-sectional study of 2261 in-school adolescent girls aged 10 -19 years. Body mass index-for-age (BMI), waist-hip-ratio (WHR), and waist-height-ratio (WHtR) were calculated from weight, height, hip, waist, and mid-upper arm circumferences measurements.

Results
The mean age was 14.9 years (± 1.78 years), the mean body weight was 47.8 kg (± 9.02 kg), compared to a calculated mean ideal weight of 54.5 kg (± 9.05 kg). Using BMI, 9.8% of these adolescent girls were underweight, 7% were either overweight or obese, 47.9% were at risk judging from WHR, 10% had abdominal obesity present using WHtR, 35.7% were malnourished, and 11.8% were obese using MUAC. South East girls were eleven times more likely to have a high BMI (OR=11.341, 95%CI=6.059-21.225) and three times more likely to have a high WHtR (OR=2.870, 95%CI=1.954-4.213) than other regions. The likelihood of being overweight/obese was higher among urban than peri-urban girls; BMI (OR=1.008, 95%CI=0.728-1.395) and $MUAC_{overweight}$ (OR=1.280, 95%CI=0.988-1.657). Older girls, 14-16yrs; WHtR (OR = 1.426, 95%CI = 0.970-2.097) and 17 -19yrs (OR = 1.024, 95%CI = 0.617-1.699) were likely to be overweight/obese compared to 10 -13yrs (OR=3.878, 95%CI=2.385-6.305). Girls 14 -16 were three times and 17-19 were six times more likely to have higher $MUAC_{overweight}$ (OR = 3.878, 95%CI = 2.385-6.305) and (OR=6.371, 95%CI=3.854-10.865), respectively than those at 10-13 years.

Conclusions
These findings underscore the significant disparities in the nutritional status of adolescent girls across regions, locations, and age ranges in Nigeria. This highlights the urgent need for targeted, region-specific nutrition-sensitive intervention programmes among adolescent girls, potentially leading to improved public health outcomes in Nigeria.

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INTRODUCTION

Nutritional status is defined as "a physiological state of an individual, which results from the relationship between nutrient intake and requirements, and from the body's ability to digest, absorb and use these nutrients" (FAO, 2007; Khan et al., 2022). Nutritional status among female adolescents is becoming a major concern because it determines health outcomes and productivity in their adult years (WHO, 2022). Adolescent nutritional status is commonly assessed using anthropometric measurements (Khan et al., 2022), which involve measuring physical dimensions and composition of the body.

Malnutrition refers to deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization (WHO, 2024). It presents as undernutrition or overweight/obesity, as well as nutrient deficiencies. Undernutrition manifests in four broad forms: wasting, stunting, underweight, and micronutrient deficiencies (WHO, 2024). Both undernutrition (underweight) and so-called "overnutrition" (overweight and obesity) co-exist among groups of adolescents.

Anthropometric indices such as weight and height are used to assess individuals' nutritional status, growth pattern and development, mainly in young children, but also at the other time of rapid growth, adolescence. WHO provides international growth standards based on age and sex-specific BMI (WHO, 2007; Rafraf, 2013; Permatasari & Chadirin, 2022). Meanwhile, early childhood growth influences height, and linear growth retardation influences adolescent stature in later years. The WHO anthropometric charts are used to determine underweight, normal weight, overweight and obesity in adolescents. Adolescent populations may differ by ethnicity in various body proportions that affect anthropometric indices (Woodruff & Duffield, 2002).

Globally, there are 1.3 billion adolescents which comprise 16% of the world's population, with 90% living in low and medium-income countries and 23% living in sub-Saharan Africa (UNICEF, 2019). Adolescence, aged 10-19 years, is the second fastest period of growth after infancy. During this period, adolescents gain up to 50% of their adult weight, more than 20% of their adult height, and 50% of their adult skeletal mass (Gebreyohannes et al., 2014). However, adolescents face a series of nutritional challenges, which could affect both their growth spurt and health as adults. Although both male and female adolescents are at risk, females are particularly vulnerable, especially to malnutrition (UNSCN, 2022).

About 23% of adolescent girls between 15-19 years have begun procreation; in addition, 1 million give birth before their 15th birthday (NPC & ICF, 2014; Kululanga et al., 2020). Adolescent mothers who are malnourished and not fully developed tend to have malnourished children (WHO_IAHO, 2024). An underweight woman also has a high likelihood of giving birth to a low-weight baby, which may not grow to its full potential or die before the fifth birthday (Saxena, 2018).

There is a growing recognition of the potential to promote a healthy start to life for the next generation by addressing health and nutritional risks in adolescents (Patton et al., 2014). Adolescence, therefore, has been identified as a window of opportunity to break the intergenerational vicious cycle of malnutrition. Despite calls for action, adolescent health has remained neglected.

In Nigeria, underweight in adolescents ranges between 12% and 28% (Otuneye et al., 2017; WHO, 2019; Uba et al., 2020; Adinma, 2020). There has been an increase in the prevalence of overweight among children and adolescents aged 5–19, from 4.1% to 14.6% and from 1.3% to 10.2% for obesity (Okagua et al., 2016; Adeleye, 2021; Adeloye et al., 2021; Samuel et al., 2022).

There is a paucity of data on the nutritional status of adolescent girls to guide the designing of intervention programmes in Nigeria (Delisle et al., 2001; Woodruff & Duffield, 2002; Brooks & Begley, 2014; Rah et al., 2017; Das et al., 2018; Hargreaves et al., 2022).

Therefore, this study was specifically designed to assess the nutritional status of adolescent girls using anthropometric indices and compare them across three regions, two locations, and three age groups in Nigeria.

METHODS

STUDY DESIGN AND SAMPLING PROCEDURE

This was a descriptive cross-sectional study among in-school female adolescents aged 10-19 years. Three geopolitical zones were selected out of the six geopolitical zones in Nigeria. Two states were selected from each of the three zones, namely, North Central (NC) (Kogi and Niger States), South East (SE) (Abia and Imo States) and South West (SW) (Osun and Ondo States).

Sampling was done using a multistage stratified random sampling procedure to select schools and students who participated in this study. In the first stage, six states were selected. In the second stage, the local government areas (LGAs) in each selected state were grouped according to their urban, peri-urban or rural status. Two mostly-peri-urban LGAs and two mostly urban LGAs were selected in each state. In the third stage, lists of secondary schools in the selected LGAs were obtained from their respective local education authorities; two schools were randomly selected by ballot from each of the LGAs. Twenty-five students were randomly selected in the junior and senior arms of the designated schools.

School registers were used to generate a sampling framework from which eventual participants were selected using a systematic sampling technique with a K^{th} interval once a participant had been chosen randomly.

SAMPLE SIZE DETERMINATION

The sample size was determined using the Research Advisors (2006) at 95% confidence level. Since parameters were determined in each of the six selected states by LGAs, the selected LGAs from each state were treated as a population. The mean population of in-school adolescent girls per LGA was 12,456. According to the Research Advisor, a sample of 370 was considered sufficient to allow reasonable estimation in each of the six states based on this population size. Assuming a non-response rate of 1%, the adjusted calculated sample size for each of the six states was 374, translating to a total minimum sample size of 2,244. This was proportionately distributed to the six states by LGAs. In all, 645 girls were interviewed in NC, 742 in SE and 874 in SW.

INCLUSION AND EXCLUSION CRITERIA

Adolescent girls aged 10-19 attending government-owned secondary schools were included in this study. Those who attended boarding schools, pregnant and lactating adolescents, those who lived in orphanage homes, and those who attended privately owned schools were excluded.

DATA COLLECTION

Four research assistants were recruited and trained to assist in data collection for each state and were trained for two days on anthropometric measurements. The field assistants worked in pairs to reduce interpersonal bias. Each respondent was interviewed for approximately 15 minutes. The data were collected concurrently in April 2023 for two weeks in all the states.

All anthropometric data were collected using the procedures recommended by WHO (2007). Weight and Height measurements were determined using a 150kg Seca Weighing Scale with a 75-200cm stadiometer. The weight was measured without footwear and with minimal clothing, and the participants were requested to stand at the centre of the platform of the weighing scale without touching or leaning on anything. The head was erect and the arms hung by the sides, then the readings were taken to the nearest 0.1kg. The readings were taken in triplicate, and the average was taken (WHO, 2007; PT Direct, 2010). The height was taken with the adolescent girl's shoes removed, both feet parallel to each other. The height measurement was read to the nearest 0.01cm. The readings were taken in triplicate, and the average was taken (PT Direct, 2010). Waist circumference was measured by asking the participant to stand comfortably with feet together and arms relaxed at their sides, not wearing bulky clothing that could interfere with accurate measurement. The measurement was taken at the natural waistline, which is usually the narrowest part of the torso between the lowest rib and the iliac crest (top of the hip bone), using a flexible, non-stretchable measuring tape made of cloth material. The tape was snug but did not compress the skin. The measurement was taken at the end of a normal breath and recorded to the nearest centimetre. For the Hip Circumference, the participants were asked to stand with feet slightly apart, and the widest part of the hips was identified; the same flexible, non-stretchable measuring tape was used and wrapped around the hips, snug but not tight and recorded to the nearest centimetre.

The mid-upper arm circumference (MUAC) was measured using flexible plastic Seca tape with the arm positioned straight, on the upper left arm midway between the olecranon and acromion process.

MEASUREMENT OF VARIABLES

For this study, age was classified into early adolescence (10-13 years), mid-adolescence (14-16 years) and late adolescence (17-19 years) (Olumakaiye, 2013; Oyewole, 2023). The ideal body weight (IBW) was calculated using Broca Index. It is a simple and effective method to determine IBW by subtracting 100 from the height in cm (Alejandro et.al., 2018). Body Mass Index (BMI) was calculated as the weight in kilograms divided by the square of the height in meters (kg/m^2) and was classified using the sex-specific BMI-for-age Z-scores WHO Growth Reference for school-aged children and adolescents (Rafraf, 2013). Percentile of <5^{th} = underweight, 5^{th}-85^{th} percentile = healthy weight, 85^{th} -95^{th} percentile = overweight and >95^{th} percentile = obese. This was done using WHO AnthroPlus. WHR was classified as no risk of abdominal obesity (No Risk$_{ABO}$) (<0.8) and at risk of abdominal obesity (At Risk$_{ABO}$) (>0.8) (Rafraf, 2013). Waist-to-height ratio (WHtR) was classified as abdominal obesity (ABO) absent (⩽0.49) and abdominal obesity (ABO) present (>0.49) (Rafraf, 2013). MUAC for overweight (MUAC$_{OW}$) was classified as no overweight (<27.9cm) and overweight (⩾27.9cm) (Rafraf, 2013), while MUAC for malnourishment (MUAC$_{Mal}$) was classified as malnourished (<22cm), not malnourished (⩾22cm).

DATA ANALYSIS

Data were cleaned, and incomplete entries were removed as outliers; 2261 participants with verified data were entered into a computer using SPSS version 24 and analysed using descriptive and inferential statistics. The descriptive statistics employed included frequency, percentage, mean, and standard deviation, while inferential statistics, such as chi-square, were used to determine the difference across regions, locations, and age groups. Binary logistic regression was used to predict overweight prevalence. The statistical significance was set to a p-value of less than 0.05.

ETHICS

Approval for the study was obtained from the Health Research and Ethics Committee of the Institute of Public Health, Obafemi Awolowo University, Ile-Ife (IPHOAU/12/2205). Permission was also obtained from the Education and Development Research Committee in the Ministry of Education. Approval for the selected states was given by the Executive Secretary of each Local Government, Local Inspectors of Education (LIEs) and principals of the selected schools. Consent was obtained from participants with assurance of confidentiality.

RESULTS

The final sample included 2261 girls. Table 1 provides the mean and standard deviation values of the age and anthropometry of the 2261 adolescent girls. The mean age was 14.9 ± 1.78 years. The mean actual body weight of 47.8± 9.02 kg was notably lower than the mean calculated ideal body weight (54.5± 9.05 kg). The actual compared to IBW are shown in Figure 1. This shows more clusters skewed to the left, indicating the actual body weights were lower than the ideal. The mean height was 1.55m (± 0.09 m), waist circumference was 67.9 cm (± 7.15 cm), and hip circumference was 84.5 cm (± 8.92 cm). The mean BMI-for-age was 20.1 kg/m2 (± 3.68 kg/m2), and MUAC was 23.7 cm (± 3.43 cm).

Figures 2 and 3 show the percentage distribution of the variables. More than half (58.9%) of the adolescent girls were within the 14 to 16-year age range, 38.7% were from the South West region, and there was an almost even distribution between those residing in peri-urban (48.3%) and urban (51.7%) areas (Figure 2). About 10% of the adolescent girls were underweight, 7% were either overweight or obese (Figure 2).

Data in Figure 3 show that 47.9% of the girls were at risk judging from WHR, 10% had abdominal obesity present using WHtR, 35.7% were malnourished, and 11.8% were obese using MUAC (Figure 3).

Table 1. Descriptive statistics of age and anthropometry of sampled adolescent girls (n = 2261)

Variable	Mean ± SD
Age (years)	14.9 ± 1.78
Actual Body Weight (kg)	47.8 ± 9.02
Calculated Ideal Body Weight (IBW) (kg)	54.5 ± 9.05
Variance between Actual and Ideal Body Weight	-6.7 ± 9.73
Height (m)	1.60 ± 0.09
Waist Circumference (WC) (cm)	67.9 ± 7.15
Hip Circumference (HC) (cm)	84.5 ± 8.92
Body Mass Index (BMI) (kg/m²)	20.1 ± 3.68
Mid Upper Arm Circumference (MUAC) (cm)	23.7 ± 3.43

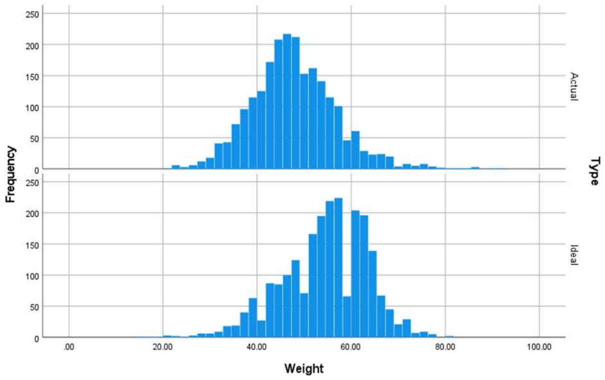

Figure 1. Distribution of actual body weight and ideal body weight

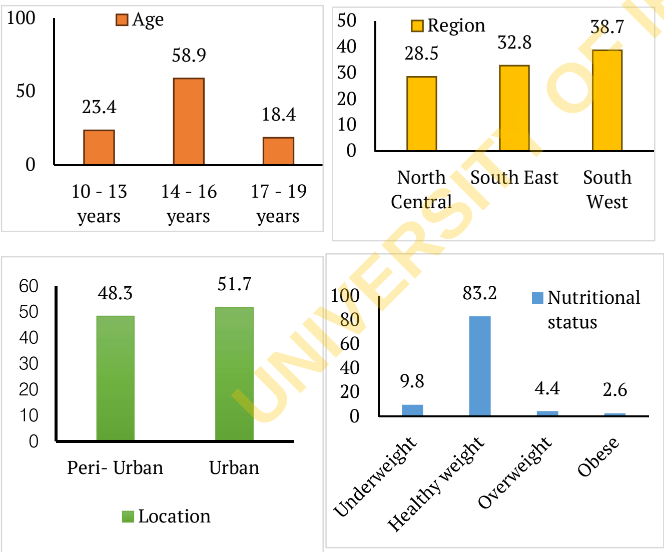

Figure 2. Percentage distribution of age, region, location and nutritional status of adolescent girls (n = 2261)

As indicated in Table 2, 117 (13.4%) of those who were underweight were from the South West region, while 75 (10%) and 47 (6.3%) of those who were overweight and obese were in the South East region, respectively. WHtR of the presence of abdominal obesity was likewise highest in the South East region, 113 (15.2%). Judging from the waist circumference (WC) measurements, most girls in all regions were at no risk, with minimal variation among regions, while 359 (41.1%) were malnourished from the South West, judging from MUAC.

Differences in the distribution among the three regions indicated significant variations in the distribution of age groups, BMI-for-age, WHR, WHtR, and MUAC for both overweight and malnourishment classifications among the three regions (p<0.05).

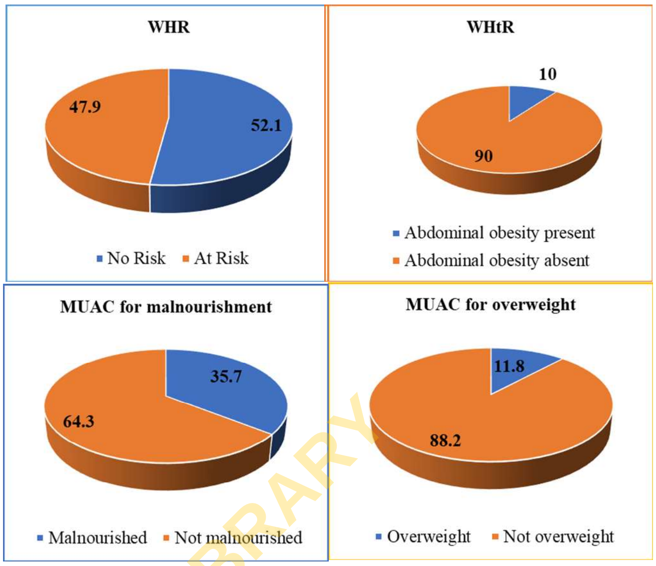

Figure 3. Percentage distribution of waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), and mid-upper arm circumference (MUAC) for both malnourishment and overweight.

As indicated in Table 3, there is a statistically significant difference in age between the urban and peri-urban populations (p = 0.003), with the peri-urban area in our sample being slightly older. There was no difference in BMI-for-age, WHtR, WC, and $MUAC_{OW}$ between the urban and peri-urban populations (p > 0.05). However, according to MUAC, the peri-urban sample was at lower risk for over- and underweight.

Table 4 breaks down nutritional status by age range. The youngest group appears to have more underweight and more overweight girls. The oldest group appears to be less overweight and obese than the younger groups using the BMI-for-age. However, older girls had more abdominal obesity present, and MUAC likewise indicated that overweight were present in older girls as well.

The binary logistic regression analysis in Table 5 shows that based on BMI and WHtR, adolescent girls in the SE region were eleven times more likely to be overweight/obese than those in other regions (OR = 11.341, 95%CI = 6.059 - 21.228) and about three times more likely to have abdominal obesity (OR = 2.870, 95%CI = 1.954 - 4.213). Those in the urban had a higher likelihood of being overweight/obese than those in peri-urban areas, based on BMI (OR = 1.008, 95%CI = 0.728 - 1.395) or $MUAC_{OW}$ **(**OR = 1.280, 95%CI **=** 0.988 - 1.657) and they had a lower likelihood based on WHR (OR = 0.610, 95%CI = 0.516 – 0.720). Older adolescent girls were less likely to be overweight/obese based on BMI or WHR. There was no difference by age based on WHtR but older girls had a higher likelihood of being overweight/obese, based on MUAC (OR = 6. 371, 95%CI = 3.854 -10.865).

Table 2: Age, Body Mass Index, Waist-to-Hip-Ratio, Waist-to Height-Ratio, Waist Circumference and Mid-Upper Arm Circumference by Region (n = 2261)

Variables	North Central (n = 645) n (%)	South East (n = 742) n (%)	South West (n = 874) n (%)	LR χ2	P-value
Age					
10-13yrs	100 (15.5)	230 (31.0)	199 (22.8)		
14-16yrs	351 (54.4)	428 (57.7)	536 (61.3)	109.534	0.001 [a]
17-19yrs	194 (30.1)	84 (11.3)	139 (15.9)		
BMI-for-age					
Underweight (< 5th percentile)	58 (9.0)	47 (6.3)	117 (13.4)		
Healthy weight (5th-85th percentile)	576 (89.3)	573 (77.2)	734 (84.0)	174.634	<0.001 [a]
Overweight (85th-95th percentile)	8 (1.2)	75 (10.1)	17 (1.9)		
Obesity (>95th percentile)	3 (0.5)	47 (6.3)	6 (0.7)		
WHR					
No Risk (<0.8)	357 (55.3)	355 (47.8)	466 (53.3)	8.634	0.013 [a]
At Risk (>0.8)	288 (44.7)	387 (52.2)	408 (46.7)		
WHtR					
Abdominal Obesity Absent (⩽0.49)	607 (94.1)	629 (84.8)	800 (91.5)	36.131	<0.001 [a]
Abdominal Obesity Present (>0.49)	38 (5.9)	113 (15.2)	74 (8.5)		
WC (cm)					
No Risk (<90)	644 (99.8)	737 (99.3)	870 (99.5)	2.397	0.347
At Risk (⩾90)	1 (0.2)	5 (0.7)	4 (0.5)		
$MUAC_{OW}$ (cm)					
Not Overweight (<27.9)	516 (80.0)	670 (90.3)	809 (92.6)	56.843	<0.001 [a]
Overweight (⩾27.9)	129 (20.0)	72 (9.7)	65 (7.4)		
$MUAC_{MAL}$ (cm)					
Malnourished (<22)	156 (24.2)	291 (39.2)	359 (41.1)	52.285	<0.001[a]
Not Malnourished ((⩾22)	489 (75.8)	451 (60.8)	515 (58.9)		

LR = Likelihood ratio, [a] Significant at P<0.05, $MUAC_{OW}$ = Mid-upper arm circumference for overweight, $MUAC_{MAL}$ = Mid-upper arm circumference for malnourishment

Table 3. Age, BMI, WHR, WHtR, WC and MUAC by Location

Variables	Urban (n = 1170) n (%)	Peri-Urban (n =1091) n (%)	LR χ2	P-value
Age				
10 -13yrs	298 (25.5)	231 (21.2)		
14 -16yrs	683 (58.4)	632 (57.9)	11.379	0.003 [a]
17-19yrs	189 (16.1)	228 (20.9)		
BMI-for-age				
Underweight (< 5th percentile)	117 (10.0)	105 (9.6)		
Healthy weight (5th-85th percentile)	972 (83.1)	911 (83.5)	0.577	0.902
Overweight (85th-95th percentile)	54 (4.6)	46 (4.2)		
Obesity (>95th percentile)	27 (2.3)	29 (2.7)		
WHR				
No Risk (<0.8)	679 (58.0)	499 (45.7)	34.284	<0.001 [a]
At Risk (>0.8)	491 (42.0)	592 (54.3)		
WHtR				
Abdominal Obesity Absent (⩽0.49)	1054 (90.1)	982 (90.0)	0.004	0.952
Abdominal Obesity Present (>0.49)	116 (9.9)	109 (10.0)		
WC (cm)				
No Risk (<90)	1163 (99.4)	1088 (99.7)	1.384	0.247
At Risk (⩾90**)**	7 (0.6)	3 (0.3)		
$MUAC_{OW}$ (cm)				
Not Overweight (<27.9)	1018 (87.0)	977(89.6)	3.529	0.067
Overweight (⩾27.9)	152 (13.0)	114 (10.4)		
$MUAC_{MAL}$ (cm)				
Malnourished (<22)	375 (32.1)	431 (39.5)	13.673	0.001 [a]
Not Malnourished (⩾22)	795 (67.9)	660 (60.5)		

[a] Significant at p<0.05, BMI (Body Mass Index), WHR (Waist to Hip Ratio), WHtR (Waist to Height Ratio), WC (Waist Circumference) and MUAC (Mid Upper Arm Circumference
Circumference), LR = Likelihood ratio

Table 4: Chi-square analysis showing the difference in the nutritional status by age range adolescent girls in Nigeria (n =2261)

Nutritional Status	10 – 13 (n =529) n (%)	14 – 16 (n = 1315) n (%)	17 -19 (n = 417) n (%)	LR X^2	P value
BMI-for-age					
Underweight	73 (13.8)	108 (8.2)	41 (9.8)		
Healthy Weight	414 (78.3)	1108 (84.3)	361 (86.6)	25.148	<0.001[a]
Overweight	27 (5.1)	61 (4.6)	12 (2.9)		
Obese	15 (2.8)	38 (2.9)	3 (0.7)		
WHR					
No Risk$_{ABO}$	190 (35.9)	725 (55.1)	263 (63.1)		
At Risk$_{ABO}$	339 (64.1)	590 (44.9)	154 (36.9)	81.257	<0.001 [a]
WHtR					
ABO Absent	487 (92.1)	1166 (88.7)	383 (91.8)		
ABO Present	42 (7.9)	149 (11.3)	34 (8.2)	6.827	0.033 [a]
WC (cm)					
No Risk	528 (99.8)	1306 (99.3)	417 (100.0)		
At Risk	1 (0.2)	9 (0.7)	-	6.178	0.112
MUAC$_{OW}$ (cm)					
OW Absent	510 (96.4)	1149 (87.4)	336 (80.6)		
OW Present	19 (3.6)	166 (12.6)	81 (19.4)	66.392	<0.001 [a]

ABO = Abdominal Obesity, OW = Overweight, [a] Significant at P<0.05, LR = Likelihood ratio

Table 5. Binary logistic regression analysis showing the odds of overweight/obesity predictors by region, location and age of adolescent girls in Nigeria

Nutritional Status	OR	95% CI	P value
	Region		
BMI (OW/OB)			
North Central (ref)	1.00		
South East	11.341	6.059 -21.228	<0.001
South West	1.558	0.754 - 3.219	0.231
WHR			
North Central (ref)	1.00		
South East	1.351	1.093 – 1.670	0.005
South West	1.085	0.885 – 1.331	0.432
WHtR			
North Central (ref)	1.00		
South East	2.870	1.954 - 4.213	<0.001
South West	1.478	0.985 - 2.216	0.059
MUAC$_{OW}$			
North Central (ref)	0.321	0.234 - 0.442	<0.001
South East	1.00		
South West	0.430	0.315 - 0.586	<0.001
	Location		
BMI (OW/OB)			
Peri-Urban (ref)	1.00		
Urban	1.008	0.728 - 1.395	0.964
WHR			
Peri-Urban (ref)	1.00		
Urban	0.610	0.516 – 0. .720	<0.001
WHtR			
Peri-Urban (ref)	1.00		
Urban	0.992	0.753 - 1.306	0.952
MUAC$_{OW}$			
Peri-Urban (ref)	1.00		
Urban	1.280	0.988 - 1.657	0.061

Table 1 continued

Nutritional Status	OR	95% CI	P value
	Age		
BMI (OW/OB)			
10 – 13 (ref)	1.00		
14 -16	0.944	0.648 – 1.375	0.764
17 -19	0.433	0.236 – 0.792	0.007
WHR			
10 – 13 (ref)	1.00		
14 -16	0.456	0.370 – 0.562	<0.001
17 -19	0.328	0.251 – 0.428	<0.001
WHtR			
10 – 13 (ref)	1.00		
14 -16	1.426	0.970 – 2.097	0.071
17 -19	1.024	0.617 – 1.699	0.928
$MUAC_{OW}$			
10 – 13 (ref)	1.00		
14 -16	3.878	2.385 – 6.305	<0.001
17 -19	6.371	3.854 – 10.865	<0.001

BMI = Body Mass Index, WHR = Waist-to-Hip Ratio, WHtR = Waist-to-Height Ratio, MUAC = Mid-Upper-Arm-Circumference, OW = Overweight, OB = Obese

DISCUSSION

In general, globally, overweight is one of the main challenges in adolescent girls (Lobstein et al., 2015). However, in our sample of urban and peri-urban Nigerian adolescent girls, there was a weight deficit on the average, leading to underweight. Similar studies reported the prevalence of underweight and undernourishment in Osun (Olumakaiye, 2008), Ilorin (Okafor et al., 2014), Lagos (Adegbenga et al., 2017), and Oyo (Omobuwa et al., 2014) in Nigeria. This is not to say that overweight is not a challenge in our sample; rather, there was evidence of a double burden of overweight and underweight among the adolescent girls in these three regions. The coexistence of overweight and underweight can be attributed to socioeconomic disparities, dietary habits, location and lifestyle differences. Urban areas might show higher rates of overweight due to greater access to ultra-processed foods and more sedentary lifestyles. In contrast, peri-urban areas could exhibit a mix of both overweight and underweight, influenced by varying levels of food security, dietary diversity, and physical activity. This has been noted globally: some low- and middle-income countries record a high prevalence of obesity despite continuing high levels of undernutrition (Lobstein et al., 2015).

The prevalence of overweight and obesity has been found to be high in the last decade in Nigeria, as reported in Benue (Musa et.al., 2012), Kano (Yusuf et.al., 2013; Umar et.al., 2018), Ogun (Akinpelu et.al., 2021), Ondo (Mustapha & Sanusi, 2013) and other regions (Ejike, 2014; Oluwasanu et.al., 2023). This can be attributed to a confluence of factors, one of which is the increasing dominance of an obesogenic environment characterised by the shift towards a more sedentary way of life (Kurdaningsih, 2016; Dias et al., 2014; Al-Haifi et al., 2013). With the advent of technology and increased access to electronic devices, learning is shifting to online modules, increasing screen time and further entrenching a sedentary lifestyle (Robinson, 2017; Gamble AL et.al., 2014; Gopalan, 2016). Opportunities for physical activity are limited due to a lack of sports facilities and activities in many schools (Oyeyemi et al., 2016; Cabrera et al., 2014). Furthermore, the availability and exposure to junk foods (Bohara et al., 2021; Aulia et al., 2021) are pivotal in this escalating trend. The proliferation of fast-food options and ultra-processed snacks has created an environment where unhealthy eating habits are reinforced. Additionally, socio-economic factors, dietary patterns, and the influence of media may also contribute to this concerning phenomenon, necessitating a comprehensive understanding of the multifaceted aspects influencing adolescent health in the Nigerian context.

The higher percentage of adolescent girls at risk of abdominal obesity in urban areas reported in this study and other developing countries (Rafraf, 2013; De Moraes et al., 2011; Castro et al., 2016) implies an increased risk of health issues related to excessive abdominal fat, such as diabetes and other obesity-related conditions in later years. This, in turn, suggests a need for targeted interventions to address lifestyle and dietary factors contributing to abdominal obesity in urban settings.

Most studies compare urban and rural (Akhter, 2013; Cordeiro et al., 2021), while the current study compares region and urban vs. peri-urban location. The North Central and South West regions may need attention regarding the prevalence of undernourishment among girls. In contrast, the South East region may need interventions related to abdominal obesity and overweight/obesity.

However, monitoring and adapting interventions based on changing trends and population dynamics are crucial. Intervention programs should focus on comprehensive health education, including awareness about different health indicators. This education should emphasize the importance of maintaining an adequate diet, avoiding ultra-processed food, engaging in regular physical activity, and understanding the implications of different anthropometric measures on health. Recognizing the diversity within regions and locations, interventions should be tailored to each community's specific needs and challenges. Community engagement and involvement are crucial for the success of health promotion initiatives.

CONCLUSION

In this study, there was a significant difference in the nutritional status of adolescent girls across regions and age ranges. However, there was a similarity across locations (urban and peri-urban). The prevalence of OW/OB is gradually increasing among adolescent girls in Nigeria, which coexists with underweight. Researchers and healthcare professionals may find this information valuable for understanding and addressing aspects of adolescent health and well-being.

Given the significant difference in age distribution (10 -19 years) among adolescents, intervention programs should be tailored to address the specific needs and health challenges prevalent in different age groups. Strategies for health education and promotion may need to be region, location and age-specific to effectively reach and engage the target population.

AUTHOR CONTRIBUTIONS

MFO: Conceptualization, formal analysis, funding acquisition, investigation, methodology, supervision, validation, and writing of the original draft. OCN: Investigation, methodology, supervision, validation, and manuscript revision. OCO: Investigation, methodology, supervision, and reviewing the manuscript. OA: Methodology, validation and editing of the manuscript. JA: Methodology, data curation, validation and analysis. BRP: Investigation, project management, data curation and manuscript revision. AG: Methodology and editing of manuscripts. EOA: Supervision, data collection and methodology.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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