Overweight and obesity among female adolescents in Nigeria; an emerging, but under-reported epidemic

Adeleye Abiodun Adeomi[1*] and Nafisat Olayinka Olatunde Lawal[1]

Abstract

Background Overweight and obesity are increasing at epidemic levels in all ages globally, but there is little nationally representative data on female adolescents in Nigeria. The focus on female adolescents is important because of the negative implications of overweight and obesity on their health and survival, and that of their unborn children.

Aim To estimate the prevalence and identify the determinants of overweight and obesity among female adolescents in Nigeria.

Methods Cross-sectional study using data from the Nigeria demographic and health survey, 2018. A total of 2,721 female adolescents aged 15–19 years were selected using cluster sampling technique. Overweight and obesity were determined using BMI-for-age reference values of World Health Organization and different explanatory variables at the individual, household and community levels were included. Binary logistic regression analysis was used to identify the determinants of overweight/obesity using five models.

Results The mean age of the respondents was 16.8 ± 1.4 years. The prevalence rate of overweight/obesity was 10.2%, but with a large variation in the geographical and socio-economic distribution. At the crude/unadjusted rate, nearly all the explanatory variables showed a statistically significant association with overweight and obesity, but at the full model which controlled for all the explanatory variables, only the household wealth index retained its statistically significant association, such that female adolescents who were from richer and richest households had about 3 times higher odds of being obese compared to those from the poorest households. (OR: 2.7; $p = 0.018$; CI: 1.18–6.18), (OR: 2.8; $p = 0.027$; CI: 1.13–7.06) respectively.

Conclusion The prevalence of overweight/obesity among female adolescents in Nigeria was 10.2%. The household wealth index remained the only factor with a statistically significant association with overweight and obesity after controlling for confounders. Efforts at addressing overweight and obesity among female adolescents in Nigeria should target those from the richer/richest households.

Keywords Obesity, Overweight, Female adolescents, Determinants, Nigeria

*Correspondence:
Adeleye Abiodun Adeomi
adeleyeadeomi@gmail.com
[1]Department of Community Health, Obafemi Awolowo University
Teaching Hospitals Complex, Ile-Ife, Osun State, Nigeria

Background

The prevalence of overweight/obesity is rapidly increasing in the low-and-middle-income countries (LMIC), particularly in Africa [1, 2]. For more than four decades, the prevalence of overweight/obesity among adolescents has been increasing rapidly globally, and more importantly in Africa [3, 4]. Research shows that between 1975 and 2016, the prevalence of obesity among children and adolescents (5–19 years) increased by 450% from 4 to 18% [5]. A study conducted among adolescents in seven African countries reported the prevalence of obesity to range from 0.6 to 9.3% [6]. Obesity is linked to more deaths worldwide than under-nutrition and has been projected to become the leading nutritional cause of death among persons in LMIC by 2030 [2]. According to the World Health organization (WHO), Africa is facing an emerging public health problem of obesity, with the prevalence among children and adolescents ranging from 5 to 16.5% [7].

About 20% of the world's populations are adolescents (10–19 years) and more than 85% of them live in LMIC [8, 9]. In Nigeria, about a quarter of the population i.e. an estimated 40 million people are adolescents [10, 11]. Obese adolescents are more likely to become obese adults hence, have higher odds of developing type-2 diabetes and cardiovascular disease. Adolescent overweight/obesity can result in bullying, discrimination and stigmatization with consequent poor school performance and quality of life [12]. Economically, the impact of overweight/obesity is projected to increase from a global gross domestic product (GDP) of 2.19% in 2019 to 3.29% with a global cost more than US$18 trillion by 2060 [13, 14] if current trend continues.

A major challenge with the existing data on adolescent overweight and obesity in Nigeria is the lack of National representativeness. This is particularly important because Nigeria is a very diverse country with socio-economic inequalities across different regions and groups [15]. ' [16] The efforts made at estimating a national prevalence from the existing scattered data has been challenging as different methodologies and reference values were used [17]. Furthermore, only little is known about the determinants. Much of the efforts at understanding the determinants have targeted few individual factors alone [18], and little about household and community factors. Targeting only individual factors may lead to over-estimation of statistical significance, and thus provide erroneous evidence. Understanding the determinants at individual, household and community levels will help to generate more accurate estimates of association and to better understand the roles of the different contextual units, and these will help in designing interventions that are effective in halting/reducing the rising prevalence of adolescent overweight and obesity in Nigeria [18].

The focus on female adolescents is important, firstly because existing studies in Nigeria and sub-Saharan Africa show that female adolescents have a higher burden of overweight and obesity compared to their male counterparts [19–21]. Overweight/obese female adolescents are at higher risk of developing cardiovascular disease, type-2 diabetes, digestive, neurological disorders etc [12]. . Additionally, an obese female adolescent is more likely to be an obese adult [22], which has been found to have negative implications on child birth and survival, and maternal mortality [23, 24]. This study therefore aimed to estimate the prevalence, and identify the determinants of overweight and obesity among female adolescents in Nigeria.

Methodology

Study setting and design

This study used data from the NDHS, 2018 [25], which was a community-based Nationally representative survey, using representative sample from all parts of Nigeria. An added advantage of the NDHS data is that it contains possibly the most comprehensive Nigerian data on individual, household and community factors which makes it possible to identify determinants of female adolescent obesity at these levels. The federal republic of Nigeria (simply called Nigeria) is made of six geo-political zones, with three in the north (Northwest, Northeast and North central) and the other three in the south (Southwest, Southeast and Southsouth). There are a total of 36 states and the Federal Capital Territory, which is the capital of Nigeria. Each of the states is divided into local government areas (LGAs), with a total of 774 LGAs in Nigeria. However, enumeration areas (EAs) were created during the National census of 2006, which are clusters/communities within each of the LGAs. A total of 1,400 clusters/communities were randomly selected across the whole country for the 2018 NDHS and used as the primary sampling units (PSUs) [25].

Sample size and sampling

The sample size for this study was 2,721, which includes non-pregnant female adolescents aged 15 to 19 years. Adolescents between 10 and 14 years were not included because the NDHS has the anthropometric data for 15–19-year-olds alone. Respondents were selected using the two-stage stratified cluster sampling technique. At the first stage, a stratified sample of EAs is selected using proportional allocation, and 20–30 households are selected from each of the selected EAs at the second stage using systematic sampling technique. Sampling weights were applied in the data analysis as appropriate to account for the non-proportional allocation of the sample to the different sub-regions and communities. The research instruments and data collection methods

have been further explained in greater details in the NDHS report [25].

Outcome variable

The outcome/dependent variable for this study is overweight and obesity, which were assessed using the BMI-for-age standard deviation (SD). For the present study, adolescents that were either overweight or obese (i.e. those who had > 1 SD) were coded as 1, while others were coded as 0.

Explanatory variables

The explanatory/independent variables are as explained below.

Individual characteristics

Age The age was categorized into; middle adolescents (15–16 years) and late adolescents (17–19 years).

Educational status This is the highest level of education completed by the respondents, and it was categorized into no education, primary and secondary or higher and coded as 0, 1 and 2 respectively.

Religion This was categorized and coded into Christian (1), Islam (2) and Others (3).

Marital status Respondent's marital status was categorized and coded into; not married (0) and married (1).

Occupational status This refers to the occupational status in the 12 months preceding the survey and it was categorized and coded into those who worked (1) and those who did not (0).

Minimum dietary diversity Dietary diversity was measured using the 24-hour dietary recall. Those who ate or drank food types from a minimum of 5 out of the 10 groups were categorized as having minimum dietary diversity and coded as 1, while those with less than 5 were categorized as Others and coded as 0.

Household characteristics

Number of Household members The usual household members (without the visitors) were categorized into and coded as; 1 to 5 household members (1), 6–10 household members (2), and more than 10 members (3).

Household wealth index This was derived by using principal component analysis to generate a wealth index score from selected household possessions and housing characteristics [25]. Using quintiles, the wealth index score was categorized and coded as into; Poorest (1), Poorer (2), Middle (3), Richer (4), and Richest (5).

Community characteristics

Region This was categorized and coded as North central (1), North east (2), North West (3), South east (4), South South (5), and South west (6).

Place of residence Respondent's place of residence was categorized into Urban and Rural and coded as 1 and 2 respectively.

Community education The median value for the proportion of female adolescents who had a minimum of secondary education in each primary sampling unit was used to divide them into those with Low level of maternal education and High level of maternal education. Low level of maternal education was coded as 1, while and High level of maternal education was coded as 2.

Community wealth level The median value of the proportion of households in the highest wealth index (i.e. richer and richest households) was used to divide them into those with Low community wealth level and those with High community wealth level. These were coded as 1 and 2 respectively.

Data analysis

Data were analyzed using STATA version 17. Descriptive analysis was done for all the variables, and tests of association was done at the bivariate level using the chi-squared test. Binary logistic regression analysis was used at the multi-variate level to control for confounders and identify the factors associated with adolescent overweight/obesity. A total of 5 models were fitted, with adolescent overweight/obesity being the dependent variable. The first model (Model 0) was the empty model consisting of the unadjusted rates, Model 1 adjusted for individual characteristics of the adolescents alone, Model 2 adjusted for the household characteristics alone, Model 3 adjusted for the community characteristics alone and Model 4 was the full model that adjusted for all the explanatory variables. Adjusted odd ratios were used at 95% confidence interval, with statistical significance set at $p < 0.05$.

Results

Figure 1 shows the prevalence of overweight/obesity among female adolescents and 10.2% of the female adolescents were overweight/obese (Fig. 1). The description of the explanatory variables is shown in Table 1, with 1182 (43.4%) middle adolescents (15–16 years) and 1539 (56.6%) late adolescents (17–19 years), (mean age = 16.8 ± 1.4 years).

At the bivariate level, prevalence of overweight and obesity was significantly higher among respondents who had secondary/higher education (13.4%, $p < 0.001$), Christians (13.8%, $p < 0.001$) those who were never/formally
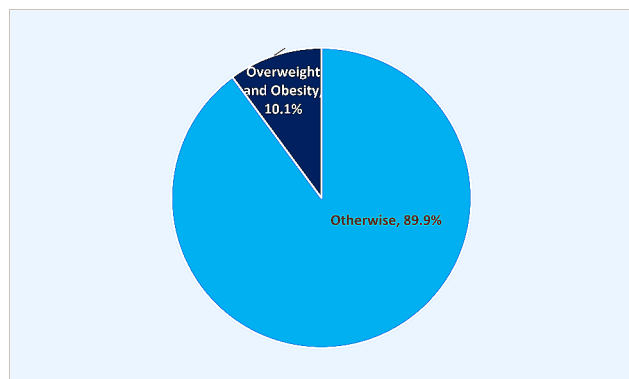
Fig. 1 Overall prevalence of adolescent overweight and obesity in Nigeria

in a union (11.3%. $p=0.002$), richest households (17%, $p<0.001$), urban residence (14%, $p<0.001$), South-south region (16.9%, $p<0.001$), communities with high level of education (13.9%, $p<0.001$) and communities with high wealth level (14.8%), compared to others. (Table 2).

At the multi-variate level, there were statistically significant associations ($p<0.05$) between overweight/obesity and most of the explanatory variables in the crude/unadjusted model (Model 0), except for age, occupation, dietary diversity and number of household members. Model 1 adjusted for individual characteristics alone, and at this level overweight/obesity had statistically significant associations with educational status alone, such that female adolescents with secondary/higher educational status had 3 times higher odds of being obese (OR: 3.0; $p<0.001$; CI: 1.59–5.82) compared to those with less than secondary education. Household wealth index was the only predicator of overweight/obesity in Model 2 which adjusted for household characteristics alone. It was such that respondents from poorer and middle households had about 3 times higher odds for obesity (OR: 2.6; $p=0.005$; CI: 1.34–4.94), (OR: 2.8; $p=0.002$; CI: 1.47–5.22) respectively, while those from richer and richest households had 6 and 7 times higher odds for overweight/obesity (OR: 6.4; $p<0.001$; CI: 3.41–11.84), (OR: 7.2; $p<0.001$; CI: 3.93–13.07) respectively, compared to those from poorest households. In Model 3 which adjusted for community characteristics alone, rural dwellers had 70% less odds of having obesity compared to urban dwellers (OR: 0.7; $p=0.046$; CI: 0.52–0.99) while those from wealthier communities had 2 times higher odds for obesity compared to those from less wealthy communities (OR: 1.8; $p<0.001$; CI: 1.30–2.59). Model 4 is the full model that adjusted for all explanatory variables, the only variable that retained its statistically significant association with overweight/obesity was the household wealth index such that female adolescents who were from richer and richest households had about 3 times higher odds of being overweight/obese compared to those from the poorest

households. (OR: 2.7; $p=0.018$; CI: 1.18–6.18), (OR: 2.8; $p=0.027$; CI: 1.13–7.06) respectively. (Table 3)

Discussion

To the best of the knowledge of the authors, this study presents de-novo nationally representative data on overweight and obesity among female adolescents in Nigeria. Another strength of the study is how it controlled for a wide range of individual, household and community factors while identifying the determinants of overweight/obesity among the respondents.

The study found that about 10% of the female adolescents were overweight/obese. While some of the existing studies reported similar prevalence rate of obesity among Nigerian adolescents [19, 20, 26–31], a systematic review in Nigeria put the range between 1 −11.4% [17]. Comparison to the existing studies in Nigeria is challenging because of the varying methodologies, and reference values used to define overweight and obesity, which might be responsible for the very wide range of the reported prevalence rates of adolescent obesity in Nigeria. While the prevalence rate in the present study is lower than what has been found in many high income countries [32, 33], it is similar to what was has been by Studies from other LMIC [6, 34]. The implication of this finding is that the prevalence rate of overweight/obesity among female adolescents in Nigeria is relatively high, despite the high burden of under-nutrition that has also been reported among children and adolescents in Nigeria [35].

While the prevalence of overweight/obesity among female adolescents in Nigeria may seem relatively low compared to the global average, i.e10% vs. 18% [5], some factors make this prevalence a cause for concern. Firstly, the prevalence of overweight/obesity among female adolescents (10.2%) is 500% more than that of female under-five children (1.9%), in the same NDHS, 2018 survey [25]. This rapid rise in the prevalence of overweight/obesity among adolescents, and female adolescents particularly needs to be properly investigated and addressed. Furthermore, while overweight/obesity has negative health implications for both sexes, it is particularly more so among females and their unborn child [23, 24]. Female obesity increases the risk of cardiovascular disease, type-2 diabetes, digestive and psychological disorders, maternal morbidity and mortality [12, 14]. It also increases the risk of congenital abnormalities, macrosomia and death in newborn children of obese mothers [36].

Another point of concern is the inequalities in the distribution, such that the rate in the South-South region and the richest households is 17% (close to the global average of 18%), while the poorest and poorer households have less than 3%, and rural communities, North-east and North-west regions have a rate of 6%. These inequalities

Table 1 Descriptive statistics of the explanatory variables (*N* = 2,721)

Variables	Frequency	Percent
Individual Characteristics		
Age (in years)		
Middle adolescents (15–16 years)	1182	43.4
Late adolescents (17–19 years)	1539	56.6
Mean	16.8 ± 1.4 years	
Educational status		
No education	683	25.1
Primary	297	10.9
Secondary or higher	1741	64
Religion		
Christianity	1127	41.4
Islam	1578	58
[a]Others	16	0.6
Marital Status		
Never/formerly in union	2095	77
Currently in union	626	23
Occupational status (last 12 months)		
Didn't work	1672	61.5
Worked	1049	38.5
Minimum dietary diversity		
Others	1246	45.8
Minimum dietary diversity	1475	54.2
Household Characteristics		
Number of usual household members (n = 2693)		
1–5	1066	39.6
6–10	1207	44.8
> 10	420	15.6
Household wealth index		
Poorest	466	17.1
Poorer	552	20.3
Middle	586	21.5
Richer	570	21
Richest	547	20.1
Community Characteristics		
Place of residence		
Urban	1218	44.8
Rural	1503	55.2
Region		
North central	391	14.4
North east	527	19.4
North west	834	30.6
South east	298	10.9
South south	307	11.3
South west	364	13.4
Community educational level		
Low	1408	51.7
High	1313	48.3
Community wealth level		
Low	1370	50.4
High	1351	49.6

[a]*The others here represent traditional worshippers and atheists*

Table 2 Distribution of the explanatory variables across overweight/obesity categories (N = 2721)

	Otherwise		Overweight /Obese		N	Statistics
	%	95% CI	%	95% CI		
Individual Characteristics						
Age (in years)						
15–16 years	89.4	87.1, 91.4	10.6	8.6, 12.9	1,182	$x^2 = 0.5253$
17–19 years	90.2	87.8, 92.3	9.8	7.7, 12.2	1,539	$p = 0.616$
Educational status						
No education	95.8	93.5, 97.3	4.2	2.7, 6.5	683	$x^2 = 58.8669$
Primary education	95.5	92.3, 97.4	4.5	2.6, 7.7	297	**$p < 0.001$***
Secondary or higher	86.6	84.3, 88.6	13.4	11.4, 15.7	1,741	
Religion						
Christianity	86.2	83.7, 88.4	13.8	11.6, 16.3	1,128	$x^2 = 29.2082$
Islam	92.5	90.2, 94.3	7.5	5.7, 9.8	1,578	**$p < 0.001$***
Others	89.9	70.0, 97.1	10.1	2.9, 30.0	16	
Marital Status						
Never or formerly in union	88.7	86.8, 90.3	11.3	9.7, 13.2	2,095	$x^2 = 14.6861$
currently in a union	93.9	91.2, 95.8	6.1	4.2, 8.8	626	**$p = 0.002$***
Occupational status (last 12 months)						
Otherwise	90.1	88.2, 91.6	9.9	8.4, 11.8	1,673	$x^2 = 0.1625$
Worked	89.6	86.2, 92.2	10.4	7.8, 13.8	1,049	$p = 0.792$
Minimum dietary diversity						
No	89.9	86.9, 92.2	10.1	7.8, 13.1	1,246	$x^2 = 0.0001$
Yes	89.9	87.8, 91.6	10.1	8.4, 12.2	1,475	$p = 0.996$
Household Characteristics						
Number of usual household members (n = 2693)						
1–5	90.8	88.4, 92.8	9.2	7.2, 11.6	1,066	$x^2 = 4.8594$
6–10	88.6	85.9, 90.8	11.4	9.2, 14.1	1,207	$p = 0.202$
>10	91.6	88.0, 94.2	8.4	5.8, 12.0	420	
Household wealth index						
Poorest	97.3	95.6, 98.3	2.7	1.7, 4.4	466	$x^2 = 87.6655$
Poorer	92.9	89.8, 95.1	7.1	4.9, 10.2	552	**$p < 0.001$***
Middle	92.7	89.6, 95.0	7.3	5.0, 10.4	586	
Richer	84.5	78.8, 89.0	15.5	11.0, 21.2	570	
Richest	83	78.2, 86.9	17	13.1, 21.8	547	
Community Characteristics						
Place of residence						
Urban	86	83.2, 88.5	14.0	11.5, 16.8	1,219	$x^2 = 36.7896$
Rural	93	91.3, 94.4	7.0	5.6, 8.7	1,503	**$p < 0.001$***
Region						
North Central	90.6	87.4, 93.1	9.4	6.9, 12.6	391	$x^2 = 62.9847$
North East	94	91.3, 95.9	6.0	4.1, 8.7	527	**$p < 0.001$***
North West	93.8	91.1, 95.7	6.2	4.3, 8.9	834	
South East	84.4	79.8, 88.1	15.6	11.9, 20.2	298	
South South	83.1	76.9, 87.9	16.9	12.1, 23.1	308	
South West	84.4	77.6, 89.4	15.6	10.6, 22.4	364	
Community educational level						
Low	93.4	91.0, 95.2	6.6	4.8, 9.0	1,408	$x^2 = 40.9649$
High	86.1	83.6, 88.2	13.9	11.8, 16.4	1,313	**$p < 0.001$***
Community wealth level						
Low	94.5	92.8, 95.8	5.5	4.2, 7.2	1,370	$x^2 = 65.9885$
High	85.2	82.5, 87.6	14.8	12.4, 17.5	1,351	**$p < 0.001$***

* Statistically significant; CI – confidence interval; x^2 – chi-squared test; p – p-value

Table 3 Determinants of overweight/obesity among female adolescents in Nigeria using logistic regression analysis (*N* = 2721)

	Model 0			Model 1			Model 2			Model 3			Model 4		
	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI
Individual Characteristics															
Age (in years)															
15–16 years (R)															
17–19 years	0.9	0.616	0.64, 1.30	0.9	0.644	0.64, 1.32							0.9	0.505	0.61, 1.28
Educational status															
No education (R)															
Primary education	1.1	0.846	0.54, 2.10	1.0	0.890	0.45, 1.99							0.6	0.291	0.26, 1.49
≥ Secondary	3.5	**<0.001***	2.13, 5.83	3.0	**0.001***	1.59, 5.82							1.8	0.122	0.85, 3.98
Religion															
Christian (R)															
Islam	0.5	**<0.001***	0.35, 0.73	0.7	0.149	0.47, 1.12							1.0	0.937	0.59, 1.63
Others	0.7	0.610	0.18, 2.72	0.9	0.833	0.24, 3.15							0.8	0.806	0.20, 3.52
Marital Status															
Not married (R)															
Married	0.5	**0.002***	0.33, 0.78	1.0	0.951	0.60, 1.74							1.2	0.632	0.64, 2.07
Occupational status															
Otherwise (R)															
Worked	1.1	0.792	0.72, 1.55	1.1	0.514	0.77, 1.67							1.2	0.405	0.80, 1.71
Minimum dietary diversity															
No (R)															
Yes	1.0	0.996	0.69, 1.46	0.9	0.642	0.62, 1.35							0.9	0.516	0.57, 1.32
Household Characteristics															
Number of usual household members (*n* = 2693)															
1–5 (R)															
6–10	1.3	0.171	0.90, 1.82				1.1	0.538	0.79, 1.56				1.1	0.571	0.77, 1.62
>10	0.9	0.683	0.57, 1.44				0.9	0.548	0.53, 1.40				1.1	0.811	0.63, 1.79
Household wealth index															
Poorest (R)															
Poorer	2.7	**0.002***	1.45, 5.20				2.6	**0.005***	1.34, 4.94				2.0	0.053	0.99, 4.21
Middle	2.8	**0.001***	1.50, 5.29				2.8	**0.002***	1.47, 5.22				1.6	0.252	0.72, 3.48
Richer	6.6	**<0.001***	3.52, 12.3				6.4	**<0.001***	3.41, 11.84				2.7	**0.018***	1.18, 6.18
Richest	7.4	**<0.001***	4.07, 13.3				7.2	**<0.001***	3.93, 13.07				2.8	**0.027***	1.13, 7.06
Community Characteristics															
Place of residence															
Urban (R)															
Rural	0.5	**<0.001***	0.34, 0.64							0.7	**0.046***	0.52, 0.99	0.8	0.233	0.56, 1.15
Region															
North Central (R)															

Table 3 (continued)

	Model 0			Model 1			Model 2			Model 3			Model 4		
	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI
North East	0.6	0.074	0.37, 1.05							0.7	0.209	0.41, 1.22	0.8	0.337	0.43, 1.33
North West	0.6	0.089	0.38, 1.07							0.7	0.164	0.41, 1.16	0.8	0.350	0.43, 1.35
South East	1.8	0.013*	1.12, 2.83							1.3	0.243	0.83, 2.11	1.4	0.266	0.78, 2.41
South South	2.0	0.010*	1.18, 3.29							1.5	0.112	0.91, 2.61	1.5	0.196	0.81, 2.76
South West	1.8	0.039*	1.03, 3.13							1.2	0.512	0.69, 2.12	1.2	0.595	0.62, 2.27
Community educational level															
Low (R)															
High	2.3	<0.001*	1.55, 3.38							1.2	0.433	0.77, 1.84	0.8	0.413	0.50, 1.33
Community wealth level															
Low (R)															
High	3.0	<0.001*	2.11, 4.17							1.8	0.001*	1.30, 2.59	1.2	0.443	0.72, 2.13

R- reference variable; * Statistically significant; CI – confidence interval; p – p-value

Model 0 is the empty model showing crude/unadjusted rates; Model 1 adjusted for individual characteristics alone; Model 2 adjusted for the household characteristics alone; Model 3 adjusted for community characteristics alone; while Model 4 is the full model that adjusted for all the explanatory variables

have been similarly reported by previous similar studies [35, 37], and may be a reflection of deeper inequalities existing in the socio-economic and regional structures in Nigeria that need to be addressed. The implication of this is that blanket interventions may not work for the whole country/sub-regions, hence proposed interventions will need to be contextual [18, 38].

After controlling for possible individual, household and community level confounding factors, the only factor that retained its statistically significant association with overweight/obesity was the wealth index. The finding of this study corroborates the findings of several previous studies which have found that socio-economic status, measured by the wealth index in this study, is a determinant of overweight/obesity among different age groups [39–41]. However, other studies done within and outside Nigeria have reported other determinants, in addition to household wealth index [18, 41–43], which in this study turned out to be merely confounders. This finding is important for policy makers and stakeholders, because it implies that it may be more effective (including cost-effectiveness) for interventions against overweight and obesity among female adolescents in Nigeria to target adolescents from richer/richest households.

A major limitation of this study is the exclusion of adolescents aged 10–14 years, because this would have given a broader perspective about female adolescent overweight/obesity in Nigeria. Another limitation of this study is reporting and recall bias, particularly the 24-hour dietary recall and other retrospective data relying on memory of a past event. Furthermore, there is an on-going debate on the use of BMI as a measure of obesity such that BMI is described as only a measure of excessive weight rather than excessive body fat. BMI purportedly does not differentiate excess fat, muscle, or bone mass nor provide any indication of the distribution of fat among adolescents. However, BMI was used here because it is still the most commonly used measure [44]. The NDHS contains the most comprehensive Nigerian data on individual, household and community factors [25], and this makes it possible to identify determinants of adolescent overweight/obesity at these levels. However, the NDHS 2018 that was used for this study is a little dated now, even though it is the most current NDHS in Nigeria presently. This is especially so because of the effect of COVID pandemic (which occurred after this study) on the socio-economic factors, which might have affected the present reality as regards overweight/obesity among female adolescents in Nigeria.

Conclusion

The study found the prevalence of overweight/obesity to be 10.2%, and also found geographical and socio-economic inequalities in the distribution of overweight/

obesity among female adolescents in Nigeria. After controlling for possible confounders at individual, household and community levels, the household wealth index remained the only factor with a statistically significant association with overweight/obesity among the respondents. Efforts at addressing overweight and obesity among female adolescents in Nigeria should target those from the richer/richest households.

Abbreviations

BMI	Body mass index
CI	Confidence interval
EA	Enumeration Area
HIC	High Income Countries
LGA	Local Government Areas
LMIC	Low- and middle-income countries
NDHS	Nigeria Demographic and Health Survey
OR	Odds ratio
PSU	Primary Sampling Unit
SD	Standard Deviation
WHO	World Health Organization

Data availability
The datasets used and/or analyzed during the current study are freely available at the demographic and health survey (DHS) website (https://dhsprogram.com/).

Declarations

Ethics approval and consent to participate
Ethical clearance was obtained for the NDHS 2018, and it was not necessary to collect an additional ethical clearance for the present study because it used de-identified secondary data from the NDHS 2018 [25].
Ethical approval was obtained by the Ethics Committee of the ICF Macro at Calverton in the USA in conjunction with the National Ethics Committee of the Federal Ministry of Health in Nigeria (ethics approval number: NHREC/01/01/2007). In accordance with the Nuremberg code and the Declaration of Helsinki, the principles of informed consent, respect for participants, fair subject selection, and favourable risk-benefit ratio were followed, and written informed consent was obtained from all respondents, and from the parents of respondents less than 18 years. Additionally, assent was obtained from those less than 18 years.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

References
1. Chukwuonye II, Ohagwu KA, Ogah OS, John C, Oviasu E, Anyabolu EN, et al. Prevalence of overweight and obesity in Nigeria: systematic review and meta-analysis of population-based studies. PLOS Glob Public Heal. 2022;2:e0000515.
2. Ellulu M, Abed Y, Rahmat A, Ranneh Y, Ali F. Epidemiology of obesity in developing countries: challenges and prevention. Glob Epidemic Obes. 2014;2:2.
3. Popkin BM, Slining MM. New dynamics in global obesity facing low- and middle-income countries. Obes Rev. 2013;14:11–20.
4. Kengne AP, Bentham J, Zhou B, Peer N, Matsha TE, Bixby H, et al. Trends in obesity and diabetes across Africa from 1980 to 2014: an analysis of pooled population-based studies. Int J Epidemiol. 2017;46:1421–32.
5. Bentham J, Di Cesare M, Bilano V, Bixby H, Zhou B, Stevens GA, et al. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet. 2017;390:2627–42.
6. 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;28(14):887.
7. World Health Organization. Obesity rising in Africa, WHO analysis finds. https://www.afro.who.int/news/obesity-rising-africa-who-analysis-finds. 2022.
8. Guthold R, Moller A-B, Azzopardi P, et al. The Global Action for Measurement of adolescent health (GAMA) Initiative D Rethinking Adolescent Metrics. J Adolesc Heal. 2019;64:697–9.
9. Shinde S, Harling G, Assefa N, Bärnighausen T, Bukenya J, Chukwu A, et al. Counting adolescents in: the development of an adolescent health indicator framework for population-based settings. eClinicalMedicine. 2023;61:102067.
10. Cortez R, Saadat S, Marinda EOO. Adolescent sexual and reproductive health in Nigeria. Nutr. Popul. Glob. Pract. Knowl. Br. 2015.
11. WHO-Africa. Country profile: adolescent health in Nigeria. Accessed from https://www.afro.who.int/sites/default/files/2019-08/6%20Nigeria%20AH18052018.pdf
12. World Health Organization, Obesity. and Overweight. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight. 2024.
13. Okunogbe A, Nugent R, Spencer G, Powis J, Ralston J, Wilding J. Economic impacts of overweight and obesity: current and future estimates for 161 countries. BMJ Glob Heal. 2022;7:1–17.
14. Abbafati C, Abbas KM, Abbasi-Kangevari M, Abd-Allah F, Abdelalim A, Abdollahi M, et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the global burden of Disease Study 2019. Lancet. 2020;396:1223–49.
15. Mayowa R. Regional imbalances and inequalities in Nigeria: causes, consequences and remedies. Res Hum Soc Sci 2016;4(18):63–175.
16. Madu IA. Spatial inequality in Nigeria: the imperative of Geographic perspectives in the development process. J Soc Econ Dev. 2006;8:105–20.
17. Ejike CCC. Child and adolescent obesity in Nigeria: A narrative review of prevalence data from three decades (1983–2013). J Obes Metab Res [Internet]. 2014 [cited 2018 Mar 12];1:174. http://www.jomrjournal.org/text.asp?2014/1/3/174/141150
18. Adeomi AA, Fatusi A, Klipstein-grobusch K. Individual and contextual factors associated with under- and over-nutrition among school-aged children and adolescents in two Nigerian states: a multi-level analysis. Public Health Nutr. 2022;25:2339–51.
19. Raimi T, Oluwayemi I, Oluwayemi M. Predictors of obesity among adolescents in Ekiti State, Nigeria. Glob J Endocrinol Metab. 2018;2:11–4.
20. Maruf FA, Aronu U, Chukwuegbu K, Aronu AE. Influence of gender on prevalence of overweight and obesity in Nigerian schoolchildren and adolescents. Tanzan J Health Res. 2013;15:1–6.
21. Fruhstorfer BH, Mousoulis C, Uthman OA, Robertson W. Socio-economic status and overweight or obesity among school-age children in sub-saharan Africa - a systematic review. Clin Obes. 2016;6:19–32.
22. Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. Obes Rev. 2016;17(2):95–107.
23. Elizondo-montemayor L, Hernández-escobar C, Lara- E. Gynecologic and Obstetric Consequences of Obesity in adolescent girls. J Pediatr Adolesc Gynecol. 2016.
24. Galliano D, Bellver J. Female obesity: short- and long-term consequences on the offspring. Gynecol Endocrinol. 2013;29:626–31.

25. National Population Commission (NPC). Nigeria and ICF. Nigeria Demographic and Health Survey 2018. Abuja, Niger. Rockville, Maryland, USA NPC ICF. Abuja, Nigeria and Rockville. Maryland, USA: NPC and ICF: NPC and ICF; 2019.
26. Ene-Obong H, Ibeanu V, Onuoha N, Ejekwu A. Prevalence of overweight, obesity, and thinness among urban school-aged children and adolescents in southern Nigeria. Food Nutr Bull. 2012;33:242–50.
27. Akinpelu AO, Oyewole OO, Oritogun KS. Overweight and Obesity: Does It Occur In Nigerian Adolescents in an Urban Community? Int J Biomed Heal Serv [Internet]. 2008;4:11–7. http://www.asopah.org
28. Sabageh AO, Ojofeitimi EO. Prevalence of obesity among adolescents in ile – ife, Osun state, Nigeria using body mass index and waist hip ratio: a comparative study. Niger Med J 2013;54(3):153–6.
29. Muhammad S, Mijinyawa SMY. Overweight and obesity among adolescents in Kano, Nigeria. J Metab Syndr. 2013;02:1–5.
30. Oduwole AA, Ladapo TA, Fajolu IB, Ekure EN, Adeniyi OF. Obesity and elevated blood pressure among adolescents in Lagos, Nigeria: A cross-sectional study. BMC Public Health [Internet]. 2012 [cited 2018 Apr 5];12:1. http://www.biomedcentral.com/1471-2458/12/616
31. Agu NV, Okeke KN, Echendu ST, Onubogu CU, Ebenebe JC, Ulasi TO et al. Socio-demographic factors associated with obesity among adolescents in secondary school in Onitsha, South East Nigeria. Open J Endocr Metabol Dis. 2023;13(7):85–106.
32. Hales CM, Carroll MD, Fryar CD, Ogden CL, Ph D. Prevalence of obesity among adults and youth: United States, 2015–2016. 2017;288:1–8.
33. Schwarz SW, Peterson J. Adolescent obesity in the United States facts for policymakers. 2010. Accessed from https://www.nccp.org/wp-content/uploads/2020/05/text_977.pdf
34. Kac G, Velásquez-Melendez G, Schlüssel MM, Segall-Côrrea AM, Silva AA, Pérez-Escamilla R. Severe food insecurity is associated with obesity among Brazilian adolescent females. Public Health Nutr. 2012;15:1854–60.
35. 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 Res. 2021;4:38.
36. Correa A, Marcinkevage J. Prepregnancy obesity and the risk of birth defects: an update. Nutr Rev. 2013;71:S68–77.
37. Adekanmbi VT, Kayode GA, Uthman OA. Individual and contextual factors associated with childhood stunting in Nigeria: a multilevel analysis. Matern Child Nutr. 2013;9:244–59.
38. Qi X, Locke J, Rehman S. Childhood and adolescent obesity in the United States: a public health concern. Glob Pediatr Health. 2019;6:2333794X19891305.
39. Chigbu CO, Parhofer KG, Aniebue UU, Berger U. Prevalence and sociodemographic determinants of adult obesity: a large representative household survey in a resource-constrained African setting with double burden of undernutrition and overnutrition. J Epidemiol Community Health 2018;72:702–7. https://doi.org/10.1136/jech-2018-210573
40. Adeomi AA, Akande RO, Olodu MD, Obiajunwa C, Oduntan O, Ogbukwo E. Cardiometabolic risk and its association with dietary diversity, activity patterns and the nutritional status of workers in tertiary educational institutions in. Southwestern Nigeria. Nigeria J Health Sci. 2022;21(1):13–8.
41. Tesfaw LM. Wealth index and other behavioral and sociodemographic characteristics associated with body mass index in Ethiopia. SAGE Open Med. 2021. https://doi.org/10.1177/20503121211016156
42. Brahmbhatt M. Social and physical determinants of obesity in adults. Adv Obes Weight Manag Control. 2017;6(1):17–23.
43. Agyemang K, Pokhrel S, Victor C, Anokye NK. Determinants of obesity in West Africa. A Systematic Review; 2021. https://doi.org/10.1101/2021.04.27.21255462
44. Adab P, Pallan M, Whincup PH, Is. BMI the best measure of obesity? BMJ [Internet]. 2018;360:15–6. https://doi.org/10.1136/bmj.k1274

Publisher's Note