Obesity among Non-Pregnant Women in the 36 States and Federal Capital Territory of Nigeria; Sub-National Variation of a National Epidemic

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ABSTRACT

Background: Various studies have reported the national prevalence of obesity in Nigeria; however, data on the sub-national variation is scarce.

***Objective:** This study aimed to investigate the sub-national distribution and variation of obesity among non-pregnant women of reproductive age in Nigeria.*

***Methods:** Nationally, representative data from the 2018 Nigeria Demographic and Health Survey (NDHS) was used to select 13,180 women of reproductive age from all the states, through a two-stage cluster sampling technique. Obesity was determined using the World Health Organization reference values for older adolescents and others. Sub-national variation was determined with binary logistic regression analysis using unadjusted and adjusted rates, and adjustment was made for individual, household and community level factors. A p-value of less than 0.05 was considere statistically significant.*

***Results:** The mean age of respondents was 29.5 ± 9.7 years, and there was mostly an even distribution of respondents across the States. The obesity prevalence among women of reproductive age was 28.5% with the burden generally higher among the southern states, compared to the northern states. Also, after adjusting for risk factors, two-thirds of the states still had a statistically significant variation in the prevalence of obesity.*

***Conclusion:** Given that sub-national variations do exist in the obesity prevalence among women of reproductive age in Nigeria, even after adjusting for commonly reported predictors, there is a need to identify state-level determinants of obesity, intending to design state-specific interventions to address this problem.*

Keywords: Obesity; women of reproductive age; determinants; sub-national variation

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INTRODUCTION

Obesity is a complex, multifactorial disease arising from a dysfunctional energy balance reinforced by an interplay of biological, social, cultural and economic factors (1–3). According to the World Health Organization (WHO), the disease has been viewed as a pandemic, affecting not less than 650 million adults in 2016 (4), with more than half occurring among women (5). In sub-Saharan Africa, despite persistent challenges with underweight, the obesity prevalence rose by 13% from the year 2000 to 2016, affecting an estimated 416 million people (6,7). This phenomenon has led to a double burden of malnutrition in the sub-region (8,9).

Women of reproductive age are disproportionately affected by obesity due to biological peculiarities with the female sex (6), poor physical activity (6,10), lower socioeconomic status (11), and sociocultural beliefs that promote weight gain (12). These patterns, further reinforced by demographic and nutritional transitions (6,11,13), have led to a rising prevalence in many developing countries with attendant implications throughout the life course of women. Maternal obesity has been significantly associated with increased risk of chronic disease (4). Furthermore, obesity predisposes pregnant women to increased perinatal risks and other complications that ultimately may contribute to maternal death (14,15). Additionally, babies born to obese mothers are also at an increased risk of obesity (4).

The majority of the studies on obesity among women in Nigeria have been scattered studies, but a few have been nationally representative giving national perspectives on the prevalence and determinants of obesity among women in Nigeria (16–18). However, most of the studies have been silent on the sub-national variations in the distribution of maternal obesity in Nigeria. Having the sub-national perspective is important because the national prevalence may not be a true reflection of the reality existing in various parts of the country. Nigeria is a diverse nation across ethnic, cultural, religious, socio-economic, sub-national and regional lines (19). Understanding the various contexts will help to design effective interventions that may help to address the rising prevalence of obesity among women in Nigeria.

Furthermore, the majority of the health-related policies and interventions in Nigeria are developed and/or implemented at the sub-national level. Nigeria, being a federal republic, has federating units that function independently of each other (19). Investigating the sub-national variation is therefore important for revenue allocation nationally, and the development/implementation of helpful interventions. Additionally, most agencies and funding for women's health/nutrition are domiciled and operate independently within the States. Hence, state-specific data may be a better reference if there is significant sub-national variation in obesity prevalence among women. This study, therefore, aimed to investigate the sub-national distribution and variation of obesity among non-pregnant women of reproductive age in Nigeria.

MATERIALS AND METHODS

Study Location

The study was carried out in the Federal Republic of Nigeria which is broadly divided into the northern and southern regions, with six geo-political zones. It has 36 states and the Federal Capital Territory (FCT). The states are divided into a total of 774 local government areas.

Study Design and Population

The study was a community-based cross-sectional study among non-pregnant women of reproductive age (15 – 49 years) in all the states and the FCT. A total of 13,180 women were selected using a two-stage cluster sampling technique. The study used secondary data from the NDHS 2018, and more details about the methodology are contained in the report(20).

Outcome Variables

The outcome variable for this study is obesity, measured using the body mass index (BMI) for those 20 years and above, and the BMI-for-age reference values for those below 20 years. Those who were overweight/obese in the 2 age groups were coded as 1 (obesity), while others were coded as 0.

Explanatory Variables

The main explanatory variable is the states, as listed in Table 1 below. To investigate if there is a statistically significant sub-national variation, a wide range of common associated factors at individual, household, and community levels were adjusted for, which are also listed in Table 1 below. Regions were removed because of multi-collinearity. Two community-level variables, namely state educational level and state wealth levels, were derived. The state education level was derived by finding the proportion of women who had secondary education or higher in the states and finding the overall median value. The states were categorised into low or high levels if they had below the median or ≥ median, respectively. Similarly, the proportion of women from the richer and richest households was derived, and the median was calculated. States with proportions below the median or ≥ median were categorised as low or high state wealth levels respectively.

Data Analysis

Data were analysed using STATA version 17 (Stata Corporation, College Station, Texas, USA). A descriptive analysis of all the variables was done and presented in Table 1 below. The distribution of obesity according to the states was done and represented graphically (Figures 2 and 3). Table 2 shows the variation of obesity sub-nationally after varying levels and adjustments (five models) using binary logistics regression analysis. Model 0 showed the unadjusted rates, while Models 1, 2 and 3 adjusted for individual, household and community-level factors, respectively. Model 4 is the full model that is adjusted for all the explanatory variables together.

RESULTS

The national prevalence rate of obesity among non-pregnant women of reproductive age was 28.5%, (Figure1) but this ranged widely from 6.9% in Sokoto to 54.6% in Anambra (Range: 47.7%) (Figure 2). Eighteen of the states had prevalence rates higher, while the remaining 19 states had prevalence rates lower than the national prevalence rate (Figure 2).

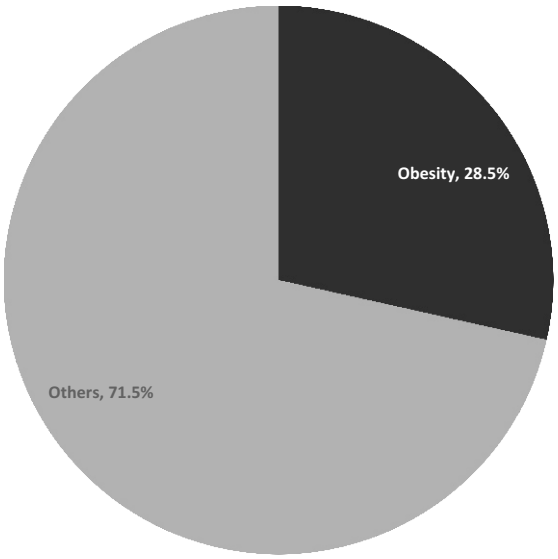

Figure 1: National Prevalence of Obesity among non-pregnant women of reproductive age in Nigeria

Three states with the highest burdens were in the southern part of the country: Anambra (54.6%), Lagos (51.0%) and Rivers (47.9%). On the other hand, three states with the lowest burdens, Sokoto (6.9%), Yobe (7.9%) and Jigawa (8.1%), all had prevalence rates of less than 10% and were all in the northern part of the country (Figures 2 and 3). Except for Ebonyi State (20.8%) and Ondo (28.2%), all other 17 states with prevalence rates lower than the National average were all Northern States. (Figures 2 and 3)

Figure 3: Map of Nigeria showing the sub-national prevalence of Obesity among non-pregnant women of reproductive age in Nigeria

Table 1 shows the descriptive analysis of the explanatory variables, with the mean age of respondents being 29.5 ± 9.7 years. Table 2 shows the sub-national variation of obesity among the respondents after adjusting for possible associated factors using logistic regression analysis. In the unadjusted model (Model 0), apart from Jigawa (OR: 1.2; p=0.642; 95% CI: 0.6, 2.6) and Yobe (OR: 1.2; p=0.740; 95% CI: 0.5, 2.9) that had no statistically significant variation with the reference state (Sokoto), all other states varied significantly in their prevalence of obesity, with all of them having higher odds for obesity than the reference state. Respondents from Anambra (OR: 16.3; p<0.001; 95% CI: 8.8, 30.1), Lagos (OR: 14.1; p<0.001; 95% CI: 8.0, 25.1) and Rivers (OR: 12.5; p<0.001; 95% CI: 6.9, 22.6) had 16 times, 14 times and 13 times higher odds of obesity compared to Sokoto respectively.

After adjusting for individual characteristics (Model 1), all the states that had statistically significant variation at Model 0 retained significant associations except for Borno (OR: 1.7; p=0.112; 95% CI: 0.9, 3.4) and Ebonyi (OR: 1.5; p=0.197; 95% CI: 0.8, 2.9). However, the odds for obesity in the three highest burden states of Anambra (OR: 2.2; p<0.001; 95% CI: 3.8, 13.2), Lagos (OR: 6.5; p<0.001; 95% CI: 3.7, 11.6) and Rivers (OR: 5.6; p<0.001; 95% CI: 3.0, 10.3) had reduced to about 2-, 7- and 4-times higher odds compared to Sokoto, with Lagos having the highest odds.

When household characteristics were adjusted for (Model 2), all the states with a statistically significant variation in Model 1 retained their significant association, including Ebonyi. Anambra (OR: 7.4; p<0.001; 95% CI: 3.9, 14.3) and Akwa Ibom (OR: 7.0; p<0.001; 95% CI: 3.5, 13.8) significantly had the highest odds for obesity (7) compared to Sokoto. Furthermore, adjustment was made for community characteristics (Model 3), and the States with statistically significant variation in Model 2 retained their significant variation. Anambra (OR: 7.9; p<0.001; 95% CI: 4.4, 14.1) retained the highest odds (8) of obesity compared to the reference State. In the final model (Model 4), after all explanatory variables were adjusted for, about two-thirds of all the states (24 States) still had a statistically significant variation in their prevalence of obesity compared to the reference State, with Akwa Ibom (OR: 4.5; p<0.001; 95% CI: 2.2, 9.0) and Anambra (OR: 4.4; p<0.001; 95% CI: 2.2, 8,7) having 5-, and 4-times higher odds for obesity compared to Sokoto, respectively.

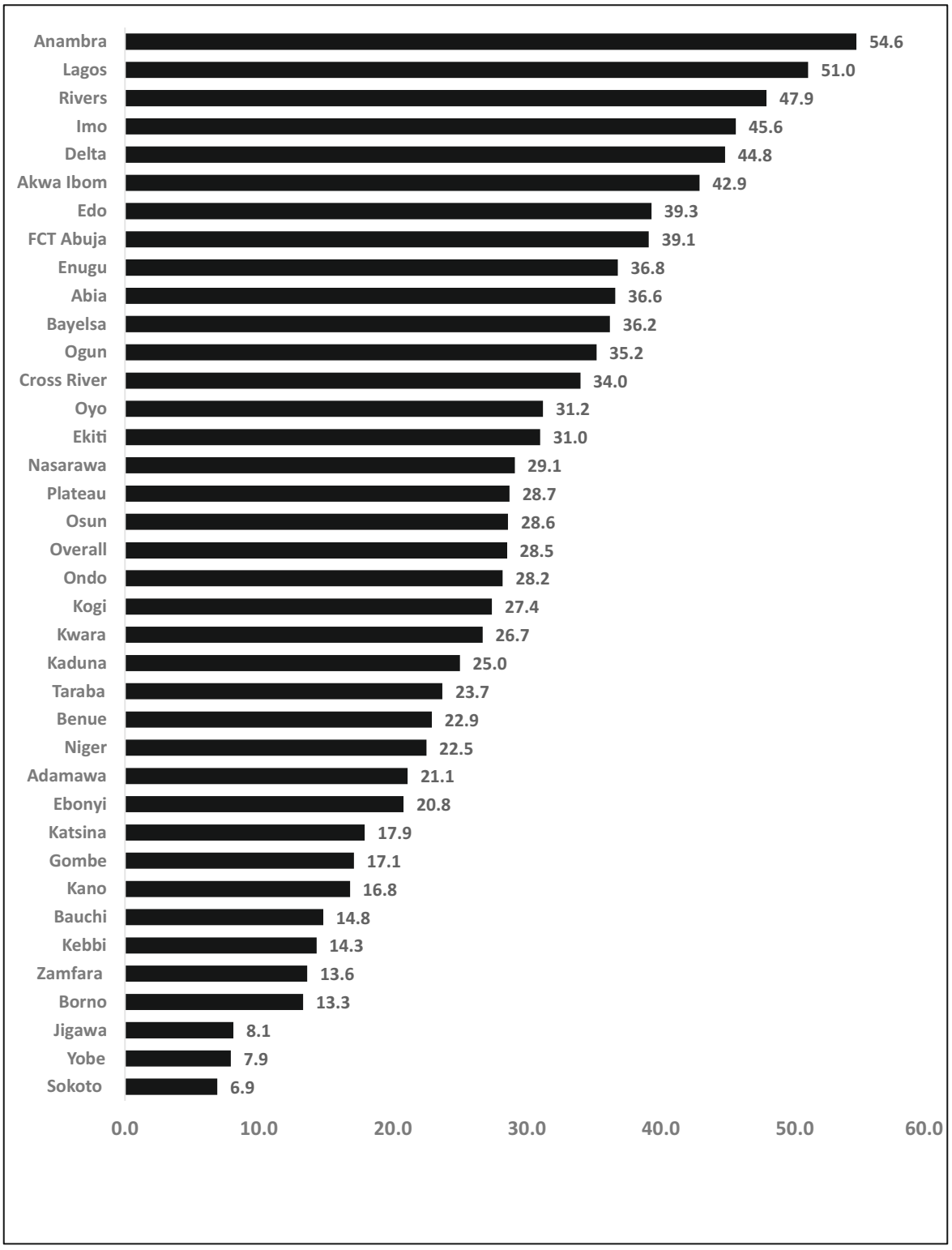

Figure 2: Sub-national distribution of Obesity among non-pregnant women of reproductive age in Nigeria

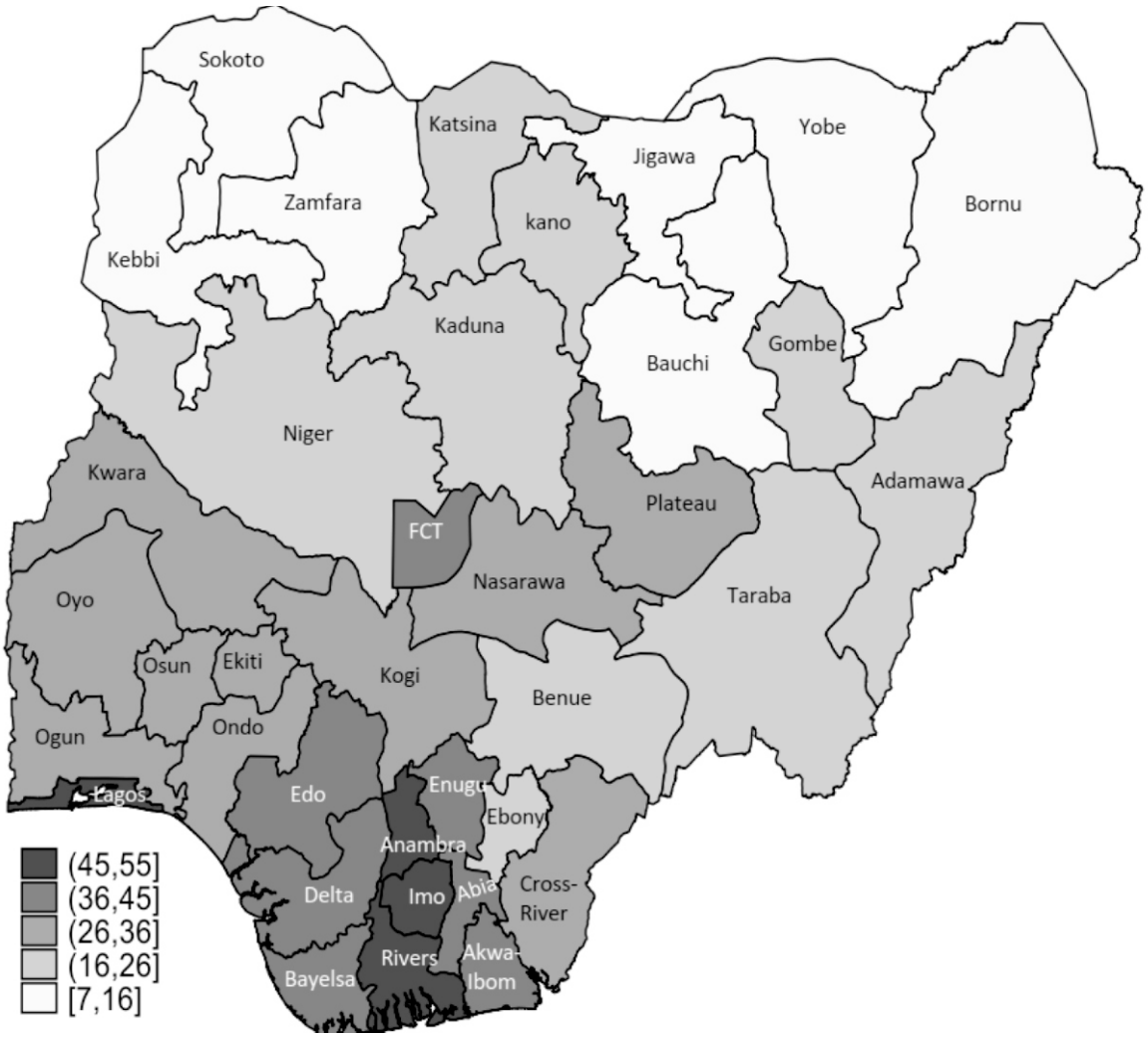

Figure 3: Map of Nigeria showing the sub-national prevalence of Obesity among non-pregnant women of reproductive age in Nigeria

Table 1: Distribution of Respondents according to the States and other explanatory variables

Variables	Frequency	Percentage
Sub-nationals		
Sokoto (R)	212	1.6
Zamfara	374	2.8
Katsina	686	5.2
Jigawa	384	2.9
Yobe	390	3.0
Borno	457	3.5
Adamawa	258	1.9
Gombe	218	1.7
Bauchi	371	2.8
Kano	671	5.1
Kaduna	729	5.5
Kebbi	332	2.5
Niger	426	3.2
FCT Abuja	106	0.8
Nasarawa	216	1.6
Plateau	260	1.9
Taraba	264	2.0
Benue	447	3.4
Kogi	193	1.5
Kwara	230	1.8
Oyo	554	4.2
Osun	341	2.6
Ekiti	186	1.4
Ondo	233	1.8
Edo	163	1.2
Anambra	471	3.6
Enugu	305	2.3
Ebonyi	317	2.4
Cross River	218	1.7
Akwa Ibom	318	2.4
Abia	222	1.7
Imo	369	2.8
Rivers	603	4.6
Bayelsa	106	0.8
Delta	284	2.2
Lagos	928	7.0
Ogun	339	2.6
Individual level Factors		
Age groups in years		
15 – 19	2,557	19.4
20 – 24	1,966	14.9
25 – 29	2,225	16.9
30 – 34	2,020	15.3
35 – 39	1,918	14.6
40 – 44	1,263	9.6
45 – 49	1,231	9.3
Mean (S..D): 29.5 ± 9.7		
Highest level of Education		
No education	4,194	31.8
Primary	2,032	15.4
Secondary	5,538	42.0
Higher	1,416	10.8

	Religion		
	Christian	6,460	49.0
	Islam	6,643	50.4
	Others	77	0.6
	Marital status		
	Never in a union	3,296	25.0
	Currently in a union	9,142	69.4
	Formerly in a union	743	5.6
	Employment status (last 12 months)		
	Not employed	3,991	30.3
	Employed	9,189	69.7
	Number of living children		
	No child	3,527	26.8
	1 – 2 children	3,373	25.6
	3 – 4 children	3,045	23.1
	5+ children	3,235	24.5
	Number of living children ever born		
	No child	3,446	26.1
	1 – 2 children	3,020	23.0
	3 – 4 children	2,680	20.3
	5+ children	4,035	30.6
	Household level factors		
	Husband/partner's education		
	No education	2,810	31.2
	Primary	1,357	15.1
	Secondary	3,361	37.3
	Higher	1,478	16.4
	Husband/partner's employment (last 12 months)		
	Not employed	304	3.3
	Employed	8,809	96.7
	Number of usual household members		
	1 – 5	5,871	45.1
	6 – 10	5,394	41.5
	> 10	1,750	13.4
	Household wealth index		
	Poorest	2,045	15.5
	Poorer	2,427	18.4
	Middle	2,652	20.1
	Richer	2,947	22.4
	Richest	3,109	23.6
	Water source		
	Unimproved	3,820	29.4
	Improved	9,196	70.6
	Community level factors		
	Place of residence		
	Urban	6,241	47.4
	Rural	6,939	52.6
	Community education level		
	Low	6,892	52.3
	high	6,288	47.7
	Community wealth level		
	Low	6,593	50.0
	high	6,587	50.0

Table 2: Sub-national variation of Obesity among non-pregnant women of reproductive age in Nigeria after controlling for known risk factors using logistics regression analysis

	[a]Model 0			[b]Model 1			[c]Model 2			[d]Model 3			[e]Model 4		
	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI	OR	p	95% CI
Sub-nationals															
Sokoto (R)															
Zamfara	2.1	**0.019**	1.1, 4.1	2.3	**0.009**	1.2, 4.2	2.6	**0.005**	1.3, 5.0	1.9	**0.028**	1.1, 3.4	2.8	**0.002**	1.5, 5.4
Katsina	3.0	**0.001**	1.6, 5.6	2.8	**0.001**	1.5, 5.3	2.7	**0.003**	1.4, 5.2	2.8	**0.001**	1.5, 5.1	2.8	**0.002**	1.5, 5.3
Jigawa	1.2	0.642	0.6, 2.6	1.1	0.887	0.5, 2.2	1.1	0.807	0.5, 2.5	1.2	0.604	0.6, 2.6	1.1	0.820	0.5, 2.5
Yobe	1.2	0.740	0.5, 2.9	1.1	0.870	0.4, 2.6	1.2	0.631	0.5, 3.1	1.2	0.705	0.5, 2.9	1.1	0.804	0.5, 2.8
Borno	2.1	**0.029**	1.1, 4.1	1.7	0.112	0.9, 3.4	1.5	0.248	0.7, 3.1	1.5	0.219	0.8, 2.7	1.3	0.494	0.6. 2.6
Adamawa	3.6	**<0.001**	2.0, 6.7	2.3	**0.009**	1.2, 4.3	3.4	**<0.001**	1.8, 6.3	2.9	**<0.001**	1.6, 5.3	2.5	**0.005**	1.3, 4.8
Gombe	2.8	**0.002**	1.5, 5.4	2.1	**0.014**	1.2, 3.9	2.3	**0.010**	1.2, 4.2	2.6	**0.001**	1.5, 4.6	1.8	0.053	1.0, 3.3
Bauchi	2.4	**0.010**	1.2, 4.5	2.1	**0.017**	1.2, 4.0	2.2	**0.021**	1.1, 4.4	2.3	**0.006**	1.3, 4.3	2.4	**0.009**	1.3, 4.7
Kano	2.7	**0.002**	1.4, 5.2	2.2	**0.012**	1.2, 4.02	2.0	**0.038**	1.0, 3.7	2.3	**0.007**	1.3, 4.1	1.8	0.065	1.0, 3.5
Kaduna	4.5	**<0.001**	2.5, 8.3	3.2	**<0.001**	1.8, 5.6	2.9	**0.001**	1.6, 5.5	3.6	**<0.001**	2.1, 6.3	2.5	**0.004**	1.4, 4.5
Kebbi	2.3	**0.012**	1.2, 4.3	2.2	**0.017**	1.2, 4.2	2.6	**0.005**	1.3, 5.1	2.2	**0.011**	1.2, 4.1	2.5	**0.009**	1.3, 5.1
Niger	3.9	**<0.001**	2.2, 7.2	3.4	**<0.001**	1.9, 6.0	2.9	**0.001**	1.6, 5.5	3.4	**<0.001**	1.9, 5.9	2.9	**0.001**	1.6, 5.3
FCT Abuja	8.7	**<0.001**	4.5,16.8	5.0	**<0.001**	2.7, 9.4	3.8	**<0.001**	1.9, 7.9	4.9	**<0.001**	2.7, 8.8	2.7	**0.007**	1.3, 5.6
Nasarawa	5.6	**<0.001**	3.1,10.1	3.4	**<0.001**	1.8, 6.3	2.9	**0.001**	1.6, 5.4	3.8	**<0.001**	2.2, 6.7	2.2	**0.026**	1.1, 3.9
Plateau	5.5	**<0.001**	2.9,10.3	2.9	**0.001**	1.5, 5.5	4.4	**<0.001**	2.3, 8.4	4.4	**<0.001**	2.4, 8.0	2.6	**0.005**	1.3, 5.1
Taraba	4.2	**<0.001**	2.3,7.7	3.0	**<0.001**	1.6, 5.3	4.1	**<0.001**	2.1, 7.8	3.9	**<0.001**	2.2, 6.9	3.3	**<0.001**	1.8, 6.3
Benue	4.0	**<0.001**	2.2,7.4	2.1	**0.015**	1.2, 3.9	3.3	**<0.001**	1.7, 6.4	3.6	**<0.001**	2.0, 6.2	2.2	**0.027**	1.1, 4.3
Kogi	5.1	**<0.001**	2.7, 9.7	2.8	**0.001**	1.5, 5.1	3.5	**<0.001**	1.7, 7.0	3.4	**<0.001**	1.9, 6.2	2.2	**0.027**	1.1, 4.5
Kwara	4.9	**<0.001**	2.6, 9.3	3.1	**<0.001**	1.7, 5.6	3.5	**<0.001**	1.8, 6.8	3.3	**<0.001**	1.8, 5.9	2.4	**0.010**	1.2, 4.7
Oyo	6.1	**<0.001**	3.4,11.2	2.6	**0.001**	1.4, 4.7	2.7	**0.002**	1.4, 5.1	3.2	**<0.001**	1.8, 5.8	1.7	0.104	1.0, 3.2
Osun	5.4	**<0.001**	2.9,10.2	2.5	**0.005**	1.3, 4.7	3.4	**<0.001**	1.8, 6.7	3.1	**<0.001**	1.7, 5.6	2.1	**0.034**	1.1, 4.1
Ekiti	6.1	**<0.001**	3.4,11.1	2.4	**0.004**	1.3, 4.4	3.4	**<0.001**	1.7, 6.6	3.2	**<0.001**	1.8, 5.7	1.8	0.098	1.0, 3.6
Ondo	5.3	**<0.001**	2.8,10.0	2.3	**0.011**	1.2, 4.2	3.2	**0.001**	1.6, 6.2	3.1	**<0.001**	1.7, 5.7	1.7	0.139	1.0, 3.3
Edo	8.7	**<0.001**	4.5,17.3	3.5	**<0.001**	1.8, 7.0	3.7	**<0.001**	1.8, 7.7	5.4	**<0.001**	2.8,10.4	2.0	0.081	0.9, 4.2
Anambra	16.3	**<0.001**	8.8,30.1	2.2	**<0.001**	3.8,13.2	7.4	**<0.001**	3.9,14.3	7.9	**<0.001**	4.4,14.1	4.4	**<0.001**	2.2, 8.7
Enugu	7.9	**<0.001**	4.4,14.2	3.6	**<0.001**	2.0, 6.5	5.1	**<0.001**	2.7, 9.7	4.5	**<0.001**	2.6, 7.8	2.6	**0.005**	1.4, 5.1
Ebonyi	3.6	**<0.001**	1.9, 6.7	1.5	0.197	0.8, 2.9	2.8	**0.003**	1.4, 5.5	2.7	**0.001**	1.5, 4.8	1.5	0.283	0.7, 3.0
Cross River	7.0	**<0.001**	3.9,12.7	3.1	**<0.001**	1.7, 5.7	4.4	**<0.001**	2.2, 8.9	4.7	**<0.001**	2.7, 8.2	2.3	**0.024**	1.1, 4.9
Akwa Ibom	10.2	**<0.001**	5.6,18.6	4.9	**<0.001**	2.7, 8.9	7.0	**<0.001**	3.5,13.8	6.5	**<0.001**	3.7,11.6	4.5	**<0.001**	2.2, 9.0
Abia	7.8	**<0.001**	4.3,41.2	2.9	**<0.001**	1.6, 5.4	3.3	**<0.001**	1.7, 6.5	4.1	**<0.001**	2.3, 7.2	1.7	0.132	0.9, 3.3
Imo	11.4	**<0.001**	6.3,20.5	4.1	**<0.001**	2.3, 7.6	6.3	**<0.001**	3.4,11.8	5.7	**<0.001**	3.3, 10.0	3.1	**<0.001**	1.7, 5.9
Rivers	12.5	**<0.001**	6.9,22.6	5.6	**<0.001**	3.0,10.3	5.7	**<0.001**	3.0,10.6	6.5	**<0.001**	3.7,11.4	3.1	**0.001**	1.6, 6.0
Bayelsa	7.7	**<0.001**	4.1,14.5	3.9	**<0.001**	2.0, 7.6	4.1	**<0.001**	2.1, 8.0	5.3	**<0.001**	2.9,10.0	2.9	**0.005**	1.4, 6.0
Delta	11.0	**<0.001**	6.1,20.1	4.9	**<0.001**	2.7, 9.0	5.7	**<0.001**	3.0,10.9	5.9	**<0.001**	3.3,10.3	3.1	**0.001**	1.6, 6.0
Lagos	14.1	**<0.001**	8.0,25,1	6.5	**<0.001**	3.7,11.6	5.6	**<0.001**	2.9,10.8	6.4	**<0.001**	3.7,11.0	3.2	**<0.001**	1.7, 6.2
Ogun	7.4	**<0.001**	4.0,13.7	3.1	**<0.001**	1.7, 5.8	2.8	**0.004**	1.4, 5.6	4.2	**<0.001**	2.3, 7.5	1.8	0.125	0.9, 3.6

*R- reference variable; * Statistically significant; CI – confidence interval; χ^2 – chi-squared test; p – p-value*

[a]Model 0 is the empty model showing crude/unadjusted rates; [b]Model 1 adjusted for individual characteristics, which include age, educational status, religion, marital status, employment status, number of living children and number of children ever born; [c]Model 2 adjusted for the household characteristics, which are husband/partner's education, husband/partner's employment status, number of usual household members, household wealth index and water source; [d]Model 3 adjusted for community characteristics, which are the residence, community educational level and community wealth level; [e]Model 4 is the full model that adjusted for all the explanatory variables.

DISCUSSION

While some studies have reported National prevalence rates for obesity among non-pregnant women of reproductive age in Nigeria, this study provides new information on the sub-national distribution and variation of obesity among this important population with emphasis on the roles various predictors play. This study also provides more perspective into the obesity prevalence across the various states and as such, the findings of this study will inform the international approach(es) to address the rising prevalence among this critical population, both nationally and sub-nationally.

This study showed that sub-national variations exist in the prevalence of obesity among reproductive-aged women in the different states of Nigeria, even after adjusting for a wide range of commonly reported individual, household, and community level predictors. Such variations have been observed in studies carried out in the United States (15), Bangladesh (21,22), Cambodia (23), China (24), and particularly in Africa (11,14,25–27). The finding of this study is important because it highlights the role of the contextual unit or the environment in which a woman lives in the prevalence of obesity. Additionally, this underscores the fact that country-wide interventions may be grossly inadequate for obesity among women of reproductive age in Nigeria.

The pattern of sub-national variation in the prevalence of obesity among Nigerian women was such that the Southern States largely had a higher burden compared to the Northern States. Similar findings of regional variations, even after controlling for risk factors, have been reported in high (15), middle (24), and low-income countries (14,21,26). A plausible argument for the regional variation in Nigeria would have been the socio-economic inequality that has been reported between the generally poorer north and richer south (28). However, the variation still existed after adjusting for the various indicators of socio-economic status including educational status, occupational status, wealth index and residence.

Also of concern is the wide sub-national variation in the prevalence of obesity among women of reproductive age in Nigeria, with a range of nearly 50% (Sokoto – 6.9% versus Anambra – 54.6%). About half of the women in Anambra, Lagos and Rivers were obese, with prevalence rates nearly twice the national average, while only less than 10% of women in Sokoto, Yobe and Jigawa were obese. Furthermore, women in Anambra and Akwa Ibom had about 500% higher odds for obesity compared to those in Sokoto even after adjusting for commonly reported predictors. Previous studies in Nigeria have similarly reported significant differences in the geographical distribution of overweight/obesity among women of reproductive age in Nigeria (16,18,29), although these differences were considered at regional and not sub-national levels as done in this study. The previous studies(16,18,29) reported higher prevalence rates in the Southern compared to the northern regions and attributed this to socio-economic factors and urbanization(18,29). This is understandable because these are the factors (i.e., socio-economic factors and urbanization) that drive nutrition transition, a change from traditional to westernized dietary patterns and increased sedentary lifestyle, which has been said to be the main driver of the obesity epidemic (30,31). . Marked sub-national variations like this have also been similarly observed in both high income and low- and middle-income countries. In the United States, there were marked disparities in the obesity prevalence with some cities having 3 to 6 times higher risks of pre-pregnancy and severe obesity compared to their counterparts (15). In another study done in China, some of the regions had more than double the odds of obesity compared to others even after controlling for common risk factors (24). In Mali, regional variations in the obesity risk among reproductive-aged women were also seen, with one region in particular (Kidal) having ten times the odds (compared to the reference state) after adjusting for risk factors (26). Generally, that about a third of women of reproductive age in Nigeria are obese should be a thing of concern. Still, this study further shows that there is a big sub-national context to this problem in Nigeria. There is, therefore, a need to investigate and identify state-level determinants of obesity among reproductive-aged women in each State in Nigeria. Furthermore, this finding underscores the need for state-specific interventions to curb obesity among reproductive-aged women in Nigeria.

It should be noted that obesity among women in this study had statistically significant associations with age, educational status, religion, number of living children, wealth index and spouse's educational status, even after adjusting for possible confounders. These findings corroborate the findings of previous studies among women of reproductive age in Nigeria (11,16,21,22,25,26). In the present study, the associations were such that women who were older, more educated, Christians with more children, from richer households, and who had more educated spouses had higher odds of being obese. This pattern of relationship has also been previously reported by studies among women of reproductive

age within and outside Nigeria ([11],[14],[16],[27]). However, the finding of this study showed that these factors alone did not explain the sub-national variation of obesity among this category of women in Nigeria. There may be a need to explore other methodological approaches including qualitative studies ([32–34]), mixed methods ([35]), and multi-level analysis ([15],[18],[22]), to explain the sub-national variation in the prevalence of obesity among non-pregnant women of reproductive age in Nigeria.

a limitation of this study is its being a cross-sectional study, meaning that causality cannot be determined.

CONCLUSION

The study concluded that sub-national variations exist in the prevalence of obesity among non-pregnant women of reproductive age in Nigeria, even after adjusting for commonly reported predictors. The sub-national variations were wide with a range of about 50% between the highest and lowest prevalence states, and there was a higher burden among the Southern States of the country. There is therefore a need to increase awareness about state-level determinants of obesity especially with regards to the sociocultural environment, with a view to designing state-specific interventions to curb obesity among women of reproductive age in Nigeria.

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Authors' contributions

Conceptualization, A.A.A., and M.A.O.; Methodology, A.A.A., and M.A.O.; Data analysis, A.A.A.; Writing – Original Draft Preparation, M.A.O., and B.O.A., Writing – Review and Editing, A.A.A., and B.O.A.; Supervision, A.A.A. All authors read and approved the final version of the manuscript.

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Institutional Review Board Statement

Ethical clearance had been previously obtained for the NDHS 2018. The present study used de-identified secondary data from the NDHS 2018, hence needed no additional ethical clearance.

Informed Consent Statement

The DHS Program obtained informed consent from the participants.

Data Availability Statement

The datasets used and/or analyzed during the current study are publicly available on the DHS Programme website upon reasonable request. (https://dhsprogram.com/).

Conflicts of interests

The authors declare no conflict of interest.

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