Socioecological Approach to Understanding Overnutrition Among Married and Cohabiting Women in Nigeria

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Abstract

Overweight and obesity are currently an epidemic affecting both developed and developing countries. Sub-Saharan Africa has a double burden of being underweight and obese and has recently been battling an alarming increase in the prevalence of overweight. This study investigates the predictors of overnutrition among married women of reproductive age in Nigeria using the socioecological model (SEM) as a framework. The study hypothesizes that the Southern region will have a higher burden of overnutrition than the Northern region. The 2018 Nigeria Demographic and Health Survey (NDHS) was analyzed. A total of 8,531 non-pregnant married women met the inclusion criteria. Hierarchical multilevel logistic regression models were fitted, informed by the SEM framework. The occurrence of overnutrition was found to be 31.4%, with regional variations showing 31.7% in the South and 31.3% in the North. When all covariates were fitted in a model, being older, being a Christian, having tertiary education, having an older partner with tertiary education, being wealthy, and living in the urban area were predictors of overnutrition in multivariate analysis. Overnutrition among Nigerian married women was high, especially in the Southern region. Predictors of overweight are at all the SEM levels; therefore, it is better to consider all the levels when planning public health interventions.

Keywords

Married women; Nigeria; obesity; overnutrition; overweight; socioecological model

Introduction

Overweight and obesity are currently an epidemic affecting both developed and developing countries (Saghafi-Asl et al., 2020). Among people aged 18 and above, an estimated 1.9 billion are overweight, and 650 million are obese (World Health Organization, 2021). Overweight and obesity contribute to 3.4 million mortalities annually (Mukora-Mutseyekwa et al., 2019). Sub-Saharan African countries, such as Namibia, Nigeria, and Zimbabwe, have a double burden of being underweight and obese (Cham et al., 2020; Nyanhanda et al., 2023) and have recently been battling an alarming increase in the prevalence of overweight (Mndala & Kudale, 2019; Mukora-Mutseyekwa et al., 2019).

Overweight and obesity are associated with several non-communicable diseases (NCDs), including coronary heart disease, stroke, type 2 diabetes, and hypertension (Mukora-Mutseyekwa et al., 2019). Obesity and overweight, defined as overnutrition, are weight "above normal" or excess body weight (i.e., ≥ 25 body mass index [BMI]) (Mathur & Pillai, 2019). Women are more likely to have a higher average body than men from puberty to menopause (Mohajan & Mohajan, 2023). Several factors may be responsible for excess weight gain in women, such as parity, inability to return to the pre-pregnancy physical activity level, age, level of education, wealth index, health decision-making, employment status, place of residence, and region (Ahmad et al., 2020; Dipietro et al., 2019; Okoh, 2013; Sarma et al., 2016; Tuoyire et al., 2016).

The investigation of overnutrition is not new in Nigeria. Alabi and Badru (2023) investigated regional variation in overweight among Nigerian women using the 2018 National Demographic Health Survey (NDHS). They found that overnutrition was high among women in Nigeria, with those in southern Nigeria exhibiting more excess weight than their counterparts in the northern region. Kandala and Stranges (2014) also investigated regional variation in overweight among Nigerian women using the 2008 NDHS; they reported that two in 10 women (20.9%) were overnourished. Okoh (2013) investigated the correlation of sociodemographic variables on overnutrition among Nigerian women of reproductive age. These studies have one thing in common: assessment of overnutrition among women of reproductive age. The present study considered overnutrition among women of reproductive age and a unique subpopulation – married or cohabiting women.

There is evidence of an association between marriage or cohabiting and overnutrition among women of reproductive age generally in Nigeria (Alabi & Badru, 2023; Okoh, 2013; Were et al., 2022). However, these studies have considered all women in the reproductive age bracket. The present study takes a different approach by assessing overnutrition among married or cohabiting women. Furthermore, the influence of husbands or partners on women's weight has gained little traction in Nigeria, and there is evidence of weight correlation between spouses in China. To fill this gap, the partner/husband's demographic variables, such as age, level of education, and employment status, were included in the present study (Chen et al., 2020).

The Socioecological Model (SEM)

The variables associated with overnutrition are present at different levels of influence, such as intrapersonal and interpersonal relationships. Therefore, we organized the variables into the three socioecological model (SEM) levels in line with earlier studies: intrapersonal,

interpersonal, and community/societal (Alabi & Badru, 2021; Mangemba & San Sebastian, 2020). The SEM posits that the health and behavior of an individual are influenced by socioenvironmental factors beyond individual health behavior (Bronfenbrenner, 1979). Therefore, this study investigates the prevalence of overnutrition and the influence of different levels of the SEM among married Nigerian women; we hypothesized that the Southern region would have a higher burden of overnutrition than the Northern region.

Methods

Data and population

This study utilized the 2018 National Demographic and Health data. The survey is the latest and the sixth one conducted on Nigeria's health status and demographic issues. The National Population Commission of Nigeria conducted the 2018 NDHS with support from agencies such as the World Health Organization, Global Fund, the United States Agency for International Development (USAID), the United Nations Population Fund, and Bill and Melinda Gates (National Population Commission (NPC) [Nigeria] & ICF, 2019). The nationally representative survey sample participants were from the 36 states of the federation and the federal capital territory (FCT) Abuja.

The survey comprised 41,821 women of reproductive age (15−49 years). The current study focused on women who are either married or living with a partner, of which 28,888 women met this criterion. This study focused on this category because some interpersonal level factors (such as marriage type, partner's education, etc.) only apply to married women and those living with a partner. The respondents without BMI records were excluded, which reduced the number of respondents to 10,588. Five respondents whose BMI figures were 'flagged' were also excluded. The flagged respondents were outliers, and their BMI was likely inaccurate. Furthermore, pregnant women at the time of the survey and those lactating for up to 2 months were excluded from our study (Sarma et al., 2016). The eventual number of eligible respondents analyzed in this study was 8,531.

Outcome variable

The body mass index (BMI) is the dependent variable in this study. The NDHS objectively measured the respondents' weight and height and reported their BMI. Body mass index is universally calculated as weight (kg) divided by the square of height (m^2). Respondents with BMI < 25 kg/m^2 were categorized as *underweight/normal weight* (coded 0), and those with BMI ≥ 25 kg/m^2 were categorized as *overnutrition* (coded 1) following previous studies (Baniissa et al., 2020; Castro et al., 2016).

Independent variables

The selection of variables was informed by the socioecological model (SEM). A total of 15 variables were identified. The independent variables were categorized into three socio-ecological levels: individual (intrapersonal), interpersonal, and community/societal. At the individual level, six variables were identified: age, education, religion, employment status,

wealth index, and health insurance. Age was reported as a ratio variable, while religion, initially categorized as Catholic, Other Christian, Muslim, Traditional, and Others, was re-categorized into Christian, Muslim, and Others. The respondents' education level was captured at four levels in the dataset: no formal education, primary education, secondary education, and tertiary education, as given in the survey data. The wealth index was captured as poorest, poorer, middle, richer, and richest. For employment, yes or no was used to describe whether or not the respondents were currently working. Similarly, health insurance had binary responses of yes or no, as given in the dataset.

At the interpersonal level, participants were asked during the survey, "Including yourself, in total, how many wives or live-in partners does your husband/partner have?" Those who chose "one" were considered monogamous, whereas those who stated "more than one" were regarded as being in a polygynous marriage. The husband/partner's age, level of education, and employment status were captured the same way as the previous level. Lastly, respondents were asked who makes health decisions with four outcomes: respondent alone, husband/partner alone, joint, and others. The number of living children and the total number of persons living in the house (family size) were reported as continuous variables in the dataset and treated as such at the inferential level of analysis.

At the community/societal level, the type of place where participants reside was categorized into urban and rural. The region was categorized into six geopolitical zones: North Central, North East, North West, South East, South South, and South West.

Data analysis

Descriptive analysis was presented with frequencies, percentages, and mean (standard deviation [*SD*]). A chart was used to show the level of overnutrition across the 36 states and the FCT. Bivariate logistic regression examined the association between each independent variable and overnutrition. Later, hierarchical multivariate logistic regression models were computed - in line with the theoretical model - starting with the individual level (Model 1). In Model 2, interpersonal-level variables were added to the first model. In Model 3, community/societal variables were included, including all variables in the study. Multicollinearity among the independent variables was checked, and no evidence of such was found, as the variance inflation factor (VIF) was less than 0.3.

The accuracy and predictability of the variables were checked using the area under the curve (AUC) obtained from the receiver operator characteristics curve. The accuracy was considered small if AUC = 0.5 – 0.6, moderate if AUC = > 0.6 – ≤ 0.7, large if AUC = > 0.7 – ≤ 0.8, and very large when AUC > 0.8 (Axelsson Fisk et al., 2021; Merlo et al., 2019). Data were analyzed with the SPSS version 26; p value < .05 was considered significant.

Ethical considerations

Permission was obtained from the Demographic Health Survey program office to utilize the data (https://dhsprogram.com/data/).

Results

The median age of the participants was 32.75 years. The majority belonged to the Islamic faith (51.1%), while 48.1% were Christians. A significant proportion had no formal education (39.2%). Thirty-three percent had up to secondary school education, and 9.5% were higher degree holders. As regards the wealth index, the two extremes were the least represented. About 18% belonged to the richest index, whereas 19.6% belonged to the poorest. The majority (73.4%) were employed, whereas only 2.7% of these women were insured. About 71% of the women were in a monogamous marriage (Table 1).

Table 1: Sociodemographic Characteristics and Other Variables of Married/Cohabiting Women in Nigeria

Variables	Frequency (8,531)	Percentage (%)
Median Age (IQR)	32.75 (26–40) years	
Religion		
Islam	4,357	51.1
Christianity	4,102	48.1
Others	72	0.8
Education		
No education	3,348	39.2
Primary	1,550	18.2
Secondary	2,823	33.1
Tertiary	810	9.5
Wealth Index		
Poorest	1,674	19.6
Poorer	1,699	19.9
Middle	1,798	21.1
Richer	1,800	21.1
Richest	1,560	18.3
Employment		
No	2,272	26.6
Yes	6,259	73.4
Insurance		
No	8,301	97.3
Yes	230	2.7
Marriage Type*		
Monogyny	6,004	70.7
Polygyny	2,483	29.3
Median (IQR) Age of Husband/Partner	43.01 (35–50) years	
Husband/Partner Education*		
No education	2,569	30.5
Primary	1,362	16.2
Secondary	3,113	37.0
Tertiary	1,376	16.3
Husband/Partner Employment		
No	327	3.8
Yes	8,204	96.2
Health Decision		
Respondent alone	936	11.0
Joint	3,145	36.9
Partner alone	4,429	51.9
Others	21	0.2

Variables	Frequency (8,531)	Percentage (%)
Household Number		
1–5	3,973	46.6
6–10	3,466	40.6
> 10	1,092	12.8
Mean household number	6.57 ± 3.69	
Number of children alive		
0	475	5.6
1–5	6,295	73.8
> 5	1,761	20.6
Mean number of children	3.64 ± 2.29	
Type of place		
Urban	3,275	38.4
Rural	5,256	61.6
Region		
North Central	1,540	18.1
North East	1,474	17.3
North West	2,020	23.7
South East	1,113	13.0
South South	1,002	11.7
South West	1,382	16.2
Body Mass Index		
Underweight	813	9.5
Normal weight	5,036	59.0
Overweight	1,697	19.9
Obesity	985	11.5
Overnutrition		
South	1,109	31.7
North	1,573	31.3

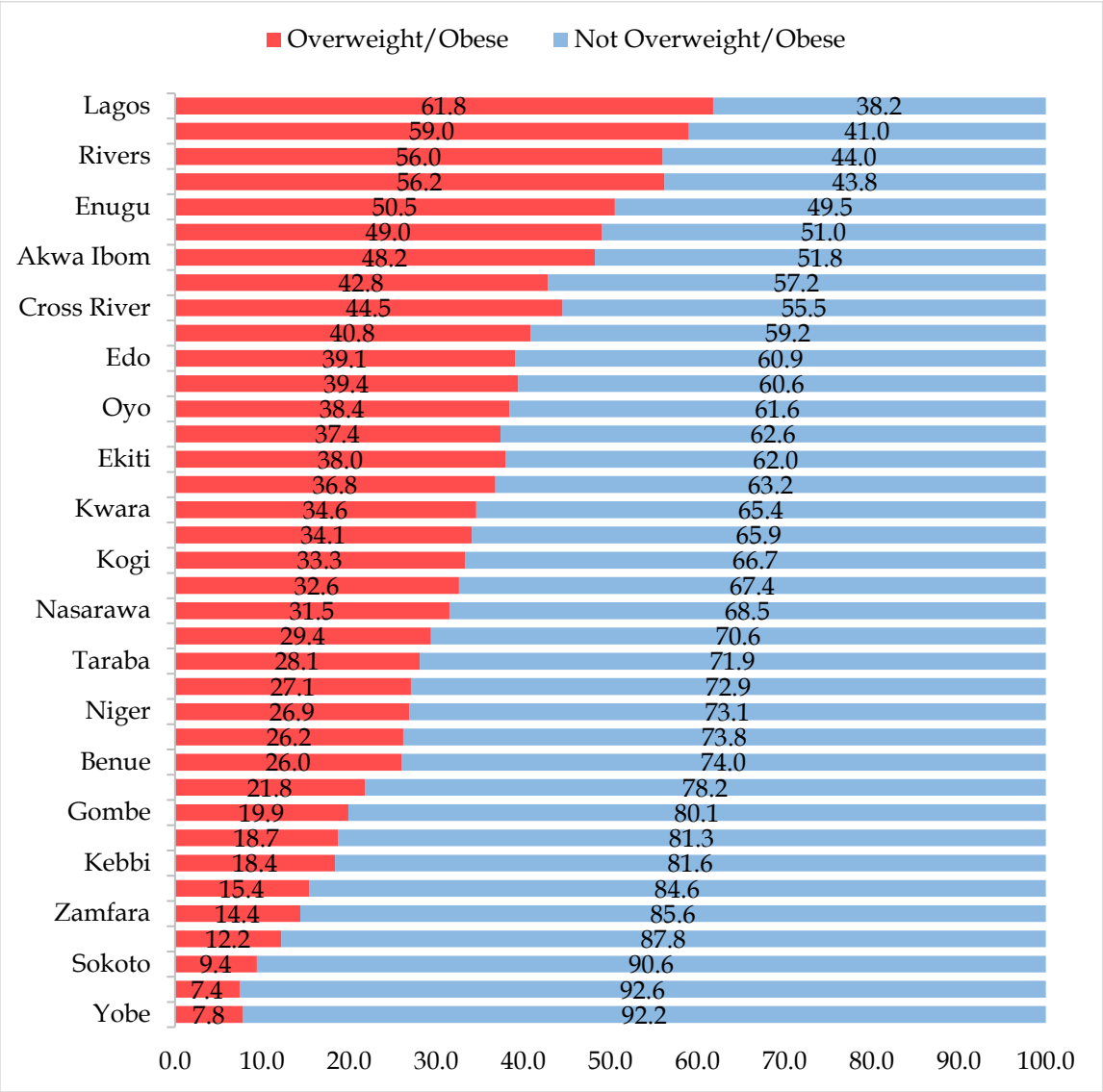
*Note: * Less than 8,531; IQR: Interquartile range; #: Total married women in South (North): 3,497 (5,034)*

Regarding the husband/partner demographics, the median age was 43 years. Over one-third (37%) had secondary education, whereas 30.5% did not have formal education; 96.2% were employed. For most women, the husband/partner made their health decisions (51.9%), 11% of the women made health decisions themselves, and 36.9% jointly made health decisions with their partners. Most households (46.6%) had between one and five members (Mean: 6.57; *SD*: 3.69), whereas about 21% of these women had more than five children alive (Mean: 3.64; *SD*: 2.29).

Prevalence of overnutrition

The prevalence of overnutrition among married women of reproductive age in Nigeria was 31.4%. Overnutrition was comparable in both regions, with 31.7% in the South and 31.3% in the North. Figure 1 shows that the top nine states with the highest prevalence of overnutrition are Southern states (four in South East and South South, with one in South West). Lagos State, the economic hub of West Africa, which has the highest population density in the country, had the highest prevalence with 61.8%, followed by Anambra (South East) at 59% and Rivers (South South) at 56.1%. Yobe State was at the base with 7.8%. The 11 states with the lowest BMI are in the northern part of the country (six of the seven states in the North West, four from the North East, and one from North Central).

Figure 1: Prevalence of Overnutrition Among Married and Cohabiting Women in Nigeria



Results from multivariate regression models

Model 1 (Individual level)

All the variables at the individual level were significantly associated with overnutrition at the bivariate level (Table 2), except employment status and insurance. Older age was a predictor of overweight (odds ratio [OR] = 1.060, 95% CI [1.053, 1.067], $p < .001$). Christians were 45.7% (95% CI [1.288, 1.647], $p < .001$) more likely to be overnourished than Muslims. Women with some level of education were more likely to be overnourished than those with no formal education. Likewise, women in the wealthiest spectrum were more likely to be overnourished than the women in the poorest spectrum. The odds increased consistently with greater wealth, with the richest women being 7.7 times (95% CI [6.154, 9.752], $p < .001$) more likely to be overnourished than the poorest women. The model explained 24.9% of the variables, while the Hosmer–Lemeshow test ($p = .685$) showed that the model fits. The variables provided a significant predictive probability at AUC 0.763 (95% CI [0.753, 0.774], $p < .001$).

Table 2: Bivariate Regression Analysis between each Independent Variable and Overnutrition among Married/Cohabiting Women in Nigerian

Predictors	Coefficient	*p* value	COR	Lower	Upper
Individual Level					
Age	0.059	**< .001**	1.061	1.055	1.067
Religion					
Islam (Ref)					
Christianity	1.031	**< .001**	2.803	2.547	3.085
Others	0.699	**< .01**	2.012	1.232	3.286
Education					
No education (Ref)					
Primary	0.933	**< .001**	2.543	2.212	2.922
Secondary	1.212	**< .001**	3.362	2.987	3.783
Tertiary	1.953	**< .001**	7.048	5.966	8.327
Wealth Index					
Poorest (Ref)					
Poorer	0.805	**< .001**	2.237	1.825	2.741
Middle	1.360	**< .001**	3.898	3.215	4.725
Richer	1.934	**< .001**	6.916	5.729	8.348
Richest	2.620	**< .001**	13.733	11.334	16.641
Employment					
No (Ref)					
Yes	0.569	**< .001**	1.767	1.581	1.974
Insurance					
No (Ref)					
Yes	1.222	**< .001**	3.394	2.597	4.437
Interpersonal Level					
Marriage Type					
Monogyny (Ref)					
Polygyny	-0.496	**< .001**	0.609	0.548	0.677
Husband/Partner Age	0.026	**< .001**	1.026	1.022	1.031
Husband/Partner Education					
No education (Ref)					
Primary	1.015	**< .001**	2.758	2.357	3.228
Secondary	1.245	**< .001**	3.474	3.047	3.959
Tertiary	1.675	**< .001**	5.341	4.589	6.217
Husband/Partner Employment					
No (Ref)					
Yes	0.361	**< .001**	1.434	1.110	1.853
Health Decision					
Respondent alone (Ref)					
Joint	-0.074	> .05	0.928	0.801	1.077
Partner alone	-0.878	**< .001**	0.416	0.359	0.482
Others	-2.672	**< .001**	0.069	0.009	0.517
Household Number	-0.029	**< .001**	0.972	0.959	0.984
Number of living children	0.041	**< .001**	1.042	1.021	1.063
Community/Societal Level					
Type of place					
Urban (Ref)					
Rural	-0.915	**< .001**	0.401	0.365	0.440
Region					
North Central (Ref)					
North East	-0.739	**< .001**	0.478	0.403	0.566
North West	-0.791	**< .001**	0.454	0.388	0.531

Predictors	Coefficient	*p* value	COR	Lower	Upper
South East	0.627	**< .001**	1.871	1.596	2.194
South South	0.653	**< .001**	1.922	1.631	2.264
South West	0.447	**< .001**	1.564	1.344	1.819

Note: COR: crude odds ratio; Bolded p values are significant

Model 2 (Interpersonal level)

The seven variables at the interpersonal level were combined with the individual-level variables and presented in Model 2. All the variables that showed predictive power in Model 1 remained significant in Model 2. However, marriage type, household number, and number of living children were not significant despite showing predictive power in the bivariate analysis. The model showed that the higher the age of the husband/partner, the higher the odds of overnutrition in the woman (adjusted odds ratio [AOR] = 1.011, 95% CI [1.003, 1.019], $p < .01$). Similar to the pattern observed in the bivariate analysis, the more educated the husbands were, the higher the odds of overnutrition in the women. Women whose husbands were employed had an increased odds of overnutrition by 35% (95% CI [1.000, 1.825], $p < .01$); this implies that women whose husbands/partners were unemployed were less likely to be overnourished. Regarding health decisions, women who made health decisions alone were more likely to be overnourished. Model 2 increased the explanatory power (i.e., Nagelkerke R^2) from 24.9% at the individual level to 25.4%. The variables in Model 2 provided a higher predictive probability at AUC 0.766 (95% CI [0.755, 0.777], $p < .001$) compared to AUC 0.763 in Model 1.

Table 3: Hierarchical Logistic Regression Analysis of Socioecological Levels and Overnutrition among Married/Cohabiting Women in Nigerian

Socioecological Levels	Model 1		Model 2		Model 3	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Individual Level H&L Test (*p*): 5.661 (.685) Nagelkerke R^2: 0.249 Model χ^2 (*p*): 1634.233 (< .001)						
Age	1.060***	**1.053, 1.067**	1.051***	**1.039, 1.062**	1.051***	**1.039, 1.062**
Religion						
Islam (Ref)						
Christianity	1.457***	**1.288, 1.647**	1.370***	**1.199, 1.564**	1.255**	**1.075, 1.465**
Others	1.220	0.720, 2.069	1.184	0.697, 2.011	0.997	0.577, 1.723
Education						
No education (Ref)						
Primary	1.304**	**1.105, 1.539**	1.190	0.999, 1.418	1.154	0.965, 1.380
Secondary	1.364***	**1.152, 1.615**	1.234*	**1.028, 1.481**	1.193	0.989, 1.438
Tertiary	1.780***	**1.424, 2.225**	1.611***	**1.255, 2.067**	1.565**	**1.216, 2.014**
Wealth Index						
Poorest (Ref)						
Poorer	1.890***	**1.529, 2.337**	1.808***	**1.458, 2.241**	1.763***	**1.421, 2.188**
Middle	2.896***	**2.350, 3.569**	2.674***	**2.159, 3.313**	2.488***	**1.999, 3.096**
Richer	4.689***	**3.787, 5.805**	4.262***	**3.418, 5.314**	3.831***	**3.041, 4.825**
Richest	7.745***	**6.152, 9.752**	6.844***	**5.385, 8.697**	6.071***	**4.699, 7.844**
Employment						
No (Ref)						
Yes	0.962	0.846, 1.094	0.907	0.793, 1.038	0.912	0.796, 1.045
Insurance						
No (Ref)						
Yes	1.280	0.947, 1.731	1.248	0.921, 1.692	1.240	0.913, 1.684
Interpersonal Level H&L Test (*p*): 3.119 (.927) Nagelkerke R^2: 0.254 Model χ^2 (*p*): 1670.796 (< .001)						

Socioecological Levels	Model 1		Model 2		Model 3	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Marriage Type						
Monogamous (Ref)						
Polygamous			0.895	0.776, 1.033	0.915	0.792, 1.057
Husband/Partner Age			1.011**	**1.003, 1.019**	1.011**	**1.003, 1.018**
Husband/Partner Education						
No education (Ref)						
Primary			1.259*	**1.037, 1.530**	1.233*	**1.013, 1.500**
Secondary			1.355**	**1.128, 1.629**	1.330**	**1.106, 1.601**
Tertiary			1.345**	**1.086, 1.665**	1.351**	**1.089, 1.677**
Husband/Partner Employment						
No (Ref)						
Yes			1.350**	**1.000, 1.825**	1.376*	**1.017, 1.861**
Health Decision						
Respondent alone (Ref)						
Joint			0.874	0.740, 1.032	0.886	0.749, 1.047
Partner alone			0.811*	**0.682, 0.964**	0.825*	**0.693, 0.982**
Others			0.086*	**0.011, 0.671**	0.091*	**0.012, 0.716**
Household Number			1.004	0.986, 1.022	1.004	0.986, 1.022
Number of living children			0.998	0.966, 1.030	0.998	0.966, 1.030
Community/Societal Level H&L Test (*p*): 1.244 (.996) Nagelkerke R^2: 0.257 Model χ^2 (*p*): 1690.857 (< .001)						
Type of place						
Urban (Ref)						
Rural					0.846*	**0.750, 0.955**
Region						
North Central (Ref)						
North East					0.875	0.719, 1.065
North West					0.826*	**0.683, 0.999**
South East					1.015	0.834, 1.234
South South					1.200	0.987, 1.458
South West					0.855	0.716, 1.021

*Note: AOR: adjusted odds ratio; Bolded AOR are significant; *** p < .001, ** p < .01, * p < .05*

Model 3 (Community/Societal level)

Community-level variables were added to the individual and interpersonal variables in Model 3. Age remained significant in Model 3. Christianity was significantly associated with overnutrition across the three models. Primary and secondary level education were predictive in the first two models but were no longer significant in Model 3. Therefore, only tertiary-educated women were significantly more likely to be overnourished, with an odds ratio of 1.565 (95% CI [1.216, 2.014], $p < .01$) than women without formal education. The wealth index remained significant, with a p of < .001 in all three models. In Model 3, the richest women were about 6.071 times (95% CI [4.699, 7.844], $p < .001$) more likely to be overnourished than the poorest women.

Also, increasing husband/partner's age and level of education remained significant predictors of overnutrition. Married women living with employed men were 37.6% (95% CI [1.017, 1.861], $p < .05$) more likely to be overnourished, as shown in Table 3. Health decisions also remained significant in Model 3; women whose partner alone makes health decisions were less likely to be overnourished (AOR = 0.825, 95% CI [0.693, 0.982], $p < .05$) compared with women who make healthcare decisions alone. Likewise, women whose health decisions

were decided by others were less likely to be overnourished than women who made health decisions themselves (AOR = 0.091, 95% CI [0.012, 0.716], $p < .05$).

This study found evidence that women living in rural areas had less overnutrition than those in the urban setting (AOR = 0.846, 95% CI [0.750, 0.955], $p < .05$). Although the region demonstrated predictive power at bivariate regression, some changes were observed in Model 3. The variable showed in the bivariate analysis that southern women have a higher likelihood of being overnourished compared to women in North Central (reference category). Still, in Model 3, it was observed that overnourished women did not differ between Southern regions and North Central. Those in the North West had a significantly lower likelihood of overnutrition (AOR = 0.826, 95% CI [0.683, 0.999], $p < .05$).

When we assessed each SEM model separately, the individual level (24.9%) predicted overnutrition than the interpersonal (16.2%) and community (12.7%) levels (see Supplementary Table). The hierarchy regression model showed that individual and interpersonal levels combined (Model 2; 25.4%) were similar to the combination of the three levels (individual, interpersonal, and community levels community; Model 3; 25.7%). Also, the Model 3 provided a sizeable predictive probability at AUC 0.767 (95% CI [0.757, 0.778], $p < .001$), which is higher than the two other models.

Discussion

Using the 2018 Nigeria Demographic and Health Survey (NDHS), the present study assessed the prevalence and predictors of overnutrition among married women of reproductive age in Nigeria through the lens of the socioecological model (SEM). The prevalence of overnutrition among married Nigerian women in the present study was 31.4%, higher than the 25.5% reported in a recent meta-analysis conducted among all women (Adeloye et al., 2021). The disparity in prevalence is likely due to the population of interest; our study focused on only married/cohabiting women, while all women, irrespective of marital status, were considered by Adeloye et al. (2021). Our finding, however, is similar to the 32% reported in a Chinese Health Survey among married women (Chen et al., 2020), 36.4% in Canada (Vézina-Im et al., 2018), and 36.6% reported in the 2015 Zimbabwe National Demographic Health Survey (Mukora-Mutseyekwa et al., 2019). However, our finding (31.4%) is higher than the 10.3% among married women in Japan (Murakami et al., 2017) and the 18% reported in Bangladesh (Sarma et al., 2016).

One study utilized the 2008 NDHS to investigate overnutrition among Nigerian women and reported a prevalence of 20.9%, about 10% less than what we found in the present study (Kandala & Stranges, 2014). Although we cannot directly compare since we investigated married or cohabiting women only, the difference may hint at the increment of overnutrition among women in Nigeria, which may be due to increasing urbanization and the consequences of sedentaryism and other overweight-prone lifestyles.

Individual level

All the variables (age, religion, education, wealth, employment, and insurance) at the individual level were significant in bivariate analysis. However, at the multivariate level (Model 1), employment status and being insured proved protective of overnutrition.

Employment status was also reported to be protective in Bangladesh (Sarma et al., 2016), and insurance protective in China (Song et al., 2020). Increasing age as a predictor of overnutrition has been similarly reported in previous studies on overnutrition conducted in sub-Saharan Africa (Kandala & Stranges, 2014), Gambia (Tuoyire et al., 2016), Ethiopia (Ahmed et al., 2020), Zimbabwe (Mangemba & San Sebastian, 2020), Malawi (Mndala & Kudale, 2019), and other regions of the world including Bangladesh (Tanwi et al., 2019), and China (Song et al., 2020). There are several reasons why older women are overweight/obese compared to younger women. The first plausible reason could be that older married women are less physically active than younger women (Cavazzotto et al., 2022).

The second reason could be linked to reproduction. The median age in this present study was 32.75 years, perhaps the peak reproduction period among Nigerian women. A previous finding from Bangladesh gives credence to this assumption; the age group 33 through 37 years had the highest odds of overnutrition compared with other age groups (Sarma et al., 2016). A third possible reason relates to metabolism. The metabolism rate reduces with age (Chia et al., 2018), meaning the tendency to add weight increases when an individual's diet remains constant. Fourth, it could be that some women find it difficult to return to pre-pregnancy weight after childbirth due to a lack of physical activity and depression (Dipietro et al., 2019). A fifth possible reason is that older women are likely to be married for a longer time, particularly in Northern Nigeria, where women get married relatively earlier. A more extended period of cohabiting may lead to higher parity, which has been linked to gestational weight gain (Tuoyire et al., 2016).

Regarding the level of education, higher education is linked to overnutrition in the present study. Highly educated women may have more economic power to live a luxurious lifestyle and escape physical labor (Al Kibria et al., 2019; Sutradhar et al., 2021); both positively correlate with obesity. This assumption was confirmed in Model 3 as the odds of overnutrition increased with the wealth index. This finding is consistent with earlier studies (Ahmad et al., 2020; Ahmed et al., 2020; Mangemba & San Sebastian, 2020; Mengesha Kassie et al., 2020; Sarma et al., 2016; Tuoyire et al., 2016). Similarly, highly educated women are more likely to work in the formal sector, where sedentarism is expected. At the same time, those with little or no education may find themselves in the informal sector, where physical labor is more prevalent (Al Kibria et al., 2019).

Regarding wealth, there is a common belief - especially among the less educated - that "*olowo lo n yokun*" [the wealthy possess abdominal fat]. So, adding weight is often seen as a sign of enjoyment and good living by many. In fact, to many, the body weight of a newly married woman reflects the extent to which her husband takes care of her. Married women who add some weight are believed to be experiencing good care from their partners.

Interpersonal level

An increase in the age of a woman's partner increases her odds of being overweight/obese. This finding further strengthens the evidence that spousal resemblance is a key factor influencing an individual's health. The change in lifestyle, environment, or socioeconomic condition of couples may explain the surge in weight gain after marriage (Chen et al., 2020). Recall that the median age of married women and their partner/husband is 32.75 and 41.01 years, respectively (Table 1). This is perhaps the age range for exploration of food and entertainment, which may increase their weight.

This study found that the higher the level of education of the husband/partner, the higher the odds of obesity in women. The odds were highest among husbands with tertiary education, but the reverse was found in an earlier study (Murakami et al., 2017). But there is a plausible reason for the current finding: educated husbands are likely to earn more than those with lesser or no education. More so, women whose husbands are employed are about more likely to be overnourished in the fully adjusted model.

Both variables were fitted in a separate regression model to test the influence of husband employment on the women's BMI (result not shown). Interestingly, the husband's employment status did not influence overnutrition in the presence of women's employment (AOR = 1.158, 95% CI [0.892, 1.505], p = .271). However, the economic strength of the women played a significant role in their journey to excess body weight gain (AOR = 1.175, 95% CI [1.563, 1.956], p < .001). This can translate to better financial circumstances to live a better life. The downside of better economic status is the ability to purchase and consume obesity-prone foods - often as a show of wealth - and engage in entertainment that promotes a sedentary lifestyle, both of which can increase body weight over the acceptable cut-off (Al Kibria et al., 2019; Sutradhar et al., 2021). In addition, this finding supports the nutrition transition theory that states that an increase in wealth leads to a shift into an unhealthy dietary pattern (Mangemba & San Sebastian, 2020; Williams et al., 2018).

Decision-making was associated with overnutrition in the present study. When couples make decisions together, it does not translate to overnutrition. However, when married women make health decisions alone, their odds of overnutrition increase. A plausible reason could be the sociocultural pressure to appear more robust, as some cultures see fatness or plumpness as a symbol of living a good life and beauty (Mengesha Kassie et al., 2020). Therefore, some married women may ensure an imbalance between energy intake and expenditure to facilitate a high Quetelet index [body mass index]. Secondary data from Malawi found no association between health decisions and overnutrition among women (Mndala & Kudale, 2019).

Community/Society level

Model 3 included the type of place and region to complete the hierarchical model analysis. The present study found that women in rural areas were less likely to be overnourished than women in urban areas. This finding is consistent with earlier studies in sub-Saharan Africa, including studies in Nigeria (Kandala & Stranges, 2014), Burkina Faso (Diendéré et al., 2019), Ethiopia (Mengesha Kassie et al., 2020), Gambia (Cham et al., 2020), Malawi (Mndala & Kudale, 2019), and Zimbabwe (Mukora-Mutseyekwa et al., 2019), and outside Africa—China (Song et al., 2020). There are a few possible reasons for this finding. One, the level of development in the urban area may not permit physical activity as most people are likely to move around with vehicles (Diendéré et al., 2019); also, there is expected to be limited space for physical activities (Ahmad et al., 2020). Two, urban areas are known for industries and commercial activities where people are busy at work or trading. The busyness forces many to feed on high-calorie food such as snacks and sugary drinks. These are likely to promote sedentary lifestyles that predispose women to overnutrition.

Regarding region, except Abuja (FCT), the first fifteen states with the highest overnutrition prevalence are in the Southern part of Nigeria. The result supports our hypothesis that the Southern region will have a higher overnutrition burden than the Northern region. Married women in Lagos State—the commercial hub of Nigeria—had the highest prevalence of overnutrition (61.8%) in Nigeria, which may be due to urbanization. Furthermore, commercial

activities in Lagos are almost 24 hours long as business starts early and closes late, fostering an obesogenic environment.

Concerning the SEM hierarchical regression to identify the level that has more influence on overnutrition among married women in Nigeria. When we assessed each SEM model separately, the individual level predicted overnutrition than the other levels. However, the final model, where all levels were combined, showed little difference when combined. Further study is required, preferably a longitudinal study, to ascertain causation between overnutrition and the SEM level that primarily predicts overnutrition among married women in Nigeria.

Conclusion and recommendations

The prevalence of overweight among Nigerian married women is high. Factors associated with overnutrition are at all the SEM levels. Individual level factors, such as age and wealth index, showed a higher prediction of overnutrition, but the prediction was stronger in the presence of the interpersonal and community levels. Therefore, it makes sense to conclude that looking at the different levels of the SEM is more important than treating them apart. It may be better to consider all the levels when planning public health interventions. A few actions can be taken to reduce overnutrition among married or cohabiting women. Counselors and clinicians must include weight management advice to the newly wedded and to be married. Furthermore, midwives need to emphasize during antenatal and postnatal care the need for women to be physically active and the dangers of overnutrition during and after pregnancy. Finally, the Nigerian Federal Ministry of Health must advocate weight management for women to reduce excess body weight.

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