Journal of Biosocial Science (2024), 56: 2, 207–231
doi:10.1017/S0021932023000238

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Slim north, fat south: explaining regional differences in abnormal weights in Nigeria

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(Received 2 January 2022; revised 6 August 2023; accepted 13 October 2023; first published online 30 November 2023)

Abstract

Weight abnormalities (underweight, overweight, and obesity) can cause life-threatening ailments. This study investigates disparities in the prevalence of underweight, overweight, and obesity between northern and southern Nigeria and their associated factors. Using the 2018 Nigeria Demographic and Health Survey (NDHS), the study analysed a sample of 12,333 women with complete records of body mass index. The study found that southern women had lower odds of being underweight than women in the north, but the reverse was the case for overweight and obesity. The prevalence of underweight was 11.6%, and it varies from 6.9% in the southern state of Enugu to 31.6% in the northern state of Jigawa. The national prevalence of overweight was 17.9%, ranging from 6.7% in Jigawa State of the northern region to 39.9% in Lagos State of the south. Similarly, the prevalence of obesity in the north was 6.1% compared to 14.4% in the south, with Anambra State of the southern region recording the highest figure of 35.5% compared to 2.1% in the Yobe State of the northern region. In all, the rate of abnormal weight was significantly higher in the south than in the north. However, the type of weight abnormality varies between the two regions. Religion, education, use of contraceptives, and wealth were associated with the three forms of abnormal weights. However, while religion was significantly associated with obesity in the north, the association was not significant in the south. This study found that wealth and education have dissimilar influences on overnutrition. While the odds of being overweight and obese increase with wealth, being educated up to a secondary level significantly reduces the odds in Nigeria and across the two regions.

Keywords: Food; underweight; overweight; obesity; north-south differences; culture

Introduction

The phenomenon of body weight – and thus food – cuts across the focus of various fields (Murcott, 2017). Medical sources have examined the causes and health implications of abnormal weights (Flegal et al., 2005; McPherson, 2007). Sociological literature has addressed what body weights represent across cultures, how weight perception is evolving (Renzaho, 2004), 'weight stigma', and 'body shaming' – the humiliation of people due to their body form and size (Bombak et al., 2019; McMahon et al., 2022). Hence, the discussion of weights and food is multidisciplinary. As Murcott (2017) rightly noted, the subfield 'sociology of food', in broad terms, shares boundaries with other disciplines, including 'nutrition and dietetics, clinical medicine, epidemiology and public health, along with health promotion and public nutrition education' (p. 200). Therefore, situating the discussion of weights within only one subfield may lead to losing

relevant information from other fields. As Abbots & Lavis (2016, p. 1) rightly noted, 'food . . . .is simultaneously symbolic, economic, political, material and nutritional . . . .'

The literature has established a nexus between culture and food (Abbots & Lavis, 2016; Alonso et al., 2018; Dao et al., 2020; Murcott, 2003, 2013; Nyamnjoh, 2018; Sibal, 2018), and since culture varies by location in Nigeria (Alabi et al., 2022; Alabi & Ramsden, 2022), one may also expect the same for food. Nyamnjoh (2018) noted that foods are expressions of identity and sociality; foods serve as a reminder of births, deaths, and the place of origin. The act of eating is symbolic; what people eat and how they eat represent them and their culture (Murcott, 2016). This resonates with the concept of 'food culture' defined as 'the attitudes, beliefs, and traditions about food and eating practiced by individuals, and the social relations and institutions connecting individuals around and through food' (Dao et al., 2020, p. 2).

People's views and attitudes towards food and weight vary across cultures. In Nigeria, for example, there is a 'fattening culture' among the Efik and Ibibio groups of Southern Nigeria where privileged girls are initiated into marriage and womanhood by isolating them in a room (known as 'fattening room') where they are fed with meals that are high in fat and carbohydrates (Etuk, 2014). This resonates with the statement of Renzaho (2004, p. 106) that 'in Africa, overweight and obesity have historically been considered a sign of success, wealth, good health and indeed optimism and happiness' (Renzaho, 2004, p. 106). Also, it reflects the saying among the Yoruba people of Southwest Nigeria that *olowo lo n yo kun* (it is the wealthy people who have protruding stomachs).

Meanwhile, the Fulani group, scattered across the African continent and well known in northern Nigeria, has been described to be historically tall and slim people (Egharevba et al., 2019; Ezeonwuka & Igwe, 2016; Sabir et al., 2011). This caught the attention of a few Nigerians who discussed the matter on Nairaland (www.nairaland.com) – an online forum where Nigerians discuss current and burning issues and request answers to personal questions. In February 2016, a user asked on a thread, 'I Haven't Seen A Fat Fulani Person, Have You?' In June 2018, another user posted 'Why There Is No Fat Fulani' on another thread. The responses provided by online users can be summarized into three. The first revolves around the Fulani gene, that is, the Fulani people are naturally slim. The second explanation is that the Fulani are traditionally nomadic, and many of them walk over long distance, which serves as a form of physical exercise. Hence, Sabir et al. (2011) stated that 'the Fulani are a normally nomadic people known for covering great distances on foot with a resulting lean physique . . . .'. The third explanation gleaned from Nairaland is that the Fulani have a traditional diet (food and herbal mixtures) that helps them burn body fat. These two examples of Efik/Ibibio and Fulani people attest to the connection between culture, food, and body weight.

In simple terms, abnormal weight refers to a body mass index (BMI) that is lower or higher than what is necessary or normal. According to the World Health Organization [WHO] (2010), a BMI of 18 to 24.9 kg/m^2 is healthy or normal. A BMI lower than 18 kg/m^2 is considered underweight; a BMI between 25 kg/m^2 and 29.9 kg/m^2 is regarded as overweight or pre-obesity, while a BMI higher than 29.9 kg/m^2 is regarded as obesity. Hence, underweight, overweight, and obesity constitute the focus of this study.

Underweight, which is a consequence of undernutrition, constitutes a public health challenge, but research in that regard has focused on children, that is, underweight/stunting among children in Nigeria (Kandala & Emina, 2016), while overweight and obesity studies focus on adults, with the tendency for some studies to collapse 'overweight' and 'obesity' into one category (Abubakari & Bhopal, 2008; Ajayi et al., 2015; John et al., 2015). Perhaps, one reason for the little interest in undernutrition among adults is its lower prevalence compared to overweight and obesity. A study of 5392 adults across five urban cities in Nigeria found that only 5% of the respondents were underweight compared to 31% and 17% for overweight and obesity, respectively (Okafor et al., 2014). Another study by Sola et al. (2011) among 435 adults in Benue State in the north-central part of Nigeria reported that only 2% of their respondents were underweight compared to 4% for

https://doi.org/10.1017/S0021932023000238 Published online by Cambridge University Press

obesity and 22% for overweight (this finding may also explain why some studies merge overweight and obesity into one category). Similarly, a study of 317 adults in Nigeria found that the prevalence was 18.5%, 13.1%, and 6.7% for overweight, obesity, and underweight, respectively (Bakari et al., 2007). Among HIV-positive respondents in the southeastern state of Enugu, the prevalence of underweight was 6.1%, 38.4% for overweight and 21.5% for obesity (Anyabolu, 2016). Being Underweight has health and social implications, including tiredness, low energy level, body shaming, reduced likelihood of surviving childbirth, and increased susceptibility to infections (Kandala & Emina, 2016; Yilmaz & Bozo, 2019). In addition, Flegal et al. (2005) reported that being underweight was associated with excess deaths in the United States.

Like undernutrition, overweight, and obesity are also public health problems. The WHO (2021) stated that the rate of obesity has increased by over 200% since 1975 and that as of 2016, 39% and 13% of people aged 18+ are overweight and obese, respectively. These figures represent over 1.9 billion and 650 million overweight and obese adults, respectively. Africa is not left out in this global health problem as the continent is experiencing an increase in the rate of overweight and obesity as well (Mndala & Kudale, 2019; Mukora-Mutseyekwa et al., 2019). According to the National Population Commission (NPC) and Inner City Fund (ICF) (2019), 40% of women of reproductive age in Nigeria have weight abnormalities; 28% are overweight or obese.

Although the three forms of abnormal weight constitute public health concerns, WHO (2021) suggests that overweight and obesity may kill more people than underweight, because they increase the risk of other health problems, including diabetes, cardiovascular disease, asthma, cancer, hypercholesterolemia, heart disease, stroke, hypertension, et cetera (Lindstrom et al., 2003; Mukora-Mutseyekwa et al., 2019). However, Flegal et al. (2005) found that being underweight and obese were associated with excess deaths, but being overweight was not. Similarly, a recent study found that, in the United States, being overweight (but not obese) is associated with lower risks of death compared to people with normal weight (Visaria & Setoguchi, 2023). The findings of this recent study suggest (1) that being 'overweight' (but not obese) may not be abnormal and (2) the need to review the measures of different weight categories.

However, overweight and obesity have been reported to increase the risk of COVID-19 complications and their severity among adults in different countries (Centre for Disease Control and Prevention, 2021; Gao et al., 2021; Hamer et al., 2020).

There is evidence that women are more at risk of weight abnormalities than men, especially in developing countries (Ameye & Swinnen, 2019; Hu et al., 2017; Kandala & Emina, 2016). This underscores the importance of investigating weight abnormalities among women in a country like Nigeria. This study investigates regional differences in the prevalence of abnormal weights (underweight, overweight, and obesity) and associated factors in Nigeria.

Understanding north-south differences in Nigeria

Nigeria comprises 36 states and a Federal Capital Territory (FCT). The 36 states are divided into six geopolitical zones (south-east, south-south, south-west, north-central, north-east, and north-west). Broadly, the six geopolitical zones are categorized into two: north (comprising north-central, north-east, and north-west) and south (south-east, south-south, and south-west). The north has 19 states and the FCT, while the south has 17 states. Before colonialism in Nigeria, traditional rulers governed the affairs of their communities and tribes. The colonial rulers subsumed the different societies and empires into two (northern or southern protectorates) and adopted the indirect rule system of governance. In 1914, the colonial masters amalgamated the two protectorates and named it 'Nigeria' for administrative convenience (Alabi, 2023). According to some writers, the amalgamation was a mistake and the reason for social unrest and regional tussle and inequality in the country (Campbell & Bunche, 2011; Obi-Ani et al., 2016) to the extent that some groups from the south-east and south-west are clamouring to be independent countries

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and secede from Nigeria. Nigeria's social and political system is sensitive, such that a president and their vice must not be from the same region. Since the return to democracy in 1999, if one region produces a president in one administration, the next must be produced by the other region, *ceteris paribus*. Aside from the north-south differences and considerations in social and political affairs, there is also a serious consideration of religions. A situation where a president and his vice or a governor and his deputy are from the same religion is seriously frowned upon in Nigeria. Nationally representative data reveal that over 70% of people in the north are Muslims, while over 70% of those in the south are Christians (National Population Commission & Inner City Fund, 2019).

However, Nigeria practices a federal system of government with little or no constitutional recognition of differences across states and regions. Consequently, national policies have been mainly uniform across different locations. Beyond the discussion of health and abnormal weights, reference to a recent political phenomenon may shed some light on the seriousness of the differences between the two regions and the peculiar challenges each region faces. Alabi (2023) noted that:

> . . . the two regions' different security challenges may prompt different responses to political violence. Their different orientations were apparent during the 2020 EndSARS protests that led to scores of deaths in the country. SARS – the Special Anti-Robbery Squad of the Nigerian police – was accused of extortion and extrajudicial killings of young people, sparking protests in many states in the Southern region and the Federal Capital Territory (FCT), Abuja. In contrast, there were pro-SARS protests in some parts of the North . . . . In addition, while the Northern governors' forum showed support for SARS and voted that the unit should continue to be a part of the Nigerian police force, governors in the South resolved that SARS should be disbanded (p. 4).

One would expect that the federal government would respond differently according to the yearnings of each region. But the federal government, as usual, failed to recognize the regional differences and instead disbanded SARS on paper.

Earlier studies have documented notable north-south differences in Nigeria. For example, Alabi et al. (2022) found that 68.3% of women in the south practiced facility delivery compared to 26.9% in the north. The reasons provided were that (1) low level of education among couples in the latter hindered the utilization of maternal healthcare services and (2) the culture of the latter discourages close contact between unrelated people of opposite sex. Hence, some pregnant women may not be delivered by a male doctor. However, the study of Adejoh et al. (2023) latter found that 51.4% of mothers in the north used insecticide-treated nets for their children (less than five years old) compared to less than 30% in the south. The explanation provided was that international organizations and donor-funded projects (including the distribution of insecticide-treated nets) are concentrated in the north because of the region's high level of poverty and vulnerability to malaria.

Alabi & Ramsden (2022) investigated the acceptance and experience of intimate partner violence in Nigeria and how they vary between the north and south. Interestingly, the results showed that women in the north significantly accept wife beating more than their counterparts in the south, but the reverse was the case for the actual experience of intimate partner violence. The authors' explanation was that wife beating often begins with a verbal altercation between husband and wife and that northern women are more likely to be submissive to their husbands. Hence, a lower prevalence of wife beating in the north compared to the south.

These earlier studies prove that both regions have some differences worthy of investigation. Hence, it may be erroneous to assume homogeneity of the country or apply uniform social intervention policies and programmes across the two regions.

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Within the context of the current study, there are a few reasons to investigate north-south differences in abnormal weights. One, population density varies between northern and southern Nigeria. The figure ranges from 51/km^2 in the north-eastern state of Yobe to 2695/km^2 in the south-western state of Lagos. In addition, each of north east (comprising six states), north central (six states and the Federal Capital Territory), and north west (seven states) is bigger than the entire southern region (comprising 17 states) in terms of land mass. Earlier research has shown that the population density of a residential area is associated with body weight (Sun et al., 2022; Wang et al., 2019). Two, there are more commercial industries in the south (e.g., Lagos, Rivers, etc.) than in the north. The concentration of industries and formal organizations in certain areas may attract foreign restaurants and food outlets. Hence, one may expect that residents in highly industrialized states will be different from those in less industrialized states in terms of the foods they eat and, consequently, in body weights.

Three, culture and food are related, as discussed in the introductory section. In Nigeria, for example, Adegboye et al. (2016) showed that there are differences in the cultural diets of the three major ethnic groups (Yoruba of south West, Igbo of south east, and the Hausa/Fulani of northern region). In their piece on labelling through food, Clement and Saibu (2020) wrote about the claims of dietary superiority between the Igbo and Yoruba, who co-reside in the city of Lagos. The authors noted that 'the Igbo often use the term *ndiofemmanu* (people of the oily soup) to show the typical lavish use of palm oil in Yoruba culinary techniques. On the other hand, the Yoruba describe the Igbo as . . . one who eats stone without drinking water, in reference to the texture of the carbohydrate or starchy meal associated with native Igbo soups' (Clement & Saibu, 2020, p. 1).

Lastly, the poverty level varies greatly between the north and south (NPC & ICF, 2019), which may affect the kind of foods that residents in each region have access to, and this may lead to a difference in the rate of abnormal weights. Based on these points, this study hypothesizes that (1) the north and south will differ significantly in their prevalence of underweight, overweight, and obesity and (2) factors associated with weight abnormalities will vary between the two regions.

Methods

Data and population

The 2018 Nigeria Demographic Health Survey (NDHS) contains data from 41,821 women of reproductive age (15–49 years). Only those with a record of BMI were included in this study. Also, pregnant women were excluded due to additional fetal weight and women who had given birth two months preceding the survey (Sarma et al., 2016). The justification is that women may retain weight after birth, but some postpartum weight is expected to have been shed two months after birth. This study analysed data for 12,751 eligible women. The dataset was split into two – one for each region (north and south). Hence, three datasets were analysed in this study: one for Nigeria, one for northern Nigeria, and the other for southern Nigeria, as done in a recent study (Alabi & Ramsden, 2022).

Outcome variable

The outcome variables of interest are abnormal weights: underweight, overweight, and obesity. NDHS obtained the weight and height of the respondents, which was used to calculate the BMI. Going by the universal measurement of BMI, women with BMI $<$18.5 kg/m^2 were classified as underweight, those with BMI between 18.5 kg/m^2 and 24.9 kg/m^2 were classified as having normal weight, those between 25 kg/m^2 and 29.9 kg/m^2 were classified as overweight, and those with $\geq$30 kg/m^2 were considered obese.

Selection of independent variables

Four predictor variables were selected. The four variables are religion, education, use of contraceptives, and wealth index. The selection of the four variables was motivated by analytical

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importance – a combination of the four variables that (1) produced good/fit statistical models and (2) meet the assumption that there are notable differences between northern and southern Nigeria. Each of the four variables also makes conceptual sense within the context of food, diet, and weight. Foods have religious meanings. The preference for certain foods and animosity for other foods may be based on religious beliefs (Sibal, 2018). For example, the animosity for pork among Muslims is based on Islamic teachings. Religion was reported in five categories by the NDHS: Catholic, other Christians, Muslims, Traditional, and others. Catholic and other Christians were merged as 'Christians,' Traditional, and others merged as 'others', while Muslim was not altered, reducing the categories to three.

Education may improve a person's ability to make choices in different aspects of life, including dietary choices. Educated people may be more aware of the negative consequences of abnormal weights and the ability to differentiate between 'natural' and 'industrial' foods and between 'organic' and 'inorganic' foods. In addition, the level of education varies between northern and southern Nigeria (Alabi et al., 2022). NDHS captured education at four levels: no education, primary, secondary, and tertiary, which reflects the Nigerian educational hierarchy; this arrangement was not altered.

There are myths around the use of contraceptives in Nigeria (Ajayi et al., 2018), which includes the belief that they may cause weight loss (thereby causing underweight) or weight gain (thereby causing overweight and obesity). The use of contraceptives had binary options of 'yes' and 'no.' Lastly, a big body size means different things across cultures, and it is regarded as a sign of wealth and success (Renzaho, 2004). The wealth index was captured by NDHS at five levels: poorest, poorer, middle, richer, and richest.

Data analysis

Data were analysed with the Statistical Package for Social Science (SPSS) version 22. This study began data analysis by testing statistical violations of assumed normality. Continuous variables that violated the normality test were reported with median and interquartile range. Frequency and percentage were used at the descriptive level of analysis. Descriptive results are presented in Table 1.

This study tested whether there are significant differences in the prevalence of underweight, overweight, and obesity between northern and southern Nigeria by running bivariate logistic regression analyses. The results are presented in Table 2. Furthermore, the prevalence of underweight, overweight, and obesity across the 36 states and FCT was presented in charts (Figures 1, 3, and 5). Patterns of differences were shown on the Nigerian map and presented in Figures 2, 4, and 6.

At the multivariate level, nine models were computed using multivariate logistic regression. Models 1, 2, and 3 (presented in Table 3) show the predictors of underweight. Model 1 is the overall/Nigeria results. Models 2 and 3 are for north and south, respectively. The same analyses were done for overweight (Table 4) and obesity (Table 5). A summary of the influence of the four predictor variables on the three outcome variables is presented in Table 6 for easy view and comparison of the results between the two regions. The national models (models 1, 4, and 7) included region (north and south) as a predictor variable. The Hosmer–Lemeshow test was used to test the fitness of the models.

Results

Univariate and bivariate analyses

Some north-south differences are observed in the sociodemographic characteristics presented in Table 1. It was found that 72.3% of women from the north were Muslims, while 85.9% of those

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Table 1. Descriptive analysis of variables

	Overall		North		South	
Sociodemographic	*N* = 12751	%	*N* = 7179	%	*N* = 5572	%
Religion						
Islam	5883	46.1	5187	72.3	696	12.5
Christianity	6751	53.0	1963	27.3	4788	85.9
Others	117	0.9	29	0.4	88	1.6
Education						
No education	3903	30.6	3574	49.8	329	5.9
Primary	2067	16.2	1047	14.6	1020	18.3
Secondary	5445	42.7	2052	28.6	3393	60.9
Tertiary	1336	10.5	506	7.0	830	14.9
Use of contraceptive						
No	10535	83.6	6368	88.7	4167	74.8
Yes	2216	17.4	811	11.3	1405	25.2
Wealth Index						
Poorest	2114	16.6	2003	26.5	206	3.6
Poorer	2372	18.6	1940	25.7	564	9.8
Middle	2811	22.0	1687	22.3	1266	21.9
Richer	2867	22.5	1146	15.2	1845	31.9
Richest	2587	20.3	776	10.3	1900	32.9
Abnormal weights						
Underweight	1481	11.6	1110	15.5	371	6.7
Normal weight	7752	60.8	4658	64.9	3094	55.5
Overweight	2278	17.9	972	13.5	1306	23.4
Obesity	1240	9.7	439	6.1	801	14.4
Median (IQR)	22.2 (12.7–58.6)		21.4 (12.7–58.6)		23.4 (13.7–54.1)	

IQR: interquartile range.

from the South were Christians. Nationally, more than half (53.1%) of the women were Christians; 46.1% were Muslims, while 0.9% practised traditional religions.

The finding on regional differences in the level of education supports the arguments of north-south differences. Overall, the proportion of the sample with no formal education is 30.6%. The majority (42.7%) had secondary education. Approximately 11% of women had tertiary education, but the distributions varied across regions. In the north, 49.8% of the women had no formal education compared to 5.9% in the south. Only 29% women in the north had secondary education compared to 61% in the south. The proportion of women with tertiary education in the south (14.9%) is twice that of the north (7%).

Notable differences were also observed in the use of contraceptives. The national prevalence of contraceptive use was 17.4%. But it varied from 11.3% in the north to 25.2% in the south, and this reinforces the notion that the beliefs and values of southern Nigeria are in tandem with the health practices of the West (Alabi et al., 2022; Kunnuji et al., 2017). Cultural and religious beliefs shape

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Table 2. Regional differences in abnormal weights

Association between region and underweight						
				95% C.I. for EXP(B)		
	B	p	COR	Lower	Upper	Omnibus Test. χ^2 (p)
Region						122.989 (<0.001)
North	–	–	1	–	–	
South	−.687	<.001	.503	.444	.571	
Constant	−1.434	.000	.238			
Association between region and overweight						
				95% C.I. for EXP(B)		
	B	p	COR	Lower	Upper	χ^2 (p)
Region						215.650 (<0.001)
North	–	–	1	–	–	
South	.704	<.001	2.023	1.840	2.224	
Constant	−1.567	.000	.209			
Association between region and obesity						
				95% C.I. for EXP(B)		
	B	p	COR	Lower	Upper	χ^2 (p)
Region						263.797 (<0.001)
North	–	–	1	–	–	
South	1.010	<.001	2.747	2.424	3.113	
Constant	−2.362	.000	.094			

the use of contraceptives. Many northern Muslims believe that higher fertility is a way of worship and that contraceptives negatively affect women's health (Hutchinson et al., 2021). In addition, the belief in 'Qadar' (i.e. predestinations) in Islam runs contrary to the use of contraceptives because every human being will have the complete number of children they have been destined to have regardless of whether they use contraceptives. Hence, 'Muslim societies discourage the use of any contraception, and social networks actively inhibit the use of contraceptives through social pressure (and stigma)' (Budhwani et al., 2018, p. 5).

Regarding wealth level, 16.6% of Nigerian women were in the 'poorest' category, but the rate varied from 3.6% in the south to 26.5% in the north. Overall, the 'richer category' had the highest proportion of 22.5%, but the regional results varied – 15.2% in the north and 31.9% in the south. In summary, a larger proportion of northern women (26.5%) fell in the 'poorest' category, while only 10.3% fell in the richest category. Contrarily, most of the southern women (32.9%) were in the 'richest' category. Another 31.9% of southern women were in the 'richer' category. Only 3.6% and 9.8% of women in the south were in the 'poorest' and 'poorer' categories, respectively.

Overall, the prevalence of underweight was 11.6%. Underweight was more prevalent in the north (15.6%) than in the south (6.7%). As shown in Figure 1, the prevalence of underweight ranged from 6.9% in Enugu State of southeastern Nigeria to 31.6% in Jigawa State of northwest. Ten states (Jigawa, Yobe, Bauchi, Borno, Gombe, Adamawa, Kano, Zamfara, Sokoto, and Kebbi) with the highest prevalence of underweight were in the north. Contrarily, eight of the ten states with the lowest prevalence were from the south. The two exceptions were the Benue

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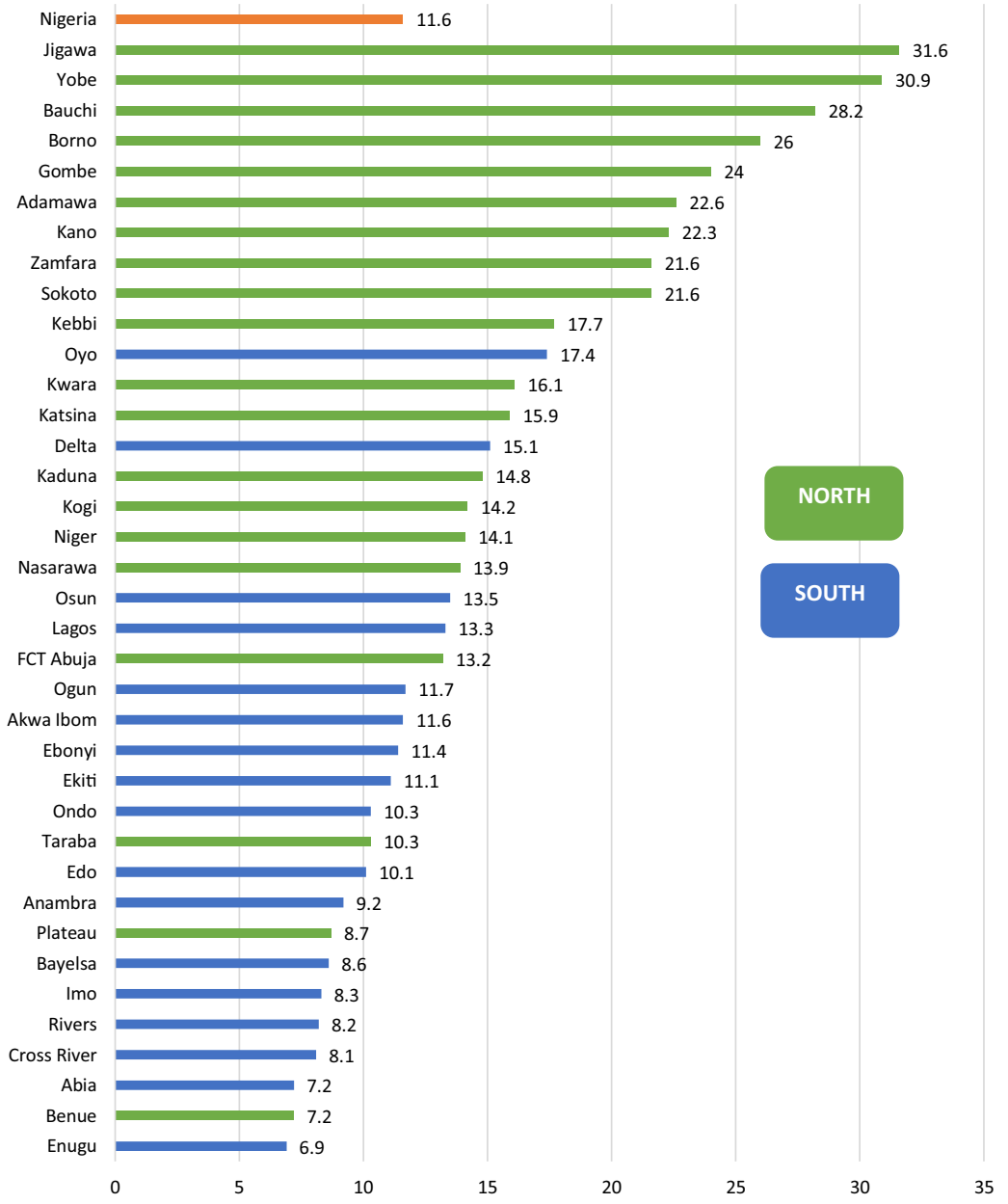

Figure 1. Distribution of underweight by states (%).

(6.9% – second lowest) and Plateau (8.7% – eighth lowest) States of north-central region. The ten states with the highest prevalence were equally shared between northwest and northeast geopolitical zones. Figure 2 shows the spatial distribution of underweight women on the Nigerian map.

The findings on the two other measures of abnormal weight suggest that the women in the north have healthier weight than their counterparts in the south. The prevalence of overweight nationally was 17.9% (13.5% in the north and 23.4% in the south). Figure 3 shows that the prevalence of overweight ranged from 6.7% in Jigawa to 39.9% in Lagos, the economic hub of

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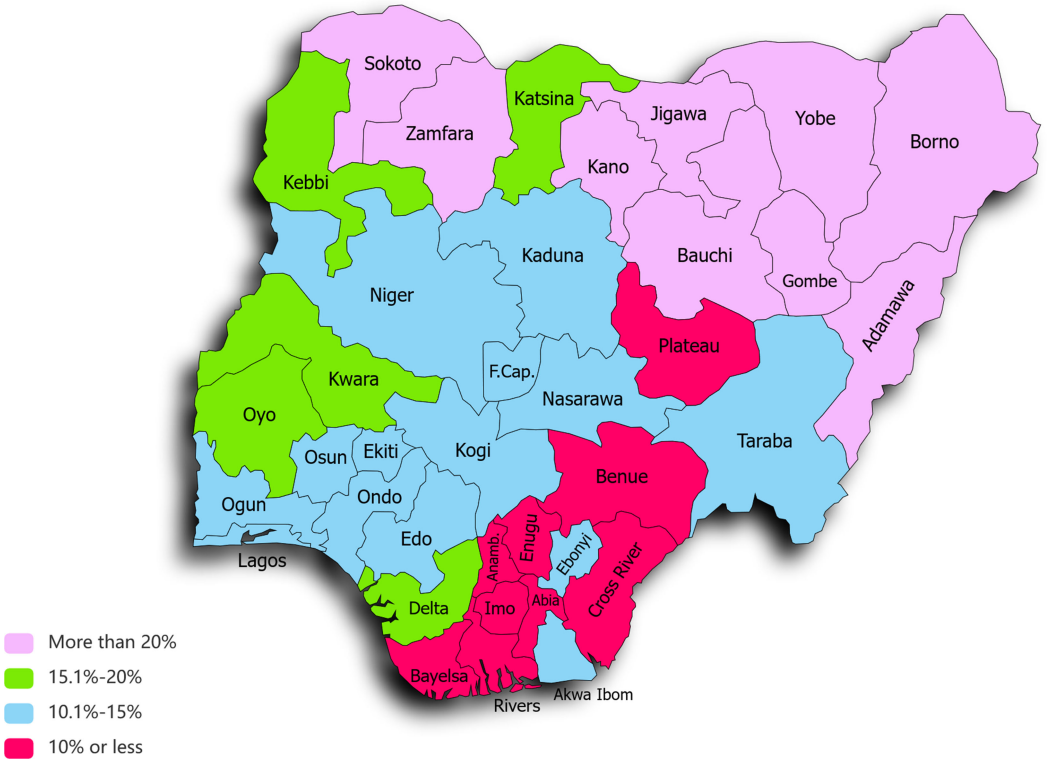

Figure 2. Map showing the proportion of underweight women across Nigerian states.

Nigeria. Sixteen states with the highest prevalence of overweight (except for the Federal Capital Territory, ranked ninth) in Nigeria are located in the south, while the eleven states with the lowest prevalence are in the north. Figure 4 shows this spatial distribution of the Nigerian map.

The prevalence of obesity among Nigerian women was 9.7% but with regional differences: 6.1% in the north and 14.4% in the south. As shown in Figure 5, Anambra State had the highest prevalence of 35.5%, followed by 35.1% in Lagos State and 27.6% in Imo State. Yobe state recorded the lowest prevalence of 2.1%, followed by Katsina State at 3.3% and Jigawa State at 3.6%. Figure 6 shows the spatial patterns on the Nigerian map.

In all, southern women recorded higher level of abnormal weights than northern women (44.5% vs 35.1%). The prevalence of abnormal weight varied from 27.6% in Benue State of northcentral to 57.6% in Lagos State of the southwest (see Figure 7). To check for statistical significance in the regional differences in the prevalence of underweight, overweight, and obesity, binary logistic regression tests were computed using only region (north and south) as the predicting factor. As shown in Table 2, women in the south appeared less likely to be underweight than women in the north (COR: 0.503; $p < 0.001$). Contrarily, women in the south were two times more likely to be overweight (COR: 2.023; $p < 0.001$) than their counterparts in the north. Southern women were 2.7 times more likely to be obese than northern women ($p < 0.001$).

Findings from multivariate analysis

Table 3 shows the predictors of underweight in Nigeria and across the two regions. Region appeared to remain a significant predictor of the three outcome variables at the multivariate level, but the effect size (gleaned from *p*-values) reduced in the three national models

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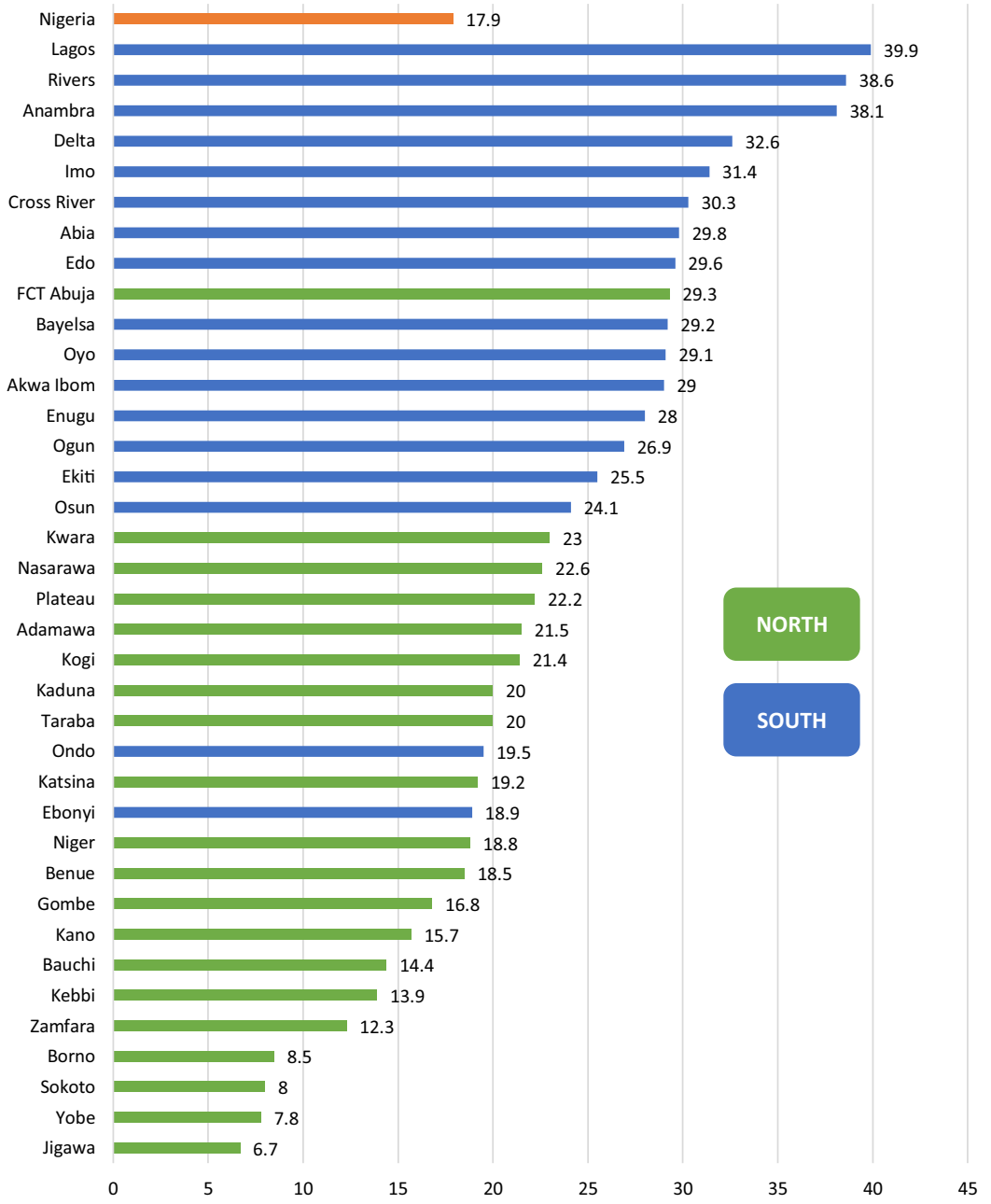

Figure 3. Distribution of overweight by states (%).

(models 1, 4, and 7). Model 1 shows that women from southern Nigeria were more likely to be underweight than those from the north (AOR: 0.831, p: 0.031). In comparison to Table 2, the predictive power of the region in Table 3 is lower when other variables were controlled for. Religion was a significant predictor across models 1, 2, and 3 in Table 3. The three models showed that Christians were significantly less likely to be underweight than Muslims. But the coefficient was higher in the north (β: −0.819; AOR: 0.441; $p < 0.001$) than in the south (β: −0.491; AOR: 0.612; $p < 0.001$).

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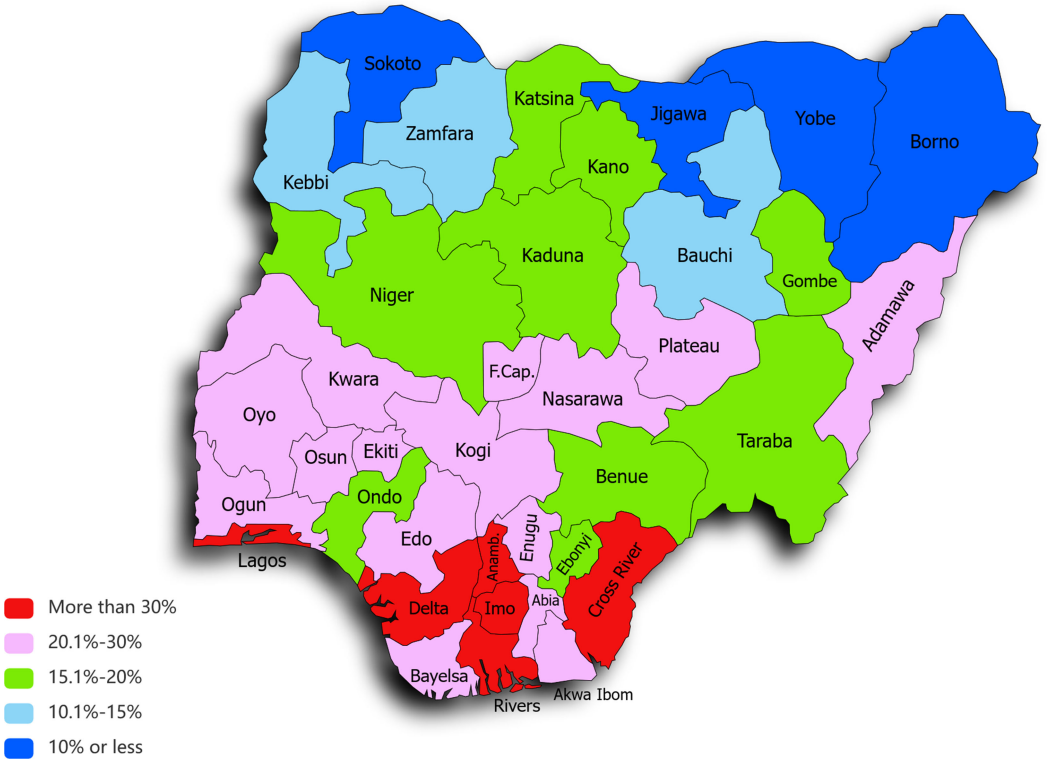

Figure 4. Map showing the proportion of overweight women across Nigerian states.

The analyses reveal evidence of regional differences in the influence of education on being underweight. At the national level, women with secondary education were 1.3 times more likely to be underweight than those without formal education (p: 0.003). In the north, the association was also significant but with mixed directions. As in the overall model, women with secondary education were more likely to be underweight than those without formal education (AOR: 1.304; p:0.006). But those with tertiary education had a lower likelihood than the reference category – no formal education (AOR: 0.646; p:0.046). In the south, education was not a significant predictor (p: 0.128).

The analyses show that contraceptive use significantly reduced the odds of being underweight across the three models. However, a slight difference was observed in the coefficients between the north (β: −0.279; AOR: 0.756; p: 0.047) and south (β: −0.561; AOR: 0.571; $p < 0.001$). Regarding the wealth index, Table 3 further showed that in Nigeria, women in the rich category were less likely to be underweight than those in the 'poorest' category. At the national level, the four other categories of the wealth index (poorer, middle, richer, and richest) were significantly less likely to be underweight than those in the poorest category. But the same pattern did not hold across the two regions. In the north, although wealth index was a significant predictor (p:0.011), only women in the poorer category (AOR: 0.757; p: 0.002) and middle category (AOR: 0.744; p: 0.004) were significantly less likely to be underweight than those in the poorest category. Those in the richer and richest categories did not differ significantly from those in the poorest category. In the south, however, only women in the richest category were significantly less likely to be underweight compared to those in the poorest category (AOR: 0.485; p:006).

Table 4 presents models 4, 5, and 6 – predictors of overweight in Nigeria, north and south. Women in the south were more likely to be overweight than those in the north (AOR: 1.140: p: 0.041).

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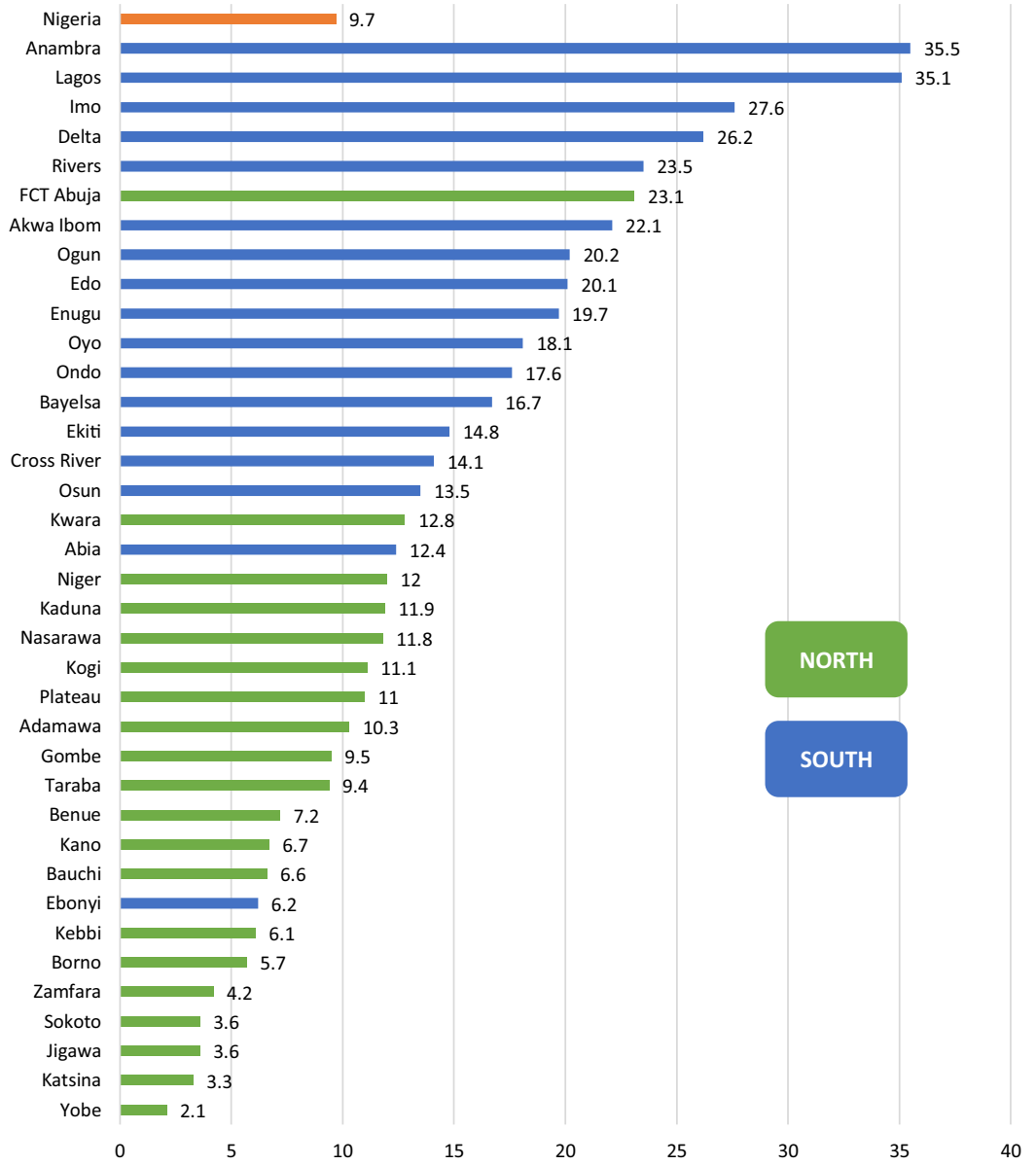

Figure 5. Distribution of obesity by states (%).

Table 4 shows that Christian women were more likely to be overweight than their Muslim counterparts across the three models (AOR for Nigeria: 1.468; AOR for North: 1.514; AOR for South: 1.444 – $p < 0.001$ in the three models).

Education was a significant predictor of overweight across the three models, but the direction was surprising. This study expected that the likelihood of being overweight would consistently reduce as the level of education increases. However, the analyses showed that only women who had secondary education were significantly different from those who had no formal education: Nigeria (AOR: 0.684, $p < 0.001$); North (AOR: 0.631; $p < 0.001$); South (AOR: 0.710; p: 0.027). Those with lower or higher than secondary education (primary and tertiary education) appeared not to be significantly different from those without formal education across models 4, 5, and 6.

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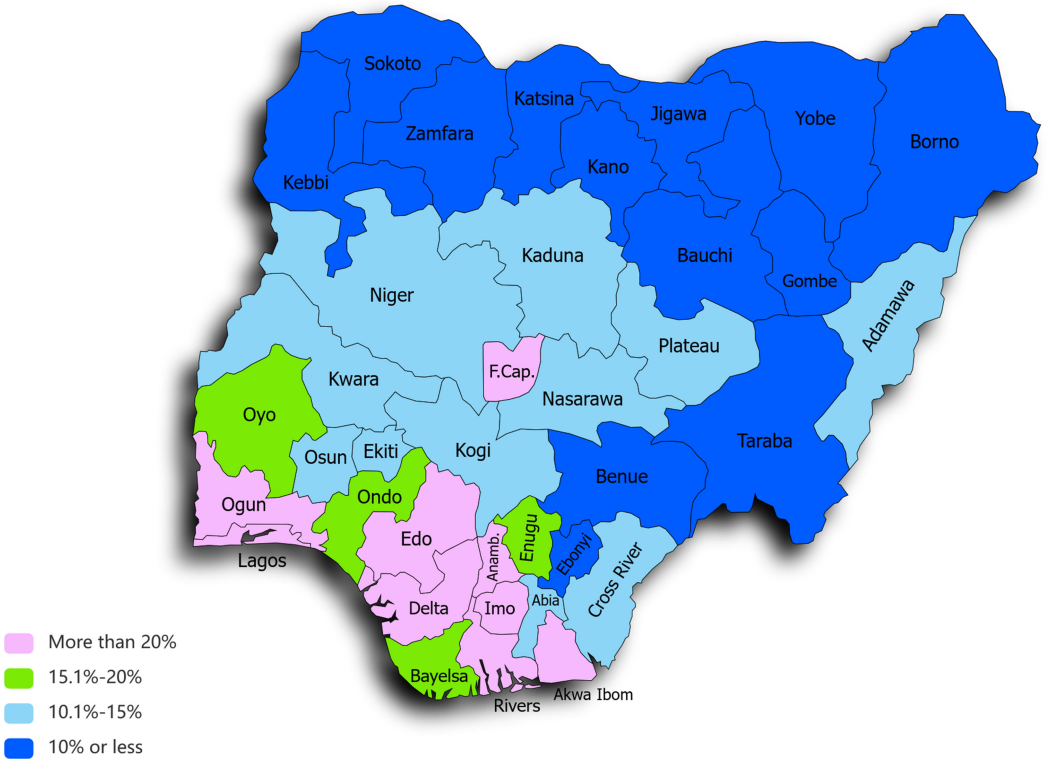

Figure 6. Map showing the proportion of women with obesity across Nigerian states.

Women who used contraceptives were significantly more likely to be overweight than those who did not use them across the three models. The odds were approximately 1.7 in Nigeria, 1.6 in the north, and 1.7 in the south ($p < 0.001$ in the three models). The analyses showed that the odds of being overweight increase with the wealth index across the three models. In the north, those in the richest category were 5.5 times more likely to be overweight than those in the poorest category; the AOR of the four categories shows a significant difference from the reference category. The AOR for the richest category in the south was 3.374. Those in the 'poorer' category did not differ significantly from those in the 'poorest' category.

Table 5 presents results on the predictors of obesity. The results show that women in the south were more likely to be obese than those in the north (AOR: 1.187; $p < 0.001$). The analyses showed that religion was a significant predictor of obesity in the overall model and in the north ($p < 0.001$ in the two cases) but not in the south (p: 0.065).

However, Christians were more likely to be obese than their Muslim counterparts across the three regions. In the north, the odds were 1.7 (β:0.544; $p < 0.001$) compared to 1.3 in the south (β:0.288; p:0.025).

Education was also a significant predictor of obesity across the three models but with some differences between the national model and the two regions. In the national model, women who had primary education were 1.3 times more likely to be obese than those with no formal education (p: 0.034), but the reverse was the case for those with secondary education (AOR: 0.718; p: 0.004). But in the north and south, only women with secondary education were less likely to be obese than those without formal education (β: −0.327; AOR: 0.721; p: 0.030 in the north; β: −0.545; AOR: 0.580; p:0.005 in the south). Surprisingly, women with tertiary education did not significantly differ from those without formal education across the three models in their likelihood of being obese.

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Table 3. Models showing the predictors of underweight in Nigeria and across regions

	Nigeria (Model 1)			North (Model 2)			South (Model 3)		
Predictors	B	p	AOR	B	p	AOR	B	p	AOR
South	−.185	.031	.831	–	–	–	–	–	–
Religion		<.001			<.001			.003	
Christianity	−.711	<.001	.491	−.819	<.001	.441	−.491	<.001	.612
Others	−.660	.067	.517	−.732	.236	.481	−.442	.331	.643
Education		<.001			<.001			.128	
Primary	−.140	.158	.869	−.190	.102	.827	.009	.974	1.009
Secondary	.252	.003	1.287	.266	.006	1.304	.335	.163	1.398
Tertiary	−.162	.304	.850	−.437	.046	.646	.206	.494	1.229
Using contraceptives	−.431	<.001	.650	−.279	.047	.756	−.561	<.001	.571
Wealth index		.004			.011			.033	
Poorer	−.276	.001	.759	−.279	.002	.757	−.320	.243	.726
Middle	−.256	.005	.774	−.296	.004	.744	−.294	.241	.745
Richer	−.262	.010	.769	−.212	.079	.809	−.452	.073	.636
Richest	−.384	.002	.681	−.117	.461	.890	−.723	.006	.485
Constant	−1.115	<.001	.328	−1.113	<.001	.329	−1.418	<.001	.242
	Omnibus test χ^2 (p): 279.949 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 7.307 (0.504)			Omnibus test χ^2 (p): 136.844 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 5.505 (0.599)			Omnibus test χ^2 (p): 37.339 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 4.104 (0.848)		

Reference category: North, Islam; no education; not using contraceptive; poorest.

Across the three models, the analyses show that women who used contraceptives were more likely to be obese than those who did not use contraceptives. The results also show that those who were rich were more likely to be obese than those who were in the poorest category ($p < 0.001$) across the three models. However, some differences were observed between the north and south. In the north, the finding was significantly consistent (the odds of being obese significantly increased with wealth index). But in the south, women in the poorer and middle categories did not differ significantly from those in the poorest (reference category). Table 6 summarises the influence of the four predicting factors on the three outcome variables in Nigeria, north, and south.

Discussion

This study investigated regional differences in the prevalence of abnormal weights in Nigeria. Interestingly, the study found that the two regions (north and south) have significant differences in the prevalence of abnormal weights, but the type of weight abnormalities is not the same between the two regions. While the north suffers underweight more than the south, the reverse is the case for overweight and obesity.

The finding that the two regions have notable differences in abnormal weights is in tandem with the reports of earlier studies that investigate north-south differences in Nigeria (Adejoh et al., 2023; Alabi, 2023; Alabi et al., 2022; Alabi & Ramsden, 2022). Specifically, the finding that the north has a higher prevalence of underweight than the south may suggest that southern women have a healthier weight than the northern women. However, the finding – that northern women

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Table 4. Models showing the predictors of overweight in Nigeria and across regions

	Nigeria (Model 4)			North (Model 5)			South (Model 6)		
Predictors	B	p	AOR	B	p	AOR	B	p	AOR
South	.131	.041	1.140	–	–	–	–	–	–
Religion		<.001			<.001			.002	
Christianity	.384	<.001	1.468	.415	<.001	1.514	.367	<.001	1.444
Others	.473	.057	1.605	.058	.926	1.060	.544	.058	1.722
Education		<.001			<.001			<.001	
Primary	−.051	.558	.951	.001	.993	1.001	−.109	.508	.897
Secondary	−.380	<.001	.684	−.460	<.001	.631	−.342	.027	.710
Tertiary	−.010	.925	.990	−.119	.436	.888	.040	.820	1.041
Using contraceptives	.512	<.001	1.669	.465	<.001	1.592	.531	<.001	1.701
Wealth index		<.001			<.001			<.001	
Poorer	.512	<.001	1.668	.505	<.001	1.658	.407	.107	1.502
Middle	.824	<.001	2.280	.915	<.001	2.497	.547	.021	1.728
Richer	1.240	<.001	3.457	1.272	<.001	3.566	1.009	<.001	2.742
Richest	1.511	<.001	4.531	1.704	<.001	5.493	1.216	<.001	3.374
Constant	−2.370	<.001	.093	−2.402	<.001	.091	−2.004	<.001	.135
	Omnibus test χ^2 (p): 673.435 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 4.566 (0.803)			Omnibus test χ^2 (p): 280.699 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 3.456 (0.903)			Omnibus test χ^2 (p): 185.267 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 1.838 (0.986)		

Reference category: North, Islam; no education; not using contraceptive; poorest.

have a higher prevalence of underweight than their southern counterparts – may be explained by at least two reasons: 'the Fulani factor' and poverty. As demonstrated in the introductory section, the Fulani are traditionally slim people (Egharevba et al., 2019; Ezeonwuka & Igwe, 2016; Sabir et al., 2011). To test the veracity of this belief, this study ran a bivariate test between ethnicity (comprising 11 different ethnic groups and 'others') to see if the Fulani significantly differ from other ethnic groups in their BMI and the prevalence of underweight. The results from logistic regression, chi-square, and analysis of variance (tables not shown) show that the Fulani women (1) have the lowest BMI and highest prevalence of underweight in Nigeria (see Figure 8) and (2) significantly differ from other ethnic groups in BMI and underweight, except for the Kanuri/Beriberi women who have similar scores and physical appearance as the Fulani.

It is unclear whether this is due to genetic factors, dietary/social factors, or a combination of both. However, it is well known that the Fulani people, especially the men, are traditionally nomadic and travel several kilometers with their herds on foot (Sabir et al., 2011), which may be a way of burning calories. It has also been established that the Fulani rely heavily on dairy products, especially unrefrigerated yoghurt and fresh milk (Adegboye et al., 2016; Vicente et al., 2019). One such food, which is common among the Fulani and Hausa, is 'fura de nunu' (a mixture of cereals – made from millet – and fermented cow milk). However, findings on the effects of dairy products on weight have been mixed. While a meta-analysis of randomized controlled trials reported that dairy products might assist weight loss (Stonehouse et al., 2016), a review study found that dairy products neither lead to weight loss nor increase weight gain (Willett & Ludwig, 2020).

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Table 5. Models showing the predictors of obesity in Nigeria and across regions

	Nigeria (Model 7)			North (Model 8)			South (Model 9)		
Predictors	B	p	AOR	B	p	AOR	B	p	AOR
South	.172	.039	1.187		–	–	–	–	–
Religion		<.001			<.001			.065	
Christianity	.442	<.001	1.556	.544	<.001	1.723	.288	.025	1.333
Others	.545	.086	1.724	.028	.979	1.028	.467	.176	1.595
Education		<.001			<.001			<.001	
Primary	.255	.034	1.291	.226	.159	1.253	.036	.860	1.037
Secondary	−.332	.004	.718	−.327	.030	.721	−.545	.005	.580
Tertiary	.183	.174	1.201	.205	.292	1.227	−.058	.787	.944
Using contraceptives	.547	<.001	1.728	.544	<.001	1.723	.537	<.001	1.711
Wealth index		<.001			<.001			<.001	
Poorer	.898	<.001	2.456	1.034	<.001	2.812	.288	.406	1.334
Middle	1.431	<.001	4.184	1.737	<.001	5.678	.553	.087	1.738
Richer	2.025	<.001	7.578	2.262	<.001	9.602	1.221	<.001	3.391
Richest	2.609	<.001	13.585	2.934	<.001	18.798	1.772	<.001	5.884
Constant	−3.955	<.001	.019	−4.233	<.001	.015	−2.625	<.001	.072
	Omnibus test χ^2 (p): 889.831 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 9.816 (0.278)			Omnibus test χ^2 (p): 390.498 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 4.006 (0.857)			Omnibus test χ^2 (p): 252.533 (<0.001) Hosmer & Lemeshow Test χ^2 (p): 3.911 (0.865)		

Reference category: North; Islam; no education; not using contraceptive; poorest.

Table 6. Summary of results

		Underweight			Overweight			Obesity		
S/N	Factors	Nigeria	North	South	Nigeria	North	South	Nigeria	North	South
1	Religion	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	X
2	Education	✓✓✓	✓✓✓	X	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
3	Contraceptives	✓✓✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
4	Wealth	✓✓	✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓

X: Not significant.
✓: $p < 0.05$.
✓✓: $p < 0.01$.
✓✓✓: $p < 0.001$.

As for the second plausible explanation (poverty), this study (as shown in Table 3) and an earlier study (Kandala & Emina, 2016) have found that the odds of being underweight decrease as wealth level increases. And since the poverty rate is higher in the north than in the south (see Table 1), it makes sense to expect a higher level of underweight in the former than in the latter because poor people may starve and be undernourished.

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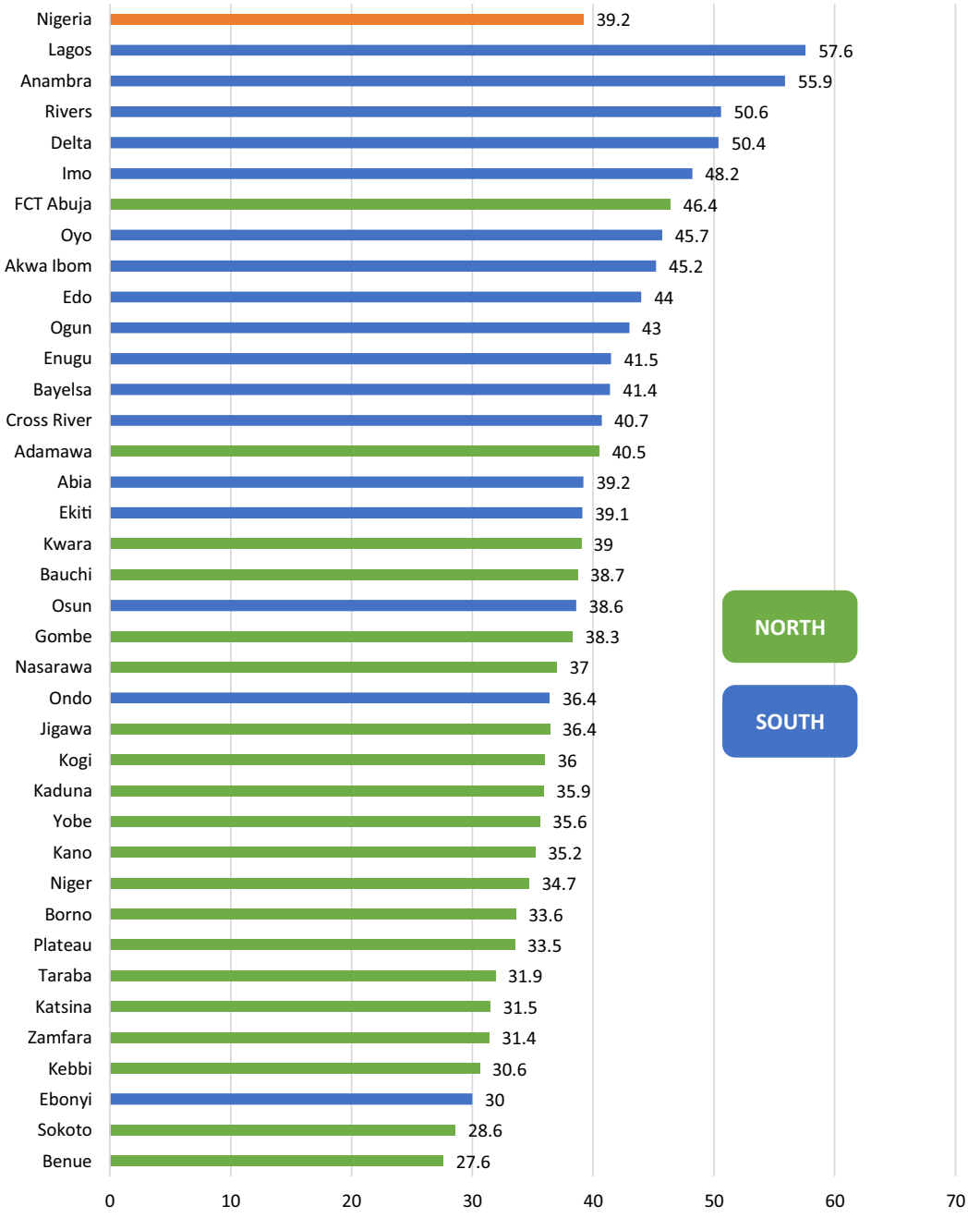

Figure 7. Distribution of abnormal weight by states (%).

This study shows that women from the south have higher odds of being overweight and obese than their counterparts from the north. Also, overall, southern women have weight abnormalities than their counterparts in the north (44.5% vs. 35.1%, $p < 0.001$).

There are plausible explanations for why women from southern Nigeria have higher risks of being overweight and obese than their counterparts from the north. One, high population density has been linked to overweight/obesity (Wang et al., 2019). The explanation provided by

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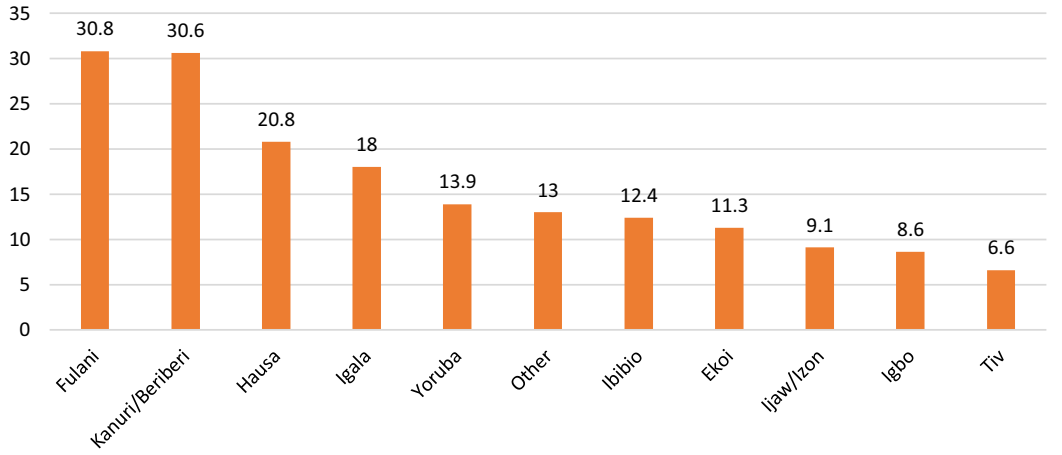

Figure 8. Prevalence of underweight by ethnicity in Nigeria (%).

Sun et al. (2022) is that 'a higher population density increases obesity risks by reducing levels of physical activity' (p. 144). To test this explanation, this study ran a bivariate correlation test between the population density of each state (using the 2006 population census figure) and BMI from the NDHS. The result returned a correlation coefficient of 0.52 ($p < 0.001$; table not shown), suggesting that the correlation between population density and weight in Nigeria is positive. In addition, the five states (Anambra, Lagos, Rivers, Delta, and Imo) with the highest prevalence of overweight and obesity are also the five states with the highest population densities in Nigeria. Furthermore, Yobe state, which has the lowest population density in Nigeria, recorded the second lowest prevalence of overweight and the lowest prevalence of obesity. In all, the average population density in the south is 503 persons per km^2 compared to 141 in the north.

A second reason is connected to culture and food. In the introductory section, Clement & Saibu's (2020) work was discussed, where the Yoruba people state that the Igbo eat high starchy and carbohydrate diets, and the latter accuses the former of eating oily foods. This study tested this intergroup labelling, with the anecdotal assumption that oily and starchy diets may lead to weight gain. It was found that the Igbo women of south-east have the second highest rate of overweight (30.6%) and obesity (23%) only after the contiguous Ijaw/Izon group (34.6% and 24.1% for overweight and obesity, respectively), see Figure 9.

Hence, it could be that the south, overall, consumes diets that are high in fat and carbohydrate frequently than the north. However, this is not to fat-shame people from a certain region or ethnic group or label their cultural diets, as the finding may also be a function of wealth, which this study found to be positively related to weight. A cross-tabulation of ethnicity and wealth (table not shown) shows that Igbo women of the south-east are the second richest group (34.2% in the richer category and 32% in the richest category) after the Yoruba of south west (32.5% and 39% in richer and richest categories, respectively). Many northern states have lower internal revenue than states in the south. This study (see Table 1) shows that the majority (26.5%) of women from the north fall in the poorest category, while the majority of those from the south are in the richest wealth index. By implication, while southern women may be able to afford any kind of food they want (including junk foods that are rich in fat, sugar, and carbohydrate) and can eat as many times as they want, northern women may have to limit the number of times they eat daily due to lack of funds. This study has indeed shown that the odds of overweight and obesity increase with wealth (see Tables 4 and 5).

A third reason is related to industrialization and the concentration of formal organization. Earlier studies have traced and connected the rise in global obesity to the change in the manner of agricultural production engendered by the industrial revolution (Gendler, 2014; Matthews, 2012).

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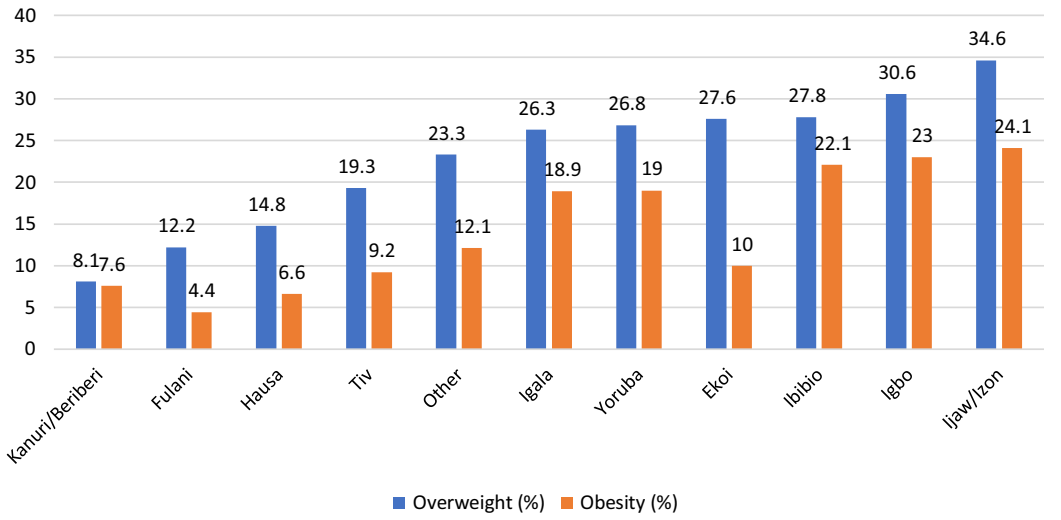

Figure 9. Overweight and obesity by ethnicity (%).

Industrialization and urbanization may come with fancy restaurants and food outlets selling fat-based foods. Also, formal organization comes with an increase in sedentary lifestyles. Southern states (such as Lagos, Anambra, Rivers, Imo, and Ogun) are more highly industrialized than northern states, and southern women are more likely to work in the formal sector than their counterparts from the north. For example, the current dataset shows that 11.6% of employed women in the south work at the professional/managerial level compared to 6.1% of northern women. Also, more women in the south work in the service sector than their counterparts from the north, but the reverse is the case for the agricultural sector. This means that southern women may have a higher sedentary lifestyle than those in the north. Perhaps, this may explain why southern women are overweight and obese more than their counterparts from the north.

The finding on the directions of the influence of wealth and education was surprising. Since wealth is supposed to increase with education (Mengesha Kassie et al., 2020), this study expected that they would have a similar influence on underweight, overweight, and obesity. But it was found that their influences are not the same: the odds of overweight and obesity increase with wealth, but those with secondary education have lower odds of overweight and obesity compared to those with no education. Our finding on the influence of education contradicts some earlier studies (Ahmed et al., 2020; Mengesha Kassie et al., 2020; Sarma et al., 2016; Tuoyire et al., 2016) that reported a positive association between the level of education and overweight and obesity. A common trend across these earlier studies is that (1) they analysed the demographic and health survey data in different countries of Africa and Asia and (2) they treated overweight and obesity as one outcome variable. This study advises future studies to, if possible, treat overweight and obesity as different outcome variables. However, a systematic review suggests that the association between education and obesity is negative in high-income countries but positive in low-income countries (Cohen et al., 2013). In this study, the effect of education on overweight and obesity cannot be said to be positive or negative because secondary education is the point where this study observed significant relationship across models 4–9. No significant effect of having tertiary education was observed in the same models. This is surprising and needs to be investigated further.

This study shows that Christian women have lower odds of being underweight compared to Muslim women in Nigeria and across the two regions. But the former (Christian women) have higher odds of being overweight and obese compared to the latter (Muslim women). Earlier

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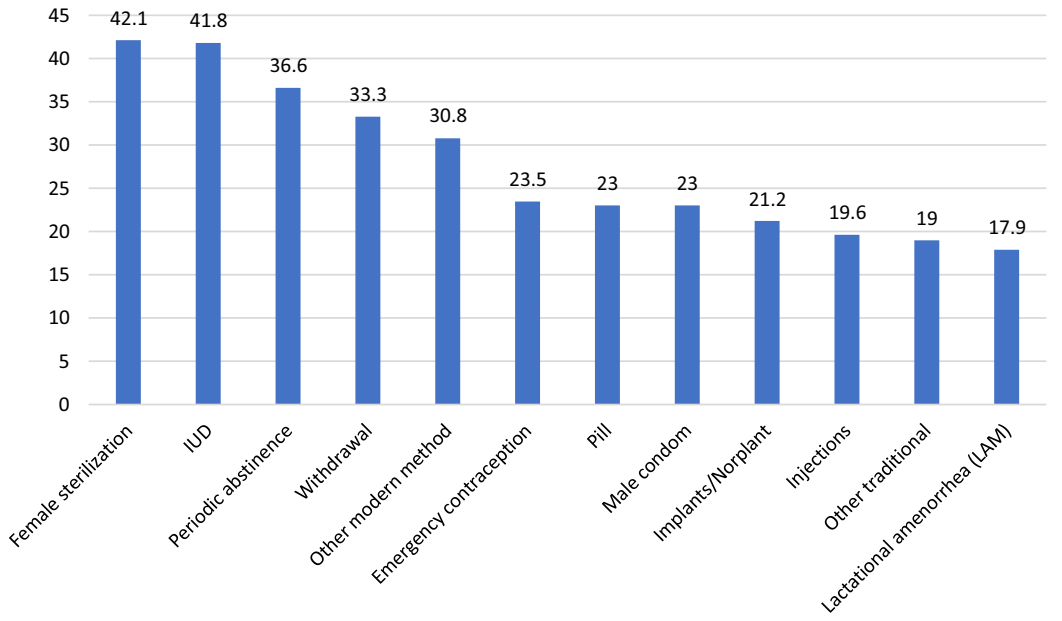

Figure 10. Prevalence of obesity by contraceptive methods (%).

studies on the influence of religion on body weight have shown mixed results (Bharmal et al., 2018; Yeary et al., 2017). However, Sibal (2018), in their explanation of the link between culture and food, hinted at why Muslims may have lower body weight compared to Christians: 'some food beliefs and practices are based on religion. Around the world, Muslims fast during Ramadan believed to be the month during which the Quran, the Islamic holy book, was given from God to the Prophet Muhammad. During this month, Muslims fast during daylight hours, eating and drinking before dawn and after sunset' (p. 3). Fasting in one calendar month may result in weight loss compared to those who did not fast at all, *ceteris paribus*. In addition, certain foods, including alcohol, which may cause weight gain, are strictly forbidden for Muslims. In some states in the north, there are reports of cases where Shari'a police destroy millions of bottles of alcohol and arrest the sellers (BBC News, 2022). Perhaps, this may explain why the coefficient of religion on the three outcome variables is higher in the north than in the south.

This study found that the use of contraceptives reduces the odds of being underweight and increases the likelihood of being overweight and obese in Nigeria and across the two regions. This finding corroborates Mangemba & San Sebastian (2020) study in Zimbabwe. The finding on the influence of the use of contraceptives is mixed in earlier studies. Vahratian et al. (2009) reported that contraceptive use had no significant influence on overweight or obesity after controlling for confounding variables (but it was significant when tested alone without any confounding variables). Similarly, Agrawal and Agrawal (2011) reported that when sociodemographic characteristics are controlled for, there was no observed significant effect of long duration use of IUD and sterilization on overweight/obesity, but prolonged use of pills was found to increase risk of overweight/obesity in their study. However, the finding of this study shows that use of contraceptives affects and changes body weight (Ajayi et al., 2018). This study ran a bivariate analysis to ascertain which contraceptive method is associated with abnormal weights, and it was found contraceptive methods were only associated with obesity but not associated with underweight and overweight. The analysis shows that 42.1% of those who did female sterilization were obese compared to 41.8% of those who had IUD and 19.6% of those took injectiions. See Figure 10.

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Limitations

This study has a few limitations. One, Nigeria is diverse, and cultural variations are not limited to North and South. For instance, this study demonstrates differences between Igbo and Yoruba, but the two ethnic groups are domiciled in the same southern region. By implication, variations exist within the same region and even within the same geopolitical zone. Hence, north-south comparison is narrow and does not show the extent of cultural diversity in Nigeria. Two, NDHS has limited variables on adult nutrition and diets, which does not allow this study to empirically investigate the association between the consumption of certain cultural diets and abnormal weights.

Three, readers may wonder why this study did not include ethnicity – as an important cultural variable – as one of the predictor variables. It is understandable that with migration, people of different ethnic groups may be found everywhere across the country. However, people of certain ethnic groups in Nigeria (especially women) are domiciled in a particular region. For example, the dataset shows that 98.9% of Hausa and 98.1% of Fulani women analysed in this study reside in the north, while 95.6% of the Igbos reside in the south. Hence, it will be difficult, for instance, to test for the effect of ethnicity in the two regions.

Conclusion

This study has shown that there are differences in weight abnormalities between the north and south and variations among ethnic groups. Unlike earlier studies (Alabi et al., 2022; Alabi & Ramsden, 2022) that suggest that the south may have better health and social indicators than the south, this study, like that of Adejoh et al. (2023), found the reverse. Women in the north have healthier weight than their counterparts in the south. Although a notable proportion of women in both regions have weight abnormalities, they type of abnormalities each region experiences is different from the others. The south suffers mostly from overweight and obesity, but the north has higher proportion of underweight. Future studies are encouraged to further investigate north-south differences in social and health outcomes and behaviours.

In addition, there is evidence that weight may vary by ethnicity and religion, and this supports the argument that food is cultural and that each ethnic and religious group may have a diet or cultural practices that may reduce or increase their weight and body size. There is evidence that Muslims have lower body weights than those who practice other religions. Perhaps, a future research collaboration between dieticians and social scientists may be apposite to investigate the amount of calories in the peculiar diets of major ethnic groups in the country and their implications for body weight.

Against the logic of the nexus between education and wealth, the two variables affect weight abnormalities differently. Overnutrition increases consistently with wealth, but the same association does not hold for education. This study found evidence that the use of contraceptives may increase women's weight, that is, those who use contraceptive tend to have higher weights than those who do not. However, a longitudinal study may be required to scientifically ascertain what contraceptive methods are associated with weight gain.

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Cite this article: Alabi TA and Badru OA (2024). Slim north, fat south: explaining regional differences in abnormal weights in Nigeria. *Journal of Biosocial Science* **56**, 207–231. https://doi.org/10.1017/S0021932023000238