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Decomposing inequality in the incidence of obesity in Nigeria

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Abstract

This study examines the socioeconomic factors responsible for income and gender related inequalities in the prevalence of obesity in Nigeria. It uses the 2013 Demographic Health Survey (DHS) on Nigeria for all the analyses. Oaxaca-Blinder decomposition was used to identified and explained socioeconomics factors responsible for disparities in the incidence of obesity in the country. The decomposition results show that females are more likely to be obese than males while the rich are more likely to be obese than the poor. Endowment and coefficient effects contributed to the gender obesity while the coefficient and interaction effects contribute significantly to the gap due to differences in income levels. Finally, the study recommends awareness creation, indoor physical exercises, balance diet, public health education, cultural and value re-orientation and establishing gymnasium, especially for rich and female households, as solution to the problem of overweight and obesity in Nigeria.

Keywords: Obesity; BMI; Overweight; Oaxaca-Blinder Decomposition

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1. Introduction

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health, leading to reduced life expectancy and/or increased health problems. Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis. Obesity is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility, although a few cases are caused primarily by genes, endocrine disorders, medications, or psychiatric illness. Evidence to support the view that some obese people eat little yet gain weight due to a slow metabolism is limited. On average, obese people have greater energy expenditure than their thin counterparts due to the energy required to maintain an increased body mass.

Assessment is usually done by weighing the patient and relating weight to height. The weight (W) in kilograms over height (H) in meters2 (H2) gives an index commonly referred to as the body mass index (BMI). The measure of BMI is used to differentiate 30 but <35, classes of obesity in patients. Class I, II and III obesity are identified with BMI of ≥ 35 but <40, and ≥40, respectively. A Person with a BMI <25 is not obese.

Despite BMI being a rough guide, it is nevertheless the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, one study found that BMI underestimates obesity especially in women with high leptin levels (>30ng/ml), although the accuracy can be improved by using the revised leptin levels to estimate body fat percentage when dual-energy X-ray absorptiometry (DEXA) is available. Though it is determined by a number of methods, but body mass index (BMI) has become the measurement of choice for many obesity researchers and health professionals. BMI is a practical indicator of the severity of obesity. A more important aspect of obesity is the regional distribution of excess body fat.

Mortality and morbidity ratio vary with the distribution of body fat, with the highest risk linked to excessive abdominal fat, usually called as Central obesity.

Waist circumference is a useful measurement to the risks associated with obesity. Waist circumference and BMI are interrelated; waist circumference provides an independent prediction of risk over and above that of BMI. Prevalence of obesity varies amongst countries depending upon environmental and behavioral changes brought about by economic development, modernization and urbanization. The variation in prevalence of obesity epidemic in various races and communities of the world may be attributed to heredity, age, sex, diet, eating patterns, life style and/or behavior.

Obesity develops as a result of a complex interaction between a person's genes and the environment characterized by long-term energy imbalance due to excessive caloric consumption, insufficient energy output (sedentary lifestyle, low resting metabolic rate) or both. Diet and life style play a significant role both in development and control of obesity. A virus Ad-36 found in obese individuals may be an additional factor to the escalating prevalence of obesity.

Every individual needs a certain amount of body fat for stored energy, heat insulation, shock absorption and/or other functions. However, excessive deposition of fat in the body, which is usually referred as overweight or obesity in literature, is dangerous. Obesity specially refers to having an abnormally high proportion of total body fat (WHO, 1998; NHLBI, 1998). As a rule, women have more body fat than men. Most health care providers agree that men with more than 25% total body fat and women with more than -30% total body fat should be considered obese.

Obesity is one of Nigeria's major health problems, with a prevalence range of 8.1%–22.2%. It is associated with a myriad of health problems, which can be classified into major and minor diseases. The major diseases associated with obesity include hypertension, diabetes mellitus, and atherosclerosis, as well as certain types of cancer. There are also many additional less-known complications of the disease. The major and minor health diseases associated with obesity exert a toll on the meager incomes of sub-Saharan African countries, including Nigeria. In many developed countries, the annual health care costs of managing obese patients run into several billions of US dollars.

2. Conceptualization of overweight and obesity

The Rational Addictive hypothesis postulates that past consumption of a good has a strong positive impact on current consumption of such a good. This in turn raises both future weight and the desire to eat more in the future (Rosin, 2008). Becker and Murphy, (1988) expounded this hypothesis in their efforts to find the reasons behind people's strict adherence to risky health behaviors like overeating, smoking and drug abuse. The theory assumes that addictions are rational as addicted subjects maximize their utility. Thus, addiction is an outcome of "a consistent plan to maximize utility over time". Cawley, (2004) develops another economic theory on obesity in his attempt to examine the underlying economic factors accounting for the upsurge in the prevalence of overweight and obesity. Economics views people as rational beings who maximize the present discounted value of their utility over their lifetime subject to their limited resources.

Menyanga, El-Sayed, Doku and Randall, (2014) reveal that Egypt had the least rate of underweight (12.6 per cent) while Djibouti had the highest rate (31.9 per cent); Ghana had least overweight prevalence (8.7 per cent) and Egypt had the highest prevalence (31.4 per cent). Obesity ranges from 0.6 per cent (Benin) to 9.3 per cent (Egypt). Moreover, females had a higher prevalence of overweight for all ages in all of the countries except Egypt and Malawi. Guedes, Rocha, Silva, Carvalhal and Coelho, (2011) relate that the probability of being overweight was higher for children who engaged in paid work, whose parents had higher education levels, who had two or fewer siblings and who were in a high economic class. Ramesh et al. (2009) says that prevalence of obesity was higher among boys and higher among children from high and middle socioeconomic groups. Agbeko, Akwasi, Andrews and Gifty, (2013) discover that age, education and wealth status had positive effects on overweight and obesity while having four or more children had a negative impact on the overweight and obesity. Other studies that explored socioeconomics effects on obesity include; Cawley et al. (2010), Devaux et al. (2011), Glanz et al. (2002), Knai et al. (2012), WHO (2014) and Okafor et al. (2014). However, none of these studies attempt to decomposed incidence of obesity in Nigeria with the aim of gaining deeper understanding of the problem in order to proffer better solutions.

3. Model specification and data source and methodology

Generally, this study relies on economic framework of Cawley's (2004) theory to model the possible determinants of excess body weight as hypothesized by all the theories. This is because the model gives room for the inclusion of other determinants of obesity.

Thus,

$$BMI = f(Time, Budget, Biological\ \&other\ Constraints) \ldots \ldots \ldots \ldots \ldots \ldots (5)$$

The structural form becomes:

$$BMI_i = \delta_1 + \delta_2 Time_i + \delta_3 Bud_i + \delta_4 Bio_i + \cdots + \delta_n Others_i + \mu_i \ldots \ldots \ldots \ldots . (6)$$

Where:

$BMI_i = Body\ Mass\ Index$;

$Time_i = proxied\ by\ age$;

$Bud_i = \ wealth\ index$;

$Bio_i = gender$;

$Others_i = \ socioeconomic\ factors$;

This study uses data from 2013 Demographic and Health Survey (DHS) on Nigeria sponsored by USAID. In order to explain regional and gender differences in prevalence of obesity and overweight, the model of Oaxaca-Blinder decomposition is used here (Blinder 1973, and Oaxaca, 1973). The model could be used to analyse regional and gender disparities in prevalence of obesity and overweight by decomposing the outcome variables between the regions, and gender into a part explained by differences in observed characteristics and the remaining part to be captured by differences in the estimated coefficients. Given the two groups A and B in both region and gender, the Oaxaca-Blinder decomposition model was derived as follows:

$$GOB = E(BMI_A) - E(BMI_B) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (8)$$

Where GOB is the gap in the prevalence of obesity or overweight; and $E(BMI_A)$ indicates the expected value of the outcome variable for group A (e.g Male) and $E(BMI_B)$ is the expected value of the outcome variable for group B both explained by the group differences in the predictors. Equation (10) was derived on the basis of the linear model stated in equation (5) below given equation (8).

$$BMI_\ell = X_\ell \delta_\ell + \mu_\ell \ldots \ldots \ldots \ldots . . \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (9)$$

Where$E(\mu_\ell) = 0, \ell \epsilon \{A, B\}$; X contains all the predictors, δ is a series of parameters and the constant, and μ is the error term. Equation (9) can be used to express the mean outcome difference in form of linear prediction at the group-specific means of the explanatory variables. Thus,

$$GOB = \ E(BMI_A) - E(BMI_B) = E(X_A)'\delta_A - E(X_B)'\delta_B \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (10)$$

Given that:

$$E(BMI_\ell) = E[(X_\ell)'\delta_\ell + \mu_\ell] = E[(X_\ell)'\delta_\ell] + E(\mu_e) = E[(X_\ell)'\delta_\ell] \ldots . . (11)$$

Where $E(\delta) = \delta$ and $E(\mu) = 0$ based on theoretical assumption. Equation (8) was derived below to determine the contribution of group differences in predictors to the overall outcome difference.

$$GOB = [E(X_A) - E(X_B)]'\delta_B + E(X_A)'(\delta_A - \delta_B) + E[(X_A) - (X_B)]'(\delta_A - \delta_B) \dots\dots (12).$$

Equation (12) contains three decompositions, which was split into the following parts:

$$GOB = E + C + I$$

The first part$[E(X_A) - E(X_B)]'\delta_B$ explains the group differences in the predictors (the endowment effect). The second part $E(X_A)'(\delta_A - \delta_B)$ captures the contribution of differences in the coefficients inclusive of the intercept differences. The last part $E[(X_A) - (X_B)]'(\delta_A - \delta_B)$ is an interaction term accounting for the possible multicollinearity in the differences in endowments and coefficients between the groups.

Note that the decomposition in equation (8) above is constructed from the perspective of Group B. This signifies that the group differences are adjusted by the coefficients of Group B to find the endowment effect (E) and coefficients (C). That is, E, C and I measures the expected variation of Group B's mean outcome should it assumes the predictor's levels of Group A. Also, the negative coefficient of Oaxaca-Blinder decomposition tells us that such a variable is narrowing the gap but positive value implies widening of the gap for the group under consideration. This is so because the Z-scores are multiplied by -1.

4. Presentation and discussion of results

Table 1 suggests that out of the 38,522 households being surveyed, it was the BMI information of only 25,248 households that had been successfully collected. As such, the total observation of the BMI is 25,248.

Table 1. Distribution of BMI in Nigeria 2013

S/No.	Body Size(BMI)	Frequency	Percentage
1.	Normal Weight	17,082	67.66
2.	Overweight	5,643	22.35
3.	Obesity	2,523	9.99
4	Sub-total	25,248	100
5.	Missing Data	13,274	
6.	Total	38,522	

Source: Authors Computation

It is shown in the table however that the households with normal weight (18.5-24.99kg/m^2) are 67.66 per cent (17,082), while those with overweight (25-29.99kg/m^2) are 22.35 per cent (5,643), all of the total observation. Moreover, 9.99 per cent (2,523) are obese (greater than or equal to 30kg/m^2. This implies that rate of obesity has increased significantly in Nigeria from 2008 to-date because it was just 6.5 per cent in 2008. Table 2 depicts some socioeconomic features of the households being surveyed in terms of age, years of education and household size.

Table 2. Other Socioeconomic Characteristics of Households in Nigeria 2013

Variables	Observation	Mean	Std. Dev.	Min	Max
Age in years	38446	45.39598	16.1991	10	95
Education Years	38079	6.563171	5.816255	0	20
Household Size	38522	4.643944	3.108378	1	35

Source: Authors computation

The age information for 38,446, education information for 38,079 and information about household size for 38,522 households had been collected.

It is further shown in the table that the mean age of the observation is 45.40 years with age range of 10-95 years, thereby resulting in the standard deviation of 16.20 years. The mean years of education are 6.56 which are also ranging from 0 to 20 years leading to standard deviation of 5.82 years. Finally, the household size is revealed to range from 1 to 35 people with mean and standard deviation of about 5 and 3 people respectively.

Table 3 shows the determining factors of gender disparity in prevalence of obesity, as asserted by some literatures and validated by binary results above .that women are more prone to obesity than men. Column (ii) in the table shows the mean predictions of being obese of male and female households. The mean prediction of male is 0.082 while that of female 0.109, resulting obesity-likelihood gap of -0.026. This means that males are 0.026 less likely to be obese than females.

This gap has been further divided into three major parts: the overall endowment, overall coefficient and overall interaction effects. The endowment effects contributed significantly to the gap by 0.0224 or 45.90 per cent. This implies that for female to be as less likely to be obese as male, female must have her born-with features improved by 45.90 per cent. It is shown moreover that the overall coefficient effects contributed significantly to the obesity-likelihood gap by -0.0438 or by -54.10 per cent. This means the female lifestyle in relation to obesity must reduce by 54.10 per cent for them to be as less likely to obesity as their male counterparts.

Table 3. Oaxaca-Blinder Decomposition of Gender Disparity in Obesity Prevalence

VARIABLES	(1) Differential	(2) Endowment	(3) Coefficient	(4) Interaction
Age in years		-0.00849***	-0.150*	0.00244
		(0.00325)	(0.0837)	(0.00161)
Age-squared		0.0108***	0.0987**	-0.00388*
		(0.00346)	(0.0424)	(0.00200)
Edu-years (log)		0.00678***	-0.0243	-0.00165
		(0.00148)	(0.0228)	(0.00155)
Household size (log)		0.00826***	0.0169**	0.00528**
		(0.00238)	(0.00827)	(0.00259)
Marital status		0.00825**	0.00221	0.00191
		(0.00385)	(0.00526)	(0.00455)
Rural		-0.00239***	-0.00290	-0.000484
		(0.000811)	(0.00496)	(0.000829)
North		0.00727**	-0.00735**	-0.00849**
		(0.00313)	(0.00290)	(0.00335)

Poor		-0.00741***	0.00535***	0.00455***
		(0.00152)	(0.00182)	(0.00156)
Hausa		-0.00187	-0.000450	-0.00273
		(0.00424)	(0.000711)	(0.00430)
Yoruba		-0.000154	0.000205	-4.53e-05
		(0.000746)	(0.00370)	(0.000815)
Igbo		0.00137	0.00648*	-0.00199*
		(0.00102)	(0.00364)	(0.00113)
Male	0.0824***			
	(0.00193)			
Female	0.109***			
	(0.00479)			
Difference	-0.0264***			
	(0.00516)			
Endowments	0.0224***			
	(0.00609)			
Coefficients	-0.0438***			
	(0.00561)			
Interaction	-0.00507			
	(0.00647)			
Constant			0.0111	
			(0.0505)	
Observations	24,554	24,554	24,554	24,554

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: Authors computation

The interaction effects of endowments and coefficients are found to contribute insignificantly to the gap. The endowment effects of the individual variables show that marital status and Northern region contributed significantly to the gap by 0.0082 and 0.0073 respectively all at 5 per cent level of significance whereas rural locality and poor wealth index contributed by -0.0024 and -0.0074 respectively at 1 per cent. Also, household size and years of education contributed to the gap by 0.0083 and 0.0068 respectively at 1 per cent while age and age squared contributed to the gap by -0.0085 and 0.0085 respectively all at 1 per cent. The remaining variables are statistically insignificant. The coefficient effects of the individual variables reveal that household size and Northern region contributed to the gap by 0.0169 and -0.0074 at 5 per cent and 1 per cent respectively whilst poor wealth index and Igbo contributed by 0.0053 and 0.0065 at 1 per cent and 10 per cent respectively. Finally, age linear and age nonlinear contributed by -0.1498 and 0.0987 at 10 per cent and 5 per cent respectively but the remaining variables are insignificant.

Furthermore, the interaction effect of individual variables tell us that household size and Northern region contributed to the gap by 0.0053 and -0.0085 at 5 per cent respectively but poor wealth index and Igbo contributed by 0.0046 and 0.0020 at 1 per cent and 10 per cent respectively. Finally, the age linear and nonlinear contributed by 0.0024 and 0.0039 at 10 respectively. Note that negative value indicates narrowing of the gap while positive shows widening of the gap.

Table 4 contains the empirical results of Oaxaca-Blinder decomposition on poor-nonpoor inequality in the probability of being obese. Column (ii) of the table indicates that the mean predictions of being obese for non-poor and poor households are 0.0997 and 0.0277 at 1 per cent respectively. This is associated with a difference of 0.0720, which suggests that non-poor households are 0.0025 more likely to be obese than poor households. This gap can be further disintegrated into three major components: the endowment, coefficient and interaction effects. The overall endowment effects contributed insignificantly to the gap.

Table 4. Oaxaca-Blinder Decomposition of Poor-Nonpoor Disparity in Obesity

VARIABLES	(1) Differentials	(2) Endowment	(3) Coefficient	(4) Interaction
Age in years		0.00656***	0.305***	0.0175***
		(0.00250)	(0.0544)	(0.00356)
Age-squared		-0.00629**	-0.136***	-0.0164***
		(0.00245)	(0.0253)	(0.00342)
Female		-0.00105	0.00666***	0.00570***
		(0.000789)	(0.00113)	(0.000994)
Edu-years (log)		0.000857	0.0911***	0.0172***
		(0.00182)	(0.0134)	(0.00255)
Household size (log)		-0.00398***	0.0467***	-0.00819***
		(0.00119)	(0.00845)	(0.00153)
Marital status		-0.000359	0.0227***	-0.00274***
		(0.000852)	(0.00864)	(0.00106)
Rural		0.00207	-0.0331***	0.0175***
		(0.00449)	(0.00937)	(0.00496)
North		0.00479	0.00961	-0.00516
		(0.00322)	(0.00710)	(0.00382)
Hausa		0.00226*	-0.0134***	0.00958***
		(0.00124)	(0.00297)	(0.00214)
Yoruba		0.000659	-7.78e-05	-0.000466
		(0.00319)	(0.000572)	(0.00342)
Igbo		-0.00203	0.00233*	0.00268*
		(0.00141)	(0.00137)	(0.00157)
Group 1 (nonpoor)	0.0997***			
	(0.00211)			
Group 2 (poor)	0.0277***			
	(0.00249)			
Difference	0.0720***			
	(0.00327)			
Endowments	0.00348			
	(0.00530)			
Coefficients	0.0313***			
	(0.00468)			
Interaction	0.0372***			
	(0.00630)			
Constant			-0.270***	
			(0.0340)	
Observations	24,554	24,554	24,554	24,554

*Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1*

Source: Authors computation

However, the coefficient effects contributed significantly to the gap by 0.0313 or 43.45 per cent while the interaction term contributed to the gap by 0.0372 or 51.67 per cent, all at 1 per cent. In terms of endowment effects of individual variables, it is established that household size and Hausa contributed significantly to the gap by -0.0040 and 0.0023 at 1 per cent and 10 per cent respectively whereas age linear and age nonlinear contributed significantly to the gap by 0.0066 and 0.0063 at 1 per cent respectively. The remaining variables are statistically insignificant.

In the area of coefficient effects of individual variables, it is demonstrated that marital status and rural locality contributed significantly to the gap by 0.0223 and -0.0331 at 1 per cent respectively but household size and education contributed by 0.0467 and 0.0918 at 1 per cent respectively. While gender and Hausa contributed to the inequality by 0.0067 and -0.0134 at 1 per cent respectively; Igbo contributed by 0.0023 at 10 per cent. Lastly, age linear and age nonlinear contributed to the inequality by 0.3054 and -0.1365 at 1 per cent whilst the remaining variables are insignificant.

With respect to interaction effects of individual variables, it is also found out that marital status and rural locality contributed significantly to the inequality by -0.0027 and 0.0175, and household size and education contributed by -0.0082 and 0.0172 respectively. More so, gender and Hausa contributed to the inequality by 0.0057 and 0.0096, and age linear and age nonlinear contributed to the inequality by 0.0175 and -0.0164 respectively. These are significant at 1 per cent. Igbo contributed to the inequality by 0.0027 at 10 per cent but the remaining variables are insignificant.

5. Conclusion and recommendation

From the study, Oaxaca-Blinder decomposition results show that there is really a gap in likelihood of being obese between women and men in Nigeria. Precisely, women are 0.0264 more probable to be obese than their men counterparts. This is majorly as a result of differences in endowments and other socioeconomic characteristics. In terms of endowment effects, it is the disparities in marital status, household size, years of educations, locality, region and wealth index, that are responsible for the gap. In the area of coefficient effects, it is also the differences in age, household size, region, wealth index and Igbo culture that determine the gap between the two groups. Lastly, with reference to interaction effect, it is the variations in age, household size, region, wealth index and Igbo, that cause the gap.

Similarly, the decomposition results validate the report that there is disparity in likelihood of being obese between the poor and non-poor households. Specifically, the results reveal that non-poor households have higher tendency to be obese by 0.0720 than the poor households. It is coefficient and interaction effects that mainly bring about the gap between the two groups. In both coefficient and interaction effects, it is the variations in age, marital status, household size, years of education, rural locality, gender, Hausa and Igbo, that led to the gap between the two groups. However, in terms of endowment effect, differences in age, household size and Hausa tradition are found to be responsible for the inequality.

First, government should undertake cultural and value re-orientation and a holistic awareness creation campaign to enlighten the masses (especially women and non-poor) on the importance of balance diet and participating in physical exercises like jogging, walking and whole lot of others through radio and TV programmes. Second, individual households, on their own, should be watching their diet and be also organizing indoor physical exercises for themselves, as these will not only normalize their weight but also strengthen cordial relationship among the members of households. Moreover, this can be done on Saturdays or any other work-less day.

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