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Research Article

Independent Effect of Income and Energy Intake on Obesity Among Nigerian Adults Population of Abeokuta, Ogun State, Nigeria

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Abstract

Income and energy intake are increasingly involved in the maintenance of nutritional status. A positive correlation between nutrition and economic prosperity to has been widely documented. This study examined the long-term effect of income and energy intake obesity among adults (20 - 64 years) in Abeokuta, Nigeria. A population based cross - sectional study of 240 adult men and women was conducted. The sampling technique purposive and randomized with the cut-off for obesity being (BMI > 30 kg/m2 and income as the estimated annual income) of the respondents. Result of the cross-sectional analyses revealed, strong direct relationships between all the variables. These were increasing individual incomes or wages and high energy intakes across gender. The logistic regression analyses of obesity including energy intake levels, income levels, and BMI at the point of study; showed significant effect of income on obesity in the male and female groups. The relationship was low among males than females, and income has lower positive association with BMI among females, than among males in both rural and urban areas (0.7 for male in the rural and 0.5 in the urban as against 0.5 and 0.3 for female in both rural and urban respectively). Findings from this study concluded that income is a factor responsible for high energy intakes, and a risk factor for increasing BMI (obesity).

Keywords: *Adults; Income; Energy Intake; Obesity*

Introduction

The structure of labour market and the characteristics of the worker depend on age, education and the extent to which the individual has a buffer of resources on which to draw in bad times [5]. Links between income, energy intake and BMI have been examined in dynamic contexts and is complicated because BMI has both stock and flow dimensions as a result of changes in prices and incomes [5].

The body mass index (BMI, which is measured by weight/height^2 and expressed in kg/m^2) depends on the net energy intake and so varies through the life course. It captures both longer and shorter term dimensions of nutrition. In developed countries obesity is a central concern, but in most low-income countries, attention has been focused on low levels of BMI, although concerns with obesity are emerging [5].

Obesity is excessive accumulation of body fat, which assessed based on the body mass index (BMI), and its complicated with higher risk of getting serious diseases like type 2 diabetes, hypertension, coronary heart diseases etc [22].

Greater income inequality implies a greater demand for restaurant services and reduced demand for some farm products [20]. The effect of income growth on dietary composition is well recognized; as wealth increases, the contribution of starchy foods falls and a still largely vegetarian diet becomes more diversified, products of animal origin - meat eggs and dairy products - loom larger in the diet [4,21].

Differentiating between the impact of price and income changes on food demand and the effects of preference shifts is important. When incomes for fairly poor people, food expenditures increase almost proportionally [2] and increasing income is not an effective way to increase nutrient intake given that the income elasticities of nutrient intake are so small [3,38-40].

Changes in food consumption and expenditures in World have been a topic of much research throughout the 20th century, so it is well known that income influences food expenditure patterns, it is also likely that the distribution of income influences the distribution of food expenditures [1,20,35,36]. This study examined the relationships between income, energy intake and BMI on obesity among adults (20 - 64 years).

Materials and Methods

The study sample consisted of two groups a group of 120 adult men (20 - 64 years) and 120 adult women (20 - 64 years). They are of diverse cultures and backgrounds of Abeokuta metropolis.

The anthropometry method was used to collect data for the body mass index (BMI, weight in kg divided by height in metres squared, kg/m^2) of at least 30.0 kg/m^2 was calculated adopting the World Health Organization [9,17,37] classification of body weight in adults according to BMI (kg/m^2) normal weight 18.5 - 24.9: overweight 25.0 - 29.9: Obese $\geq$ 30.0.

The socioeconomic data collected were used to determine the incomes which were estimated as annual income. Income (per annum) classified as: #30,000 - #110,000 (low) = 1, #120,000 - #200,000 (medium) = 2, #210,000 and above (high) = 3.

The energy consumption was studied for each subject on the same day of anthropometric measurement. The subjects were asked about the types and amounts of foods consumed within the last 24 hrs (using food models) which gave the 24 hrs dietary recalls.

The energy contents were estimated using food composition tables and other available published and unpublished data for Nigeria [8]. The values were compared with the RDA of FAO/WHO [6].

All the data collected were analyzed based on the research question raised. The first question was the relationship between income, energy intake and prevalence of obesity. The second question addressed was whether income and energy intake affected or have chance of affecting risk of being obese.

Logistic regression was used in all analyses. Analyses of income levels were adjusted for energy intake levels. In order to adjust for potential confounding, the models included age (continuous variable) and BMI. Confounders included in the cross - sectional analyses are mentioned in the table footnote. In all the analyses, the linearity of age effects were tested and confirmed. In all the analyses, a 5% significance level was used, and the estimated odds ratios are given with 95% confidence limits (CI).

The advantage of this study is that the study design was prospective; and was without recall bias in the assessment of dietary intake. Misclassification in BMI due to possible differential errors in reporting was beforehand avoided (the height and weight were objectively measures).

Results

Table 1 showed the distribution BMI and the proportion of the median and the range among the rural and urban subjects. The greatest increase in median BMI was found at the high levels of income and energy intake, which were significant among the urban female subjects.

	BMI (kg/m^2) Median Male (n = 60)	BMI (kg/m^2) Range Male (n = 60)	BMI (kg/m^2) Median Female (n =6 0)	BMI (kg/m^2) Range Female (n = 60)
Rural	25.3	22.8 - 32.9	28.5	20.8 - 36.4
Urban	29.6	22.3 - 44.6	32.3	25.8 - 46.1

Table 1: *The median and range of the BMI ≥ 30 kg/m^2 across the localities.*

Table 2 shows the cross-sectional analyses of the data based on relationship income and energy intake has with obesity. There was clear association between income level and obesity in either group.

	Rural				Urban			
	Male		Female		Male		Female	
	%	OR	%	OR	%	OR	%	OR
Income level								
None	92	1	5	1	7	1	9	1
Low	25	L25 (021-321)	35	2.81 (1.21 - 4.11)	21	1.26 (0.81 - 3.36)	25	0.93 (0.17 - 3.55)
Medium	333	133 (024-2.51)	25	1.63 (0.11 - 3.61)	39	2.13 (1.41 - 5.63)	26	1.17 (0.66 - 2.61)
High	32.5	0.51 (0.16-L25)	35	0.91 (0.85 - 4.20)	33	0.77 (0.61 - 3.37)	40	0.39 (0.28 - 2.15)
Energy intake level								
Normal	22	1	23	1	13	1	3	1
C RDA (low)	42	2.22 (1.12-4.90)	37	1.26 (0.31 - 5.22)	35	0.15 (0.12 - 3.61)	47	3.16 (1.71 - 7.20)
> RDA (high)	36	326 (0.91-7.16)	40	2.17 (0.95 - 8.19)	52	1.67 (0.54 - 4.14)	50	4.64 (2.15 - 6.29)

Table 2: *Percentage distribution and odds ratios (OR)[a] with 95% confidence intervals for obesity (BMI ≥ 30 kg/m^2) from the cross-sectional analysis of income levels and energy intake levels for the subjects.*

[a]: Adjusted for income and energy intake.

In this result most of the subjects were obese, and there was a tendency for an increase in the level of obesity as income and energy intake levels increases in both groups and genders.

At both groups, there were more obese women than men. There was an increasing energy intake level in women of medium and high income levels in both groups.

Table 3 showed that in both, there was a tendency to increased odds ratios with higher level of income and energy intake. The odds ratios for income levels and energy intake levels were estimated in a common model for the rural and urban groups' BMIs. It further revealed that adjustment for the confounders did change the crude estimates of the urban low income and urban high energy intake levels. There were associations between energy intake and income and presence of obesity as some significant increase trends in odds ratios for BMI.

Table 4 revealed the association between income and BMI, where high positive association was seen; which was also seen in its relationship with energy intake among the urban groups, but a bit lower among the rural groups. These results were of little significant effects on the development or maintenance of obesity among the rural and urban subjects, respectively.

	Rural		Urban	
	Crude OR	Adjusted OR	Crude OR	Adjusted OR
Income level				
None	1	1	1	1
Low	1.15 (0.25 - 3.32)	0.75 (0.32 - 3.93)	1.41 (0.25 - 3.24)	1.42 (1.24 - 3.56)
Medium	1.18 (0.28 - 2.96)	1.60 (0.43 - 4.12)	0.81 (0.15 - 2.15)	1.55 (0.26 - 4.17)
High	1.20 (0.52 - 1.63)	1.73 (0.18 - 2.42)	1.64 (0.52 - 1.98)	2.13 (0.11 - 5.25)
Energy Intake Level				
Normal	1	1	1	1
< RDA (Low)	0.85 (0.42 - 3.55)	0.65 (0.33 - 4.51)	1.51 (0.63 - 2.16)	1.27 (0.26 - 3.11)
> RDA (High)	0.93 (0.21 - 0.95)	0.95 (0.12 - 3.16)	2.32 (0.10 - 5.11)	2.93 (0.31 - 5.23)

Table 3: *Prospective analysis of odds ratios (OR) with 95% confidence intervals for obesity (BMI ≥ 30 kg/m²) as determined by income levels and energy intake levels of the subjects.*

	Income Male (n = 60)	Income Female (n = 60)	Energy intake Male (n = 60)	Energy intake Female (n = 60)
Rural BMI (kg/m²)	0.796	0.592	0.337	0.702
Urban BMI (kg/m²)	0.529	0.324	0.203	0.607

Table 4: *Correlation of income, energy intake and BMI of the subjects.*

This relationship was further revealed in figure 1 and 2, where the income levels were compared separately with the BMI and energy intakes across localities and genders. It was observed that highest levels of energy intakes were seen among the rural and urban males than females not minding the income levels. But the BMI was higher among the rural and urban females than the males with the highest value among the high income urban group.

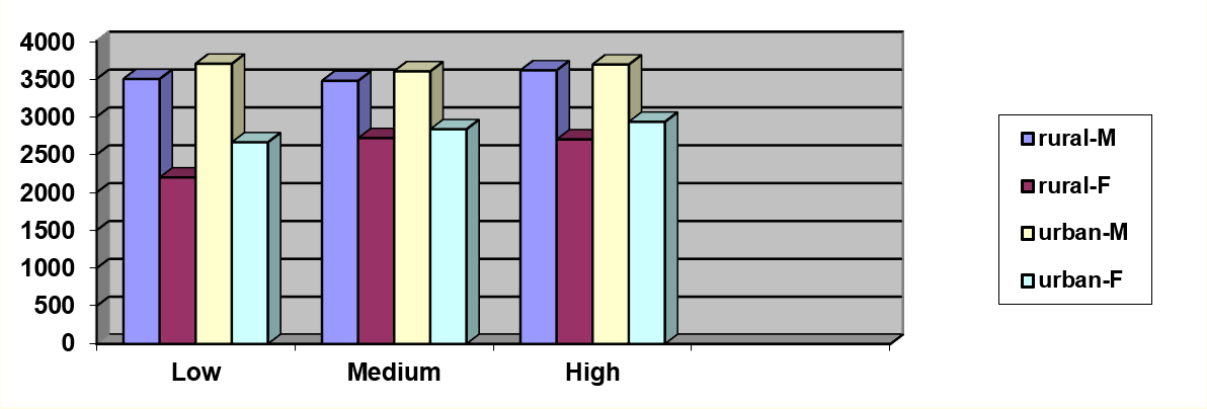

Figure 1: *Levels of the mean Energy Intake kcal/d and Income among rural and urban genders.*

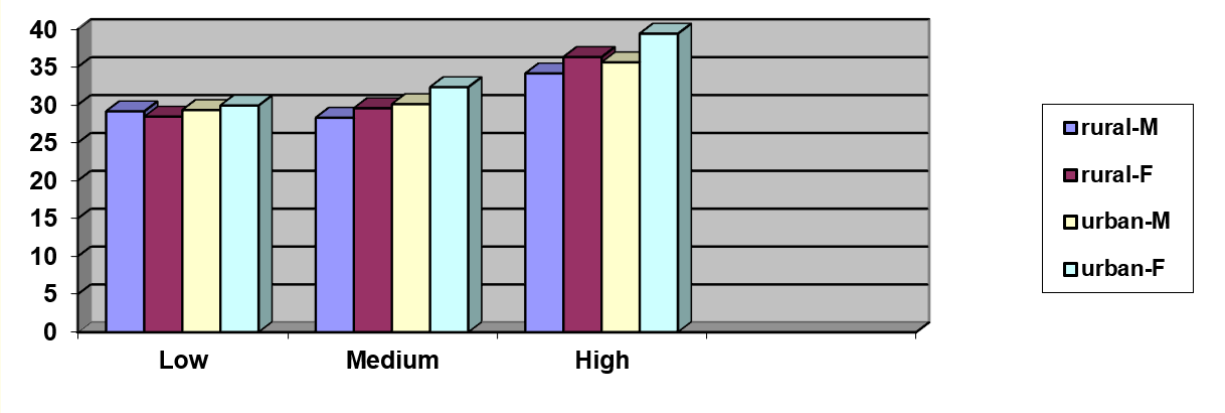

Figure 2: *Levels of the mean BMI kg/m2 and Income among rural and urban genders.*

Discussion

In this study, there was a profound support to a long-term effect of income, and energy intake on prevalence of obesity. This reflects a direct association between income levels and energy intake levels and obesity; which is in agreement with the findings of Popkin [10] who used cross-country and in-depth analysis of the China study to explore these relationships.

It was also seen based on the hypothesis that prevalence of obesity increases with increasing income and increasing food intake, which seems in agreement with the results from some cross-sectional studies. According to Monteiro., *et al*. [7], the risk of obesity in men strongly increased with income in urban and rural region, and strongly associated with income in women in rural region (direct association). In developed economy, there is vast evidence of a consistent strong inverse association between different measures of socio-economic status, including income [11].

This study clearly demonstrated that the greater the income, the greater the BMI and the greater the likelihood of being obese (Figure 1 and 2), while the energy intake was greatly determined by the gender differences; which is also a function of the types of food consumed; typically, Nigerian diets consist of refined carbohydrates which are cheap; and also eggs, poultry, meat, legumes and some cereals provides the protein and saturated fats, which are expensive.

It is reassuring that a concomitant analysis of the long-term relation between income and energy intake, assessed by the same measures, and obesity in a different study population followed over many years essentially gave the same results [4]. In those studies, it was moreover possible to take into account the possible effects of changes in income and energy intake in the period before the time period in which the changes in obesity level were observed. This is supported by WHO/PAHO survey on obesity in Latin America which revealed an increasing trend in obesity as countries emerge from poverty, especially in urban areas: and increasing transition to Western diets that are high in calories [12,25].

The study in East and West Africa revealed, the dietary changes had just begun in the urban areas; but today is increasing dramatically among the high income class, and among the high energy intake groups. The results from this study did not exclude a long-term link between the effects of socioeconomic status/income/energy intake/obesity and productivity/work performance. Study from Europe

and the United States demonstrated that obesity is negatively associated with a person's productivity and work performance [31-34]. Fat mass accumulations inhibit movement and reduce overall productivity [13,14].

Obesity affects productivity by increasing morbidity and mortality [15]. This situation makes ill person to contribute less to the economy (high degree of absence from work place), and creating a drain on economic resources [16,23,24,28]. On the other hand, in a public health perspective, it is essential to illustrate the long-term relationships in the changing population in a vicious circle. Even though there may be fundamental differences between increased income with resultant increasing obesity and reduced obesity with resultant increasing productivity.

The tendency to reduced obesity may be due to increasing discomfort based on the reducing ability to purchase Western food and individual willingness to reduce fat mass (through physical activities and dietary management programs) [26,34-36].

In a similar study which examined whether changes in food prices are associated with changes in obesity prevalence among women in developing countries, and assessed effect modification by individual socioeconomic status (SES), it was found through the post-estimation analysis which computed the relationship between food price inflation and predicted mean probabilities of being obese, by SES [27,29,30,38]. The result showed that rising food price inflation was strongly associated with women's obesity prevalence, and SES consistently modified the relationship. The SES differences were widest across educational strata and were most pronounced when income was highest [45,46]. Overall, for every 1-unit increase in income, predicted mean obesity prevalence was increasing between high SES compared to low SES [25,27,36].

Conclusion

In conclusion, these findings showed significant relationship of income and energy intake in both rural and urban areas on maintenance of obesity in adults [38-41]. Also, the poorest populations, in terms of income and energy intake, often reside in rural areas (low SES), while the urban poor (medium SES) have improved income and energy intake [45,46].

There is a strong link between income which may dictate the energy intake through the food price inflation and obesity in adults in developing countries, which can be clearly modified by individuals' SES [42,43]. Greater income was associated with greater obesity prevalence usually among women in higher SES groups, who may be net food buyers most at risk of obesity in low-income and middle-income countries [25,34,35].

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Author Contributions

Conceived and designed the experiments. Performed the experiments. Analyzed the data. Wrote the first draft. Contributed to the final paper. All authors approved the final version.

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