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Impacts of Frequency of Food Consumption on BMI of Adult Nigerians

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Abstract

Frequency of consumption of energy dense foods can lead to the prevalence of obesity and associated metabolic diseases. Obesity epidemic is still increasing globally, with its accompanying environmental pressures. This study focused on assessing the impacts of total energy intake, body mass index and frequency of food consumption on BMI among adults (aged 20 - 64 years) population in Abeokuta, Ogun State, Nigeria. The study gathered information on total energy intake using 24hr dietary recall to determine the caloric intake (kcal/d) compared with Recommended Daily Allowance (RDA). The Body Mass Index (BMI) using cut off ≥ 30 kg/m^2 and food consumption frequency was obtained on daily and weekly basis on food groups consumed. The results showed the energy intake levels of range between 3379 - 3507 kcal/d for rural males, 1366 - 2864 kcal/d for rural females; and 3416 - 3798 kcal/d for urban males, 2331 - 2924 kcal/d for urban females. Both urban and rural males and females had average BMIs of less than 30 kg/m^2, putting them in the overweight category. The frequency of food consumption (predominantly energy-dense foods) is seen to be on the high side, which reflects as moderately high BMI of the respondents. The findings is reflective of the obesity pandemic in the developing countries compared to developed countries that are already in nutrition transition.

Keywords: *Food Consumption; BMI; Adult Nigerians*

Introduction

Increasing availability of energy-dense foods and frequency of the consumption, coupled with physical inactivity has an increased adiposity in genetically predisposed individuals [1]. Obesity epidemic has over the years been existing based on the factor that there has been availability of foods rich in sugar and fat. Their selection and consumption is determined by their inherent attractive flavor [2].

Why are we eating what we are eating? Food choices are determined by crucial development of behavioural, pharmacological and physiological mechanism. Adequate intake of energy from three micro nutrients and essential nutrients, vitamins and minerals is important for the survival. They are mixed in natural and processed foods, while their adequacy is extremely difficult and complex task [2]. Carbohydrate and fat intake are the underlying factor for the development of obesity, diabetes and metabolic diseases. Although, generally there is a hierarchy in nutrient self-regulation; intake of salt and protein (essential amino acids in particular) are actively defended (hard regulation), but weak evidence for carbohydrate (soft regulation), and little to no evidence for fat (no regulation) [3]. This study

focused on the impacts of frequency of food consumption and the total energy intake in relation to obesity prevalence as determined by the BMI (kg/m^2) of the respondents.

Materials and Methods

A pre-tested questionnaire was used to collect information from sampled population of two hundred and forty adults (male-120, female-120) within the age bracket of 20 years - 64 years. The sample cohorts were randomly and systematically selected from the enumerated households in both Abeokuta LGAs localities in Ogun State, Nigeria.

The anthropometric measurement is the measurement of height and weight. These determine the changes in body composition, and pattern of growth and development of an individual. The anthropometric measurement of the subjects were taken to compute the body mass index (kg/m^2) adopting the World Health Organization [4] classification of body weight in adults; normal weight (18.5 - 24.9 kg/m^2), overweight (25.0 - 29.9 kg/m^2), obese (≥ 30 kg/m^2). The height measurements were obtained using calibrated standing ruler and measured to the nearest 0.1 cm. the weight measurements were also obtained using digital scale, which was periodically checked for precision with known weights, and measure to the nearest 0.1 kg.

Validated food frequency questionnaire was used to obtain information on the food consumed, where the food groups ranged from Cereals (rice, maize, oat, rye, millet, sorghum), Roots and tubers (yam, cassava, potato), Legumes (beans, ground nut, soya beans), Fruits and vegetables (mango, orange, cashew, carrot, spinach, cabbage, cucumber, watermelon), Dairy (milk, yoghurt), Beverages and alcohol and carbonated drinks (cocoa drinks, cocacola drinks, pepsi drinks, beers, wines, gins), Meats (beef, chicken, turkey, fish, crab, shrimp, crayfish, snail), Fats and oils (vegetable oils, palm oil, butter, margarine), and Bakery products (bread, rolls, cookies, pies, pastries, muffins). 24hr dietary recall questionnaire were used to information used assessing meal pattern and dietary habits of the respondents, by identifying numbers of times a specific food item is consumed in a defined times span [8-12]. The 24hrs dietary recalls gave the information on the type and amount of foods consumed within the last 24hrs (using food models).

The energy contents of the food determined the energy consumption of each subject. The energy intakes were estimated using food composition tables and other available published and unpublished data for Nigeria [13]. The values were compared with the RDA of FAO/WHO [4]. The data collected were analyzed using descriptive statistic and charts statistical analysis compared the urban and rural subjects using to tests, the difference were considered significant at $P < 0.05$. The results were expressed and presented as means ± S.D and percentages [14-16].

Results

The energy intake levels were higher than RDA in both rural (3056 kcal/d) and urban (3296.5 kcal/d) [5,6]. The BMI levels were higher among urban female (28.49 kg/m^2) compared with rural females (27.64 kg/m^2). Similar results were observed among urban males (29.30 kg/m^2) with lower BMI among rural males (26.17 kg/m^2) [6]. The results showed the range of these values and how these values deviated from their mean values (Table 1).

Energy intake (kcal/d)	Rural		Urban	
	Male: n = 60	Female: n = 60	Male: n = 60	Female: n = 60
Range	3379-3507	1366-2864	3416-3708	2331-2924
Mean ± SD	3498 ± 29.29	2614 ± 23.25	3691 ± 29.91	2892 ± 33.14
BMI (kg/m^2)				
Range	22.82-32.88	20.75 – 36.43	22.31- 44.61	25.80-46.13
Mean ± SD	26.17 ± 3. 63	27.69 ± 6.01	29.30 ± 4.69	28.49 ± 5.80

Table 1: *Mean energy intake (kcal/d) and the mean BMI (kg/m^2) of the respondents.*

The major suppliers of macronutrients (carbohydrate, proteins, fat and oil) are the food groups listed in table 2 and 3. The Cereals and products (CP), Root/t\Tubers and products (RTP). Legumes and products (LP), Fruits/Vegetables and products (FVP), Dairy products (DP). Beverages/Alcohol/Carbonated drinks (BACD), Meat products (MP), Fats and Oils (FO) and Bakery products (BP).

The food consumption pattern of the rural respondents were shown in table 2, which follow a pathway of intakes (≤ 3days/week) according to gender (male and female) showed that CP (76.87% vs 55%), RTP (16.67% vs 41.67%), LP (31.67% vs 28.33%), FVP (35% vs 25%), DP (71.67% vs 65%), BACD (35% vs 41.67%), MP (43.33% vs 40%), FO (0% vs 0%), and BP (25% vs 31.67%). In these data majority of the rural males are consuming cereals CP (76.87% vs 55%) than the rural females, while high percentage of the rural females consumed roots and tubers RTP (16.67% vs 41.67%) than the rural males. But none of both rural groups consumed fats and oils FO (0% vs 0%) less than or 3 days/week. This finding also revealed more rural females consumed beverages and alcohol and carbonated drinks BACD (35% vs 41.67%) than their rural males' counterparts; but both groups were less than average of respondents' population. Moreso, lower percentage of both groups were consuming bakery products BP (25% vs 31.67%) less than or 3 days/week.

On the pathway of intakes (between 4 - 7 days/week) according to gender (male vs female), the result revealed that CP (23.33% vs 45%), RTP (83.33% vs 58.33%), LP (68.33% vs 71.67%), FVP (65% vs 75%), DP (28.33% vs 35%), BACD (65% vs 58.33%), MP (56.67% vs 60%), FO (100% vs 100%), and BP (75% vs 68.33%). The data expressed that higher percentage of the rural females were eating cereals CP (23.33% vs 45%) than the rural males, while higher percentage of the rural males consumed roots and tubers RTP (83.33% vs 58.33%) than their rural females' counterpart. Highest percentages of both rural groups consumed fats and oils FO (100% vs 100%) between 4-7 days per week. The consumption pattern pathway of rural respondents' showed more rural males consuming beverages and alcohol and carbonated drinks BACD (65% vs 58.33%) than their rural females' counterparts, which are a bit higher than average; while more rural males consumed bakery products BP (75% vs 68.33%) between 4 - 7 days per week than the rural females.

	Rural			
Food Groups	**≤ 3 days/week (Frequency/%) Between 4 - 7 days/week (Frequency/%)**			
	M (n = 60)	**F (n = 60)**	**M (n = 60)**	**F (n = 60)**
Cereals and pdts	46 (76.67%)	33 (55%)	14 (23.33%)	27 (45%)
Roots/Tubers and pdts	10 (16.67%)	25 (41.67%)	50 (83.33%)	35 (58.33%)
Legumes and pdts	19 (31.67%)	17 (28.33%)	41 (68.33%)	43 (71.67%)
Fruit/Vegetable and pdts	21 (35%)	15 (25%)	39 (65%)	45 (75%)
Dairy pdts	43 (71.67%)	39 (65%)	17 (28.33%)	21 (35%)
Beverages/Alcohol/Carbonated drinks	21 (35%)	25 (41.67%)	39 (65%)	35 (58.33%)
Meats and pdts	26 (43.33%)	24 (40%)	34 (56.67%)	36 (60%)
Fats and Oils	0 (0%)	0 (0%)	60 (100%)	60 (100%)
Bakery pdts	15 (25%)	19 (31.67%)	45 (75%)	41 (68.33%)

Table 2: *Pattern of consumption and consumption frequency of the respondents based on food groups (rural).*

The pattern of food consumption based on food preference and food choices determine the development of weight gain and body weight regulation [6,7]. The role played by these food consumption pattern among the urban respondents can also be deduced from the data displayed in table 3 which also follow the pathway of intake (≤ 3days per week) according to gender (male vs female). CP (8.33% vs 10%), RTP (6.67% vs 11.67%), LP (3.33% vs 5%), FVP (6.67% vs 3.33%), DP (8.33% vs 8.33%), BACD (13.33% vs 15%), MP (3.33% vs 3.33%), FO (0% vs 0%), and BP (5% vs 3.33%). These data showed that more urban females consumed cereals CP (8.33% vs 10%) than

their urban males counterparts, same pattern of urban females consuming roots and tubers RTP (6.67% vs 11.67%) than urban males was also seen, Both groups of urban respondents did not consume fats and oils FO (0% vs 0%) less than or 3days per week. Low percentages of both urban males and urban females were consuming beverages and alcohol and carbonated drinks BACD (13.33% vs 15%), while more lower percentage of both groups consumed bakery products BP (5% vs 3.33%) less than or 3days per week.

The pathways of intakes (between 4 - 7 days per week) according to gender (male vs female) showed that CP (91.67% vs 90%), RTP (9.33% vs 88.33%), LP (96.97% vs 95%), FVP (93.33% vs 96.67%), DP (91.67% vs 91.67%), BACD (86.67% vs 85%), MP (96.67% vs 96.67%), FO (100% vs 100%), and BP (95% vs 96.6%). The data showed that high percentage of both urban males and urban females consumed cereals CP (91.67% vs 90%), while high percentage of urban females consumed roots and tubers RTP (9.33% vs 88.33%) as compared to lower percentage of urban males. Highest percentages of both groups of urban respondents consumed fats and oils FO (100% vs 100%) between 4 - 7 days per week. The finding also revealed higher percentages of the urban males and urban females consuming beverages and alcohol and carbonated drinks BACD (86.67% vs 85%); while highest percentages of both respondents consumed bakery products BP (95% vs 96.6%) between 4 - 7 days per week.

This study focused more on cereals, roots and tubers, fats and oils, beverages and alcohol and carbonated drinks as major contributors of energy consumed by the respondents in both rural and urban localities. Energy and calorie are regarded as the major causes of increasing body mass index BMI, and obesity and its complications such as coronary heart diseases, diabetes, stroke, hypertension, hyperlipidemia etc.

	Urban			
Food Groups	**≤ 3 days/week (Frequency/%) Between 4-7 days/week (Frequency/%)**			
	M (n = 60)	**F (n = 60)**	**M (n = 60)**	**F (n = 60)**
Cereals and pdts	5 (8.33%)	6 (10%)	55 (91.67%)	54 (90%)
Roots/tubers and pdts	4 (6.67%)	7 (11.67%)	56 (93.33%)	53 (88.33%)
Legumes and pdts	2 (3.33%)	3 (5%)	58 (96.67%)	57 (95%)
Fruit/vegetable and pdts	4 (6.67%)	2 (3.33%)	56 (93.33%)	58 (96.67%)
Dairy pdts	5 (8.33%)	5 (8.33%)	55 (91.67%)	55 (91.67%)
Beverages/alcohol/carbonated drinks	8 (13.33%)	9 (15%)	52 (86.67%)	51 (85%)
Meats and pdts	2 (3.33%)	2 (3.33%)	58 (96.67%)	58 (96.67%)
Fats and oils	0 (0%)	0 (0%)	60 (100%)	60 (100%)
Bakery pdts	3 (5%)	2 (3.33%)	57 (95%)	58 (96.67%)

Table 3: *Patterns of consumption and consumption frequency if the respondent based on food groups (urban).*

These results are reflection of factors that contributed to the prevalence of obesity in the sub-population. Majority of the urban respondents consumed more of the energy giving foods at higher frequency of between 4 - 7 days per week. The foods were moderately consumed by the rural respondents except for the fats and oils (FO). The consumption behavior can be attributed to affluence, food preferences, and food choices; which had always been the disparities between the rural and the urban people.

Table 4 show the usuality of intake of meals that contained energy-giving food groups. These were taken through the 24hr dietary recall, which showed that 89% of the females in the rural localities claimed they consumed energy-giving foods usually, 85% of the females in the urban localities also claimed to consume energy-giving foods usually. The usuality of intakes of these meals was seen to be at the

Localities	Usuality of intake of meals and foods
	Response (% respondents)
Urban	
Male	N (26%) Y (74%)
Female	N (15%) Y (85%)
Rural	
Male	N (25%) Y (75%)
Female	N (11%) Y (89%)

Table 4: *Percentage response of respondents' usuality of intake of meals and foods.*

same rate among the males in the rural and urban localities. This is observed in table 4 also showing 75% for rural male respondents and 74% for urban male respondents, while figure 1 and 2 which express the percentage consumption patterns of the various food groups gave similar patterns. Although, the quality of the meals taken by the respondents and the metabolic natures of the respondents are different, the usuality of intakes of their meals and foods consumption patterns among the rural males and the urban males are at the same level (Table 4, figure 1 and 2).

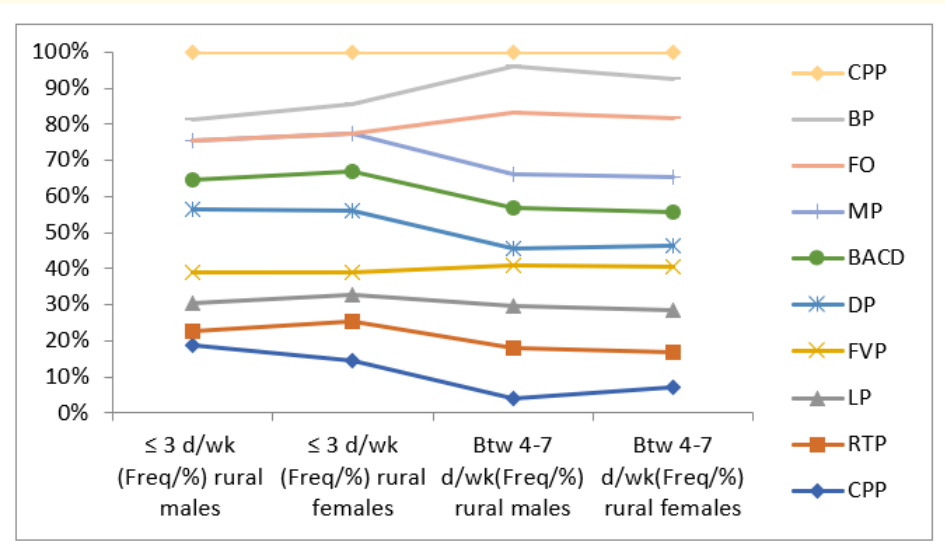

Figure 1: *% consumption pattern of the respondents based on food groups in the rural localities.*

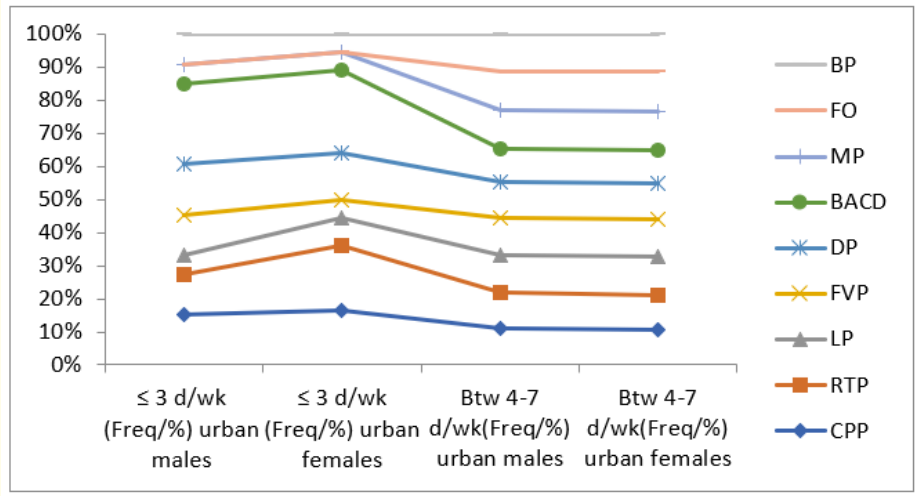

Figure 2: *% consumption pattern of the respondents based on food groups in the urban localities.*

Discussion and Conclusion

The attractive nature and functions of these sugar and fat foods are some of the factors that promote their choices, selection and consumption. Consumption of higher percentage of these foods and increasing frequency of their consumption is a significant factor in the current rate of the obesity epidemic [2]. The effects of some sugar (fructose, galactose) in stimulating appetite and flavor conditioning is of importance. Also, gut-brain pathway in human food appetite and preferences has also been revealed [2]. All these further strengthen the fact that frequency of consumption of sugars, and the appetition mechanism can determine the Body Mass Index (BMI) of individual and the population.

The data show relationship of energy-dense foods to BMI. Cereals (rice, maize, oat, rye, millet, sorghum), roots and tubers (yam, cassava, potato), legumes (beans, ground nut, soya beans), fruits and vegetables (mango, orange, cashew, carrot, spinach, cabbage, cucumber, watermelon), dairies (milk, yoghurt), beverages and alcohol and carbonated drinks (cocoa drinks, cocacola drinks, pepsi drinks, beers, wines, gins), meats (beef, chicken, turkey, fish, crab, shrimp, crayfish, snail), fats and oils (vegetable oils, palm oil, butter, margarine), and bakery products (bread, rolls, cookies, pies, pastries, muffins) had impacts on BMI based on their consumption rate of between 4 - 7 days per week which seems high with increasing frequency of consumption and increasing BMI. The same pattern of consumption of these energy-dense foods was seen among the respondent in the rural and urban localities. This was attributed to some environmental and modern food industries' pressures resulting in overeating, due to promotion and heavy advertisement of cheap energy-dense foods, which are often nutritionally poor [16,17]. The BMI is also related to factors like exercise and physical activity, sedentary lifestyle, or work; which were evaluated in relation to food consumption (especially energy intake) as determinants of BMI, and obesity epidemic [6,19-21].

Therefore, sugar conditioned preferences, can be used in preventing or treating obesity. The results of this finding is a good data which can be explored, manipulated and extrapolated to reflect the complicated nature of food intake and frequency of intakes, based on food choices and food preferences as reflected in table 2-4 and figure 1 and 2. Conclusively, the finding showed that frequency of food consumption determined the Body Mass Index (BMI) of the respondents, looking at the energy intake levels of the respondents. However, taste

and cost of the energy-densed foods has modifying effect, as their acquisition is based on the purchasing power as determined by income and wages. Developed countries or localities are more vulnerable or prone to have higher prevalence of obesity due to higher rate of affluence compared to the developing countries or localities. Further exploration is needed to bring out more facts on causes of overeating and obesity.

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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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