

Association of Dietary Patterns and Overweight among University Students Southeast, Nigeria

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ABSTRACT

Background: An unhealthy diet is a risk factor associated with the rising prevalence of overweight, obesity and other non-communicable diseases. Paucity of data exists on dietary patterns (DP) of university students in Nigeria.

Objective: The study employed the use of dietary pattern analysis to characterise diets of university students, as well as investigate the association of the identified patterns with overweight.

Methods: A cross-sectional study of university students selected after multi-stage sampling from five tertiary institutions in Southeast, Nigeria was conducted. Socio-demographic data was collected, while body mass index (BMI) was calculated to determine overweight (BMI >25kg/m²). Dietary patterns were assessed using principal component analysis (PCA) of 124 food and beverage items derived from a validated food frequency questionnaire. Logistic regression was used to test associations between dietary patterns and overweight.

Results: The prevalence of overweight was 19.9%. Four dietary patterns identified using principal component analysis were (1) "healthy", (2) "bread and drinks", (3) "snacks" and (4) "alcohol" dietary patterns, and these explained 47.1% of variation in the diets of the students. The "alcohol" DP (characterized by alcoholic and non-alcoholic beverages) was significantly associated with overweight (odds ratio (OR) = 1.202, $p=0.002$) in both gender. Males had higher odds of consuming foods from the "alcohol" DP (OR= 1.175: $p=0.035$), and were less likely to adhere to the "healthy" DP (OR=0.822; $p=0.014$) compared to females.

Conclusion: The findings suggest that the "alcohol" dietary pattern may increase the risk of overweight. Interventions aimed at improving dietary patterns among university students are required.

Keywords: Dietary pattern, overweight, obesity, food consumption, University students.

Introduction

Diet is one of the fundamental risk factors for health, disease, and disability in the world (1). An unhealthy diet is a significant risk factor associated with the rising prevalence of overweight, obesity and metabolic syndrome (2, 3, 4). In developing countries, nutrition transition has increased the prevalence of overweight, obesity and other non-communicable diseases worldwide (5, 6). This transition is characterized by overconsumption of energy-dense processed foods, which are relatively cheap and readily accessible (6, 7).

Nutrition transition may explain the relationship between changes in dietary practices and chronic

diseases among young adult populations in universities (8, 9). The university environment exposes students to adopt certain dietary practices or habits. The adaptation to Western diet as students enter the university, are usually high in fat and low in fruits and vegetables as studies have shown (10, 11). This is of significant public health importance given the association between poor diet and poor health status. Healthy nutrition during the young adult stage has substantial long-term health benefits (12). Despite the importance of nutrition, many young adults do not consume diets that are consistent with dietary guidelines (12, 13).

Consuming a variety of foods rather than a single isolated nutrient or food item is essential for adequate intake of nutrients. The use of dietary patterns has currently been advocated for characterizing the whole diet and understanding the role of diet in chronic diseases (14, 15). Dietary patterns (DP) relate to habits regarding food and beverage consumption, which are often influenced by environmental and cultural factors. Dietary pattern analysis may be a useful tool to assess the role of diet in disease and health as well as overall dietary habits (16). Dietary patterns cannot be measured directly, however; statistical methods are available to characterize them (17). The a-posterior analysis involves the use of multivariate statistics such as factor/principal component analysis (PCA) and cluster analysis (14). The a-prior is based on recommendations of food consumption models (e.g. Mediterranean diet, Chinese diet, Asian diet) (14). The study of dietary patterns is critical because it describes the whole diet and investigates its associations with diseases (18, 19). Most research on dietary patterns have focused on adults (20), children (21, 22) and adolescents (23, 24) in high-income countries, and a few in low and middle-income countries (25, 26, 27, 28). Published empirical evidence on typical dietary patterns of Nigerians, inclusive of university students are sparse. Few existing studies have focused on consumption of specific food groups or meal consumption patterns and not on an empirical description of patterns in dietary components (29, 30, 31). This study, therefore, employed the use of dietary pattern analysis to characterize diets of university students, as well as investigate the association of the identified patterns with overweight.

Materials and Methods

Study design and population

Data used in this study was from a cross-sectional survey conducted in five tertiary institutions Southeast, Nigeria. The institutions were Ebonyi State University, Abakaliki, Imo State University, Owerri, University of Nigeria, Nsukka, Michael Okpara University of Agriculture, Umudike, and Anambra State University, Uli. Those included were apparently healthy students attending the selected tertiary institutions, aged 18 to 35 years and willing to participate in the study. Pregnant or lactating women, and individuals with any form of physical disability or on treatment for chronic

illness were excluded. The study was approved by the Ethics Committee of the Federal Medical Centre, Umuahia.

Sample size determination and sampling technique

Sample size was calculated using the Araoye (32) formula as follows:

$$N = \frac{z^2 \times p(100-p)}{x^2}$$

Where N = sample size, Z = confidence level (which was taken as 95% with a degree of probability of 1.96%, approximated to 2%, p = prevalence of overweight among young adults, taken as 25% (33), 100-p = percentage of young adults not overweight, x^2 = level of precision, taken to be 5%. A minimum sample size of 300 was obtained. Three hundred students were selected from each of the five tertiary institutions to obtain a total sample size of 1,500. Ten percent was added to make up for drop outs. A total of 1610 subjects were eventually selected using multistage sampling. A list of all the state and federal government owned tertiary institutions in the Southeast geopolitical zone was obtained and simple random sampling was used to select five (5) schools. Balloting without replacement was used to select 300 students who met the eligibility criteria from each university in the different faculties or colleges. Oral informed consent was obtained from the students before participating in the study.

Data collection

A validated questionnaire was used to obtain information on socio-demographics (age, gender, marital status, monthly allowance and academic year), dietary habits (number of meals eaten daily and meal skipping), lifestyle factors (exercise), anthropometric measurements (height and weight) and food consumption pattern. The questionnaire was pre-tested in another tertiary institution, not included in the final analysis. Trained nutrition and dietetic students administered the questionnaire and carried out anthropometric measurements.

Anthropometric measurements

Height was measured with a portable calibrated measuring rod and recorded to the nearest 0.1cm. Body weight was measured using a

calibrated portable scale (HANA brand) with a maximum capacity of 120 kg. The respondents removed their shoes and heavy clothing prior to weighing, and weight was taken to the nearest 0.1 kg (34). Body mass index (BMI) was calculated as weight in kilograms divided by the square of the height in meters and used as proxy measure for overweight (BMI >25kg/m²) (34).

Food intake and dietary pattern assessment

An interviewer-administered qualitative Food Frequency Questionnaire (FFQ) was used to collect information on food consumption pattern. Traditional foods (identified by their local names) available in the local markets were included in

the Food Frequency Questionnaire (FFQ). A total of 124 food and beverage items were identified and this was further categorized into 17 food groups in the food frequency questionnaire. The food grouping was based on the similarity of nutrient profile, processing and culinary usage. The list of the 17 food groups is summarized in Table 1. Participants were asked to recall all the foods and drinks they had consumed over the past one year and to estimate their frequency of consumption (daily, weekly, monthly or occasionally). The summation of the number of times each constituent food item(s) were consumed within the past one year gave an indication of food groups consumed. Dietary

Table 1: Food groups used in the dietary pattern analysis and description of the food groups

	Food groups	Description
1	Breakfast cereals	Breakfast cereals (cornflakes, goldenmorn), custard, pap, <i>joro</i>
2	Bread	
3	Legumes	Beans, bean balls (<i>akara</i>), bean pudding (<i>moi-moi</i>), green peas, bambara nut (<i>okpa</i>), black beans (<i>akidi</i>), bread fruit (<i>ukwa</i>), oil bean (<i>ugba</i>), soyabean, melon (<i>egusi</i>), groundnut (cooked or roasted), <i>fio-fio</i>
4	Oils	Butter, margarine, mayonnaise, vegetable oil, groundnut oil, peanut oil, soya bean oil, olive oil, palm oil
5	Milk and dairy	Milk, yoghurt, ice-cream
6	Fish and sea foods	Cray fish, tin fish (sardine, Titus, geisha), dried fish, stock fish, prawn (<i>oporo</i>), fresh fish (mackerel, scumbia), crab,
7	Snacks	Biscuits, cake, meat pie, buns, egg roll, chinchin, puffpuff, pancake
8	Whole grains	Wheat, millet, white corn, yellow corn, oats, pop corn,
9	Fruits	Pawpaw, pineapple, water melon, apple, banana, avocado pear (<i>ubebekee</i>), plum, cashew, coconut, sour -sop, guava, bush mango (<i>ugiri</i>), orange, African star apple (<i>udara</i>), velvet tamarind (<i>icheku</i>), native pear (<i>ube</i>), garden egg (<i>anara</i>), tangerine, mango, grape, pepper fruit (<i>mmimi</i>)
10	Roots and tubers	Water yam, sweet potatoes, irish potatoes, cocoyam, garri, <i>fufu</i> , abacha, Ripe plantain, unripe plantain, pounded yam
11	Meat	Beef, pork, goat meat, Snail (<i>ejula</i>), Periwinkle (<i>isam</i>)
12	Carbonated drinks	Malt drink, orange juice, mixed fruit juice, carbonated drinks or soda (coca-cola, pepsi, fanta. etc)
13	Pasta and rice	Rice, spaghetti, Noodles
14	Poultry and eggs	Eggs, chicken, turkey
15	Vegetables (soups and sauces)	Fresh tomatoes, tin tomatoes, pepper, cabbage, Carrot, cucumber, onions, okro, Spinach, green pepper, water leaf, bitter leaf (<i>bnugbo</i>), scent leaf (<i>nchuanwu</i>), hoot leaf (<i>uziza</i>), Ukazi, <i>Amaranthus</i> (green), Curry leaf, fluted pumpkin (<i>ugu</i>), uha, garden egg leaf (<i>akwukwoanara</i>), <i>nturukpa</i>
16	Cocoa,tea and coffee beverages	Tea, coffee, cocoa/chocolate,
17	Alcoholic beverages	Wine, beer, whisky/brandy/gin

patterns were derived by principal component analysis (PCA) using varimax loading of the 17 food groups from the FFQ. Each identified pattern from principal component analysis were saved for use in linear regression analysis.

Statistical analysis

Data entry, cleaning and statistical analysis were performed using SPSS (version 25.0, SPSS, Chicago, IL, USA). Descriptive statistics were performed to characterize the study population. For the dietary pattern analysis of the 17 food groups using PCA, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were used to determine the adequacy of the data set, prior to extraction. The number of factors to extract were based on the Eigenvalues >1 , visual identification of break-point in the screened plot, and factor interpretability (28, 29, 30). Four dietary patterns were identified, explaining 47.1% of the variability in food consumption. The food groups with loadings ≥ 0.3 on a pattern were considered to have a strong association with that pattern and retained in order to aid interpretation of results. Positive loading indicated that the dietary variable is positively associated with the factor, whereas, negative loading reflects an inverse association with the factor. Dietary patterns were labelled based on

the composition of food groups in each identified pattern. Logistic regression was used to calculate odds ratio for overweight in relation to the identified dietary patterns. The regression model was further adjusted for gender and used to compare overweight (dependent variable) and identified dietary patterns. A p-value of ≤ 0.05 was regarded as statistically significant.

Results

Basic characteristics of the university students

Table 2 shows the characteristics of the university students. A total of 1610 university students were sampled and included in the analysis. Slightly more than half (53.9% and 51.5%) were females and aged between 18 to 22 years, respectively. About two thirds (67.6%) were in higher levels, 65.8% skipped meals and more than half (59.8%) engaged in ≥ 30 minutes exercise daily.

Table 3 presents bivariate associations between overweight and participant characteristics. The prevalence of overweight was 19.9%. Overweight was significantly associated with age ($p= 0.001$), gender ($p= 0.000$), and academic level ($p= 0.01$)" (Table 3).

Table 2: Characteristics of the university students (n=1610)

Variables	n, %
Age (years)	
18-22	829 (51.5)
>22	781 (48.5)
Gender	
Female	868 (53.9)
Male	742 (46.1)
Academic level	
100 level	522 (32.4)
>100 level	1088 (67.6)
Meal skipping	
Yes	551 (34.2)
No	1059 (65.8)
Monthly allowance	
<#10,000	1010 (62.7)
$\geq 10,000$	600 (37.3)
Exercise (≥ 30 minutes/day)	
Yes	962 (59.8)
No	648 (40.2)

Table 3: Bivariate association between participant characteristics and overweight

Variables	Overweight (n, %)	p-value
Age (years)		
18-22	137 (42.8%)	0.001*
>22	183 (57.2%)	
Gender		
Female	227 (70.9%)	0.000*
Male	93 (29.1%)	
Academic level		
100 level	86 (26.9%)	0.01*
>100 level	234 (73.1%)	
Meal skipping		
Yes	266 (83.1%)	0.064 ^{ns}
No	54 (16.9%)	
Monthly allowance		
<#10,000	198 (61.9%)	0.111 ^{ns}
≥10,000	122 (38.1%)	
Exercise (≥ 30 minutes/day)		
Yes	176 (55.0%)	0.053 ^{ns}
No	144 (45.0%)	

*significant at $p \leq 0.05$, ns= not significant

Table 3 represents the four major dietary patterns that emerged from the survey of university students. The four major patterns identified explained 47.1% of the variability in food consumption (Table 3). The first "Healthy" DP explained the most variance (28.5%) and was heavily dominated by a variety of fruits, vegetables, legumes (bambara nut, bean cake and pudding), meat, fish/sea foods and milk/dairy products. The second "Bread and Drinks" DP had high factor loading for bread, cocoa beverages, tea, coffee and carbonated drinks. The third "Snacks" DP consisted of bakery products and breakfast cereals. It is worthy to note that patterns 2 and 3 represent foods that are readily available and can be purchased from tuck shops in and around the campuses. They also consist of foods which require no preparation prior to consumption. The fourth "Alcohol" DP consisted of beer, wine and other alcoholic and non-alcoholic beverages.

Associations between overweight and identified dietary patterns

Table 4 shows the odds ratio (OR) values for overweight according to the four dietary patterns. In the crude analysis, the "Alcohol" DP was significantly associated with overweight (odds ratio (OR) =1.202, $p=0.002$). No significant relationship was apparent between overweight and the other dietary patterns. After adjusting for sex in the second model, males were observed to be less likely to adhere to the "Healthy" DP (OR=0.822; $p=0.014$) and also had higher odds of consuming foods from the "alcohol" DP compared to females (OR=1.175; $p=0.035$).

Table 3: Factor-loading matrix for the food groups based on the four dietary patterns identified

Food groups	Dietary patterns			
	Healthy	Bread/drinks	Snacks	Alcohol
Breakfast cereals	0.113	0.037	0.603	-0.047
Bread	-0.012	0.810	0.224	-0.099
Legumes	0.628	0.092	0.210	-0.034
Oils	0.629	0.148	0.052	0.107
Milk and dairy	0.619	0.077	0.022	0.278
Fish and sea foods	0.600	0.198	0.175	-0.072
Snacks	-0.116	-0.009	0.689	0.296
Whole grains	0.453	0.088	0.284	-0.324
Fruits	0.637	-0.071	0.092	0.243
Roots and tubers	0.476	0.130	0.357	-0.332
Meat	0.629	0.123	0.025	-0.109
Carbonated drinks	0.434	0.631	-0.025	0.079
Pasta and rice	0.257	0.208	0.485	0.024
Poultry and egg	0.479	0.094	0.011	0.051
Vegetables	0.661	0.186	0.051	0.081
Cocoa,tea and coffee	0.307	0.568	0.028	0.365
Alcoholic drinks	0.187	0.102	0.172	0.697

The cut-offs for a strong positive value are in bold.

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Table 4: Logistic regression analysis of associations between overweight and identified dietary patterns

Variables	Dietary patterns			
	Healthy pattern	Bread and drinks pattern	Snacks pattern	Alcohol pattern
BMI (kg/m²)				
Normal	Ref	Ref	Ref	Ref
Overweight	0.962 (0.851 – 1.089)	1.090 (0.966-1.231)	1.082 (0.958-1.221)	1.202(1.067-1.351)
p-value	0.541	0.162	0.206	0.002*
Sex				
Female	Ref	Ref	Ref	Ref
Male	0.825 (0.704-0.965)	1.099 (0.950 – 1.271)	1.047 (0.900 – 1.217)	1.175 (1.011-1.366)
p-value	0.016*	0.108	0.898	0.035*

*significant at $p \leq 0.05$, ns= not significant

Discussion

In this cross-sectional study, dietary patterns of university students in South east, Nigeria were characterized and analysed for association with overweight. Given the paucity of data on the study population, the findings have important implications. The findings demonstrate that dietary patterns of the university students have associations with their gender and BMI. Adherence to the "Alcohol" DP was more associated with overweight in both sex, whereas, males were less likely to adhere to the "Healthy" DP compared to females.

The results obtained suggests that the dietary pattern of the university students is typified by high consumption of snacks, bread, alcoholic and non-alcoholic beverages, soda, legumes, fat/oils, vegetables, pasta and noodles, fruits, milk/dairy and fish products. Our data suggests a variety of foods from the food groups were eaten. The "Healthy" DP with the highest factor loading consists of traditional foods commonly consumed in the Southeastern part of Nigeria. This dietary pattern was heavily loaded with legumes, fruits, vegetables, meat, fish and milk group. These are healthy foods and good sources of micronutrients and phytochemicals; thus, may contribute to reduction in overweight and obesity (38), even though, they were not associated with overweight in this study. On the other hand, an unhealthy or western dietary pattern may increase overweight/obesity risk (38). Stratification based on gender in this study revealed males were less likely to adhere to consumption of "healthy" DP when compared to females. Similar to the "Healthy pattern" in this study, the "healthier pattern" identified among Equatorial Guinea

migrants to Spain (28) and the "mixed pattern" among Ghanaian migrants to Europe (27) were strongly associated with female sex.

The other three dietary patterns derived in this study can be described as typical "modern foods". The "Alcohol" DP was associated with a higher risk of overweight in both sex, whereas, the "Bread/drinks" and "Snacks" DP were not. The non-significant association between the "Bread/drinks" and "Snacks" DPs with overweight is rather surprising. A study in the USA found a higher consumption of sugar-sweetened beverage to be associated with higher weight gain and risk of developing type 2 diabetes (35). Kruseman *et al.* (39) found an increase in the consumption of sweetened beverages among African refugees in Geneva. Renzaho and Burns (40) in a study of African immigrants living in Australia found increased consumption of unhealthy foods such as pizza, breakfast foods and other fast foods. The "Bread/drinks" DP in this study provides an indication of food pattern of university students which involves consumption of easy on-the-go meals such as soft drinks and junk foods that do not require preparation. Soft drinks contain large amount of sugar in a rapidly absorbable form and an increase intake of soft drinks has been reported in developing countries (41).

The "Snacks" DP in this study is consistent with previous studies among university students on consumption of high fatty snacks (42, 43). A possible explanation for the high snack consumption may be attributed to greater availability of such foods within and around university campuses. Again, a lack of finance

might also predispose university students to consumption of these foods that are high in fat and sugar. This was corroborated in a study among university students where income was a major determinant of food insecurity (42). Furthermore, lack of time to prepare foods and other socioeconomic factors may also predispose students to consumption of fatty snacks (43). This highlights the role of environment and food availability in the choice of foods consumed by university students. Similar to our study, Becquey *et al.* (19) found no significant relationship between overweight and "Snack" pattern among adults in Ouagadougou. However, the same study (19) found a positive association between the consumption of "Modern food pattern" and overweight. The authors thus suggested that both patterns are typically "urban" (19). Also, a study among Asian students who migrated to the USA and lived there for three months reported an increase in consumption of salty and sweet snacks as well as fats (44). The literature has been consistent on the association between consumption of high-energy nutrient foods and body weight gain (45, 46). It has been reported that the consumption of snacks and junk foods high in fat and sugars constitutes a risk factor for overweight, obesity and cardiovascular diseases (45, 46). With the increasing number of fast-food "joints" on campuses and a high frequency of undergraduates "eating out", an increase in the risk of non-communicable diseases appears inevitable (31). The recent nutrition transition in developing countries from traditional fibre-rich diets to "western-styled" fast-foods has been reported to affect the dietary habits of young adults, such as students of universities and other tertiary institutions (47). A survey of undergraduates in Southwest and Southeast, Nigeria revealed that over 70% and 58.1%, respectively consumed snacks regularly (47, 48). Poor dietary habit is reported to be a significant public health problem when young adults transit to the university (45). Also, the lack of knowledge of healthy food choices is known to negatively influence eating habits and nutritional status of university students (49).

Comparison of identified dietary patterns in this study with other population groups in other countries showed some similarities (22, 50, 51). For instance, the "Snacks" pattern identified in

this study was similar to "Snacky" pattern identified among Spanish children and adolescents (50), the "Pizza and drinks" pattern identified among Korean children (22) and the "Junk" pattern (crisps, sweets, fried and takeaway foods, soft drinks) among children in South-West England (51). The "Bread and drinks" DP identified in our study was similar to the "Junk" pattern (crisps, sweets, fried and takeaway foods, soft drinks) described by Northstone and Emmett (51). In Africa, only few studies have been conducted to identify dietary patterns of population groups using empirical methods. Most of the studies have labelled the main dietary patterns as "Traditional" patterns and these are typified by grains cereals, roots (25, 26), legumes and traditional green leafy vegetables (26) and roots, tubers and plantains (52). Others that have studied African migrants in various parts of Europe have labelled their patterns as "Mixed" (27) and "Healthy" patterns (28). The strong adherence to the alcohol DP among our study population suggests a propensity towards a poor diet among our study population. It has been suggested that alcohol calories may be a significant contributor to the rise in overweight and obesity (53). For instance, Farhat *et al.* (54) found that frequent drinking and smoking were significantly associated with overweight and obesity among girls. Moderate alcohol intake may be associated with reduced risk of becoming overweight and obese, particularly among women, still, higher alcohol use (e.g., binge-drinking) may increase overweight and obesity risk (55, 56), particularly in men (57).

The strength of our study lies in the fact that this is the first study to identify dietary patterns in a young adult population using PCA, as well as investigate its relationship with overweight among university students in Southeast of Nigeria. Another strength is the use of a culture appropriate FFQ to obtain information on food consumption, though we did not collect information on portion sizes to quantitatively assess dietary intake and food preparation methods. The FFQ has however been identified as a quick and valid tool to assess food consumption and when combined with other factor analysis, allows studying dietary patterns in relation to health outcomes.

A limitation is the cross-sectional nature of the

study which did not permit examination of causal relationship between the dietary patterns and overweight. Again, the results may not be generalized to the entire population of university students in Nigeria due to use of only one out of the six geopolitical zones in the country, however, our sample comprised of students from other geopolitical zones. There was also a possibility of recall bias during the FFQ interview. This bias was minimized as the research assistants administered the questionnaire and ensured they collected information from the entire population in a similar manner. Despite the limitations, the study contributes to a new body of knowledge about the dietary pattern of university students, an under studied population. The choice of PCA to perform dietary pattern in our sample was based on the fact that data is sparse on food consumption patterns of Nigerian students using this method.

Conclusion

Our study lends support to the concept of nutrition transition currently sweeping round low and middle-income countries. Consumption of foods from the "alcohol" DP was found to be significantly associated with overweight in both sex, whereas, males were more likely to consume foods from the "alcohol" DP. Such a dietary pattern may have great clinical significance, suggesting that high-calorie diets may increase the risk of overweight and obesity. Interventions aimed at improving dietary patterns, eating habits and nutritional status among university students should be employed. Again, more research is needed in other geopolitical regions and among different populations in Nigeria to better understand dietary patterns and associated factors.

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Conflicts of interest

The authors have no conflict of interest to declare.

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