Discoveries in Public Health
Publication of the Faculty of Public Health, College of Medicine, University of Ibadan, Nigeria.

Volume 1 June, 2022 - pp 55-66

Diet Quality of Adults with Overweight and Obesity in Southwestern, Nigeria

Opeyemi Olamide Akintimehin and **Rasaki Ajani Sanusi**
Department of Human Nutrition and Dietetics, University of Ibadan, Ibadan, Nigeria.
Corresponding Author E-mail: ope.akintimehin@gmail.com

Abstract
Poor diet quality is a leading and preventable cause of adverse health, which includes non-communicable diseases (NCDs). However, there is little information regarding the quality of diet of overweight and obese adults in Southwestern, Nigeria. Therefore, the objective of this study is to determine the diet quality of adults with overweight and obesity in Southwestern, Nigeria. The study was descriptive and cross-sectional. It involved 223 participants from three states in Southwestern, Nigeria. Dietary intake was assessed using 24-hours dietary recall and analysed to determine the energy and nutrient intake. Adequacy of energy and nutrients was determined using estimated energy requirement and estimated average requirements, respectively. Height (m) and weight (kg) were taken to determine the Body Mass Index (BMI) (kg/m^2). Diet quality was assessed using the 100-point Diet Quality Index – International (DQI-I) and categorized as low (0-33), average (34-66) and high (67-100). Descriptive statistics, analysis of variance and Pearson correlations were used to analyse data at $p< 0.05$ level of significance. High quality diet was achieved by 21% of the participants and majority did not meet recommendations for fruits, vegetables, calcium and vitamin C. Moreover, in the proportion that met food-group and nutrient recommendations: rural vs urban: fruits (1% vs 0%), vegetables (5% vs 2%), root/tubers/grains (12% vs 24%), and protein (86% vs 92%). Participants' diet quality had a positively weak correlation with BMI ($r=0.07$; $p<0.05$). Continued recommended fruits and vegetables intake should be considered as efforts to improve the diet quality and health outcome of adults with overweight and obesity.

Keywords:
Diet quality,
Adult,
Overweight,
Obesity,
Nigeria.

La Qualité de l'alimentation des adultes en surpoids et obèses dans le sud-ouest du Nigeria

Résumé
Une alimentation de mauvaise qualité est l'une des causes principales évitables de problèmes de santé, notamment les maladies non transmissibles (MNT). Cependant, il existe peu d'informations concernant la qualité de l'alimentation des adultes en surpoids et obèses dans le sud-ouest du Nigeria. Par conséquent, l'objectif était de déterminer la qualité de l'alimentation des adultes en surpoids et obèses dans le sud-ouest du Nigeria. L'étude était descriptive transversale et a impliqué 223 participants de trois États du sud-ouest du Nigéria. L'apport alimentaire a été évalué à l'aide d'un rappel alimentaire de 24 heures et analysé pour déterminer l'apport énergétique et nutritionnel. L'adéquation de l'énergie et des nutriments a été déterminée en utilisant respectivement les besoins énergétiques estimés et les besoins moyens estimés. La taille (m) et le poids (kg) ont été pris pour déterminer l'indice de masse corporelle (IMC) (kg/m2). La qualité de l'alimentation a été évaluée à l'aide de '100-point Diet Quality Index – International (DQI-I)', l'indice de qualité de l'alimentation à 100 points - International (DQI-I) et classée comme faible (0-33), moyenne (34-66) et élevée (67-100). Les statistiques descriptives, l'analyse de la variance et les corrélations de Pearson ont été utilisées pour analyser les données au niveau de signification à $p < 0,05$. Une alimentation de haute qualité a été atteinte par 21 % des participants et la majorité n'a pas respecté les recommandations pour les fruits, les légumes, le calcium et la vitamine C. 0 %), des légumes (5 % contre 2 %), des racines/tubercules/céréales (12 % contre 24 %) et des protéines (86 % contre 92 %). La qualité de l'alimentation des participants avait une corrélation positivement faible avec l'IMC ($r=0,07$; $p<0,05$). La consommation continue recommandée de fruits et de légumes doit être envisagée dans le cadre des efforts visant à améliorer la qualité de l'alimentation et les résultats pour la santé des adultes en surpoids et obèses.

Mots-clés:
Qualité de l'alimentation,
Adulte,
Surpoids,
Obésité,
Nigeria

Introduction

Overweight and obesity are defined by the World Health Organization (WHO) as Body Mass Index (BMI) greater than or equal to 25; and BMI greater than or equal to 30 respectively (1). These are known global issues, with high prevalence rates in developed and developing countries alike (1-3). They are major risk factors for cardiovascular disease (CVD), type 2 diabetes mellitus, a third of cancers, and musculoskeletal disorders, which are classified as non-communicable diseases (NCDs). Hence, a major public health concern. It is mostly caused by a poor diet, high sedentary lifestyle and low physical activity which are behavioural risk factors that could be changed (1). In 2016, over 1.9 billion people aged 18 and above were overweight of which 39 percent were men and 40 percent were women, with over 650 million being obese; 11% men and 15% women respectively. Obesity rates have risen in the previous four decades and are continuing to rise to epidemic levels (4). By 2021, prevalence of overweight and obesity among adults aged 18 years and over were 39% and 13%, respectively (1). However, it was projected by Kelly *et al*., that by 2030, there will be 2.16 billion overweight and 1.12 billion obese people in the world (5). A trend analysis by Popkin and Slining also suggested that more than two billion of the worldwide population are currently overweight or obese (6). The global increase in the incidence of overweight and obesity has been attributed to the availability and access to unwholesome meals and sugar-sweetened beverages, which are often less expensive than healthier choices. Although an energy imbalance between calories consumed and expended is the immediate cause of overweight and obesity, the fundamental causes are more intricate. Furthermore, this condition is exacerbated by a lack of physical activity (7).

Diet quality indices in nutritional epidemiology is emerging and it is important to recall that certain population subgroups with different socio-demographic characteristics may have significantly different diet characteristics, and thus the index's utility may vary accordingly (8). A diet quality index calculates a score based on pre-determined criteria for what defines a healthy or unhealthy diet. This often evaluates the gradation of observance to a set of nutritional guidelines or a recommended dietary pattern such as the Mediterranean diet which it is based on foods, nutrients, or both. Most diet indices have been employed as markers of quality of a diet since higher index scores have been linked to improved nutritional and food intakes as well as decreased mortality and risks of disease risks (9). The Diet Quality Index – International (DQI-I) focuses on concerns related not only to chronic diseases but also to problems of undernutrition. This provides a global tool for monitoring healthfulness of diet and for exploring aspects of diet quality related to the nutrition transition (10).

Dietary indices that use an *a priori* approach, such as the DQI-I, are based on current nutrition research and identify conceptually defined dietary components that are considered important for health promotion and that reflects risk gradients (11). Each category of the DQI-I evaluates various diet components. The intake of dietary nutrients essential to guard against undernutrition and deficiency diseases is measured by adequacy. Variety assesses the overall variety as well as protein variety, while adequacy assesses the intake of those dietary nutrients essential to prevent malnutrition and deficiency disorders. Overall balance assesses diet in terms of energy source proportions and fatty acid composition; moderation assesses food and nutrient intake in relation to chronic diseases that may necessitate restriction; and moderation assesses food and nutrient intake in relation to chronic diseases that may necessitate restriction. These classifications assist researchers in determining which aspects of the diet should be improved (12). The most popular technique to test the validity of diet quality indices is to link them to dietary adequacy or chronic disease risk (13-14).

Previous researches into diet quality assessment showed an average score among adult women (15), no correlation between diet quality index and BMI waist circumference or waist-to-hip ratio (16); higher scores weakly correlated with decreased BMI (17); and an inverse relation to BMI (18); one-point increase in diet quality (DQ) was associated with a 1.4 percent reduction in the risk of abdominal obesity (19); lower scores individuals had a 90% and 50% greater risk for general obesity and overweight, respectively (20); individuals in the highest quartile of the index had a 40% decreased risk of general obesity (21); BMI fell marginally in higher scores (22); highest quartile associated with a 35% decreased probability of being overweight or obese, as well as abdominal obesity (23); diet quality was not substantially linked with BMI or WC (24); higher scores were related with a lower BMI (25); higher score in females was not associated with overweight/general obesity, whereas a higher score in males was associated with a lower risk of overweight/general obesity, and a higher score in total respondents was associated with a lower risk of overweight/general obesity (26); a one-unit increase in HEI score was associated with a 0.095 kg/m2 decrease in BMI (27). The link between diet quality and women's risk of becoming overweight or obese was discovered (28). A 10-point rise in DQ score related with a 10% lower risk of acquiring 10 kg in whites who were normal weight at baseline, but a 15% higher risk in blacks

who were obese at baseline (29). DQ index was inversely related to both BMI and body fat percentage (30). DQ index also identified that women with the poorest diet quality ate diets that were low in energy, carbohydrate, and micronutrients and high in total fat, particularly saturated fat, and alcohol (31). Furthermore, diet quality was found to be related with lower risk of being overweight and obese (32). Among the elderly, the index showed low-weight individuals having higher chance of having a low-quality diet compared to those of normal weight, and those who consumed four meals per day had a greater chance of having a low and average quality diet, respectively (33). A high diet quality score was associated with a decreased odd of being overweight or obese (34).

These findings suggest that overweight/obesity risk reduction may be possible through strategies that optimize the diet quality of individuals and with the highlighted gaps on diet quality assessment in relation to excessive body fatness. This study adapted the DQI-I for use in a cross-sectional study of adults with overweight and obesity in Southwestern, Nigeria.

Methods

Study Designs and Participants

This descriptive cross-sectional study consisted of 223 overweight/obese adults, aged from 20 to 60 years. It was conducted in three states from Southwestern Nigeria (Ogun, Osun and Oyo) from May to August 2017. The exclusion criteria were as follows: pregnant and lactating women, older adults, resident of the location less than three years, individuals on medications that can affect dietary intake and who did not give informed consent to participate in the study. Approval for the study was obtained from the University of Ibadan and University College Hospital (UI/UCH) Ethics Review Committee, with number UI/EC/16/0298.

Measurements

An interviewer administered questionnaire was used to collect information from the participants. The questionnaire included socio-demographic and socio-economic characteristics of the participants – household income, education, marital status, occupation.

Anthropometrics

Heights and weights of participants were measured utilizing a manual bathroom scale and a locally made Stadiometer respectively. Measured heights and weights were used in calculating participants' BMI. BMI category was based on the standard categories of overweight 25-29.9 kg/m^2 and obese $\geq$30kg/m^2.

Dietary Intake

Consenting participants completed a single 24-hour dietary recall via interview to capture the intake within the past 24 hours. The interview was unannounced based on the participant's availability, which was any week day. The Elizabeth Stewart Hands and Associates (ESHA) food processor was used to analyse the food intake. Food models were used in estimating the portion size.

The multiple-pass method was followed to help ensure more accurate participant recall. Participants initially gave a brief description of the dietary intake for the previous day, then further probed for more details of food preparation and portion sizes. After all dietary information were collected, the food list was reviewed again by the interviewer with the participants.

Data from the dietary analysis using the ESHA food processor were used to calculate DQI-I score as described by Kim *et al* (11). The DQI-I score measures diet quality based on the nutritional concerns of both developed and developing countries. Scores for each component are summarized in each of the four main categories. The scores for all four categories are summed, resulting in the total DQI-I score, ranging from 0 to 100 (0 being the poorest and 100 being the highest dietary quality). Participants were classified into terciles based on their DQI-I total score. According to this study, a score $\leq$ 33 suggests a diet of "poor" quality, from 34 to 66, a diet that "needs improvement", and a score $\geq$ 67, a "good diet" in terms of quality.

Statistical Analysis

The IBM Statistical Package for Social Sciences (IBM/SPSS) version 20.0 was used for statistical analyses. Continuous data were presented as mean ± standard deviation and non-continuous data as frequency (percentage). Percentages of participants meeting the recommendations for each DQI-I component and total DQI-I scores were calculated. A Chi-square (X^2) analysis was performed to determine whether there was a significant difference between the proportions of participants meeting the DQI-I component and total DQI-I recommendations. To determine whether other socio-demographic and socio-economic variables were associated with diet quality, analysis of variance was performed with participant's DQI-I score, a continuous variable, as the outcome variable and the following categorical characteristics: education, household income, BMI category, marital status, age and gender separately. The association between BMI and DQI-I score was determined using Pearson correlation. Variables found significant from the analysis of variance ($P<0.05$) were entered into a regression model to determine predictors of diet quality. Forward stepwise

regression was used and variables with a significance level <0.50 were included in the final model. The use of this large level is suggested to avoid overfitting the data (35). All variables included in the final model are considered potential predictors of diet quality of adults with overweight and obesity, regardless of their p value. Results are reported as means and standard deviations. A p value <0.05 was considered significant.

Results

There were 223 adults with overweight and obese that completed the 24-hour dietary recall. Characteristics of the participants are reported in Table 1. About half of the participants were females and were below 30 years old. Majority of the participants were overweight, Yoruba, Christians and married. Most of the participants had tertiary education, were business owners, had monthly income between less than ₦10,000 and ₦20,000. Also, more than half of the participants' source of energy was government generated and had access to either well or borehole.

Energy intake, protein, carbohydrate, fat, iron, folate and vitamin A were 1866.6±946.6 kcal, 69.9±42.0g, 333.3±185.2g, 29.2±20.6g, 10.1±6.4, 0.8±0.6 and 776.8±489.2, respectively. Mean ± standard deviation of height, weight, BMI, waist circumference, hip circumference and waist to hip ratio of the participants were 1.61±0.09 m, 1.61±0.09 kg, 29.86±4.26 kg/m2, 96.44±12.77 cm, 107.62±13.36 cm and 0.94±0.63 respectively. There was no significant difference between the rural and urban participants, p>0.05.

The mean ± standard deviation of DQI-I score was 55.6±8.8 for the participants (see Table 2). None of the participants met the recommendation of overall food group variety, while few met the recommendation of within-group variety from protein source. However, there was no significant difference in the proportion of those that met the recommendation in both rural and urban areas. Majority of the participants did not meet the recommendation for fruit and vegetable group but met the recommendation of protein. The difference in the proportion of those that met or did not meet the recommendation of fruits, vegetables, root/tubers/grains, protein in rural and urban area was not significant except for fibre group p<0.05.

In the adequacy component of the DQI-I, majority met the recommendation for iron and very little met the recommendation for calcium and vitamin C. The difference in the proportion of those that met the recommendation for calcium between the rural and urban area was significant p<0.05. In the moderation component of the DQI-I, majority met the recommendation for cholesterol and sodium but few met the recommendation for total fat and saturated fat. However the difference in the proportion between rural and urban was not significant, p>0.05. Majority of the participants were within medium "diet needs improvement" category; few had high quality diet and the difference in each category was not statistically significant. More than half of the participants met their recommendation for root/tubers/grains, fibre, protein, iron, total fat, saturated fat, cholesterol, sodium and empty calorie. However, only a few met the recommendations for fruits and vegetables, calcium, and vitamin C. None of the participants met the recommendation for macronutrient ratio and few for fatty acid ratio.

There was no significant difference in the association between DQI category and socio-demographic characteristics of the participants (see Table 3). In the analysis of variance, gender, age, monthly income and BMI were significantly associated with DQI-I score (see Table 4). Diet quality was higher among participants that were females, less than 30 years old, had monthly income between ₦21,000 and ₦30,000 and obese. However, there was no association between sector, gender, age, religion, ethnicity, education, marital status, occupation, monthly income, BMI and diet quality category (p>0.05). Gender, age, education, marital status, monthly allowance and BMI that were significantly associated with diet quality were entered into the stepwise regression model to determine predictors of diet quality. Gender and BMI remained in the final model (adjusted r2=0.07; p<0.05). The effect sizes of the variables in the final model were as follows: gender (β coefficient=0.23; standard error [SE]=1.16; p=0.001) and BMI (β coefficient=0.14; [SE]=1.19; p=0.036).

Table 1: Characteristics of the study participants

Variables	Overall (n=223) N(%)	Rural (n=112) N(%)	Urban (n=111) N(%)	*P* value
Sex of respondents				
Male	112(50.20)	52(46.40)	60(54.10)	0.255
Female	111(49.80)	60(53.60)	51(45.90)	
Respondent's age (yrs)				
=30	98(43.90)	41(36.60)	57(51.40)	0.053
31-40	48(21.50)	25(22.30)	23(20.70)	
41-50	53(23.80)	29(25.90)	24(21.60)	
51-60	24(10.80)	17(15.20)	7(6.30)	
Mean ±SD	35.45±11.53	37.33±11.96	33.55±10.80	
BMI category				
Overweight	140(62.80)	74(66.10)	66(59.50)	0.247
Obese	83(37.20)	38(33.90)	45(40.50)	
Religion				
Christian	122(54.70)	65(58.00)	57(51.40)	0.602
Islam	99(44.40)	46(41.10)	53(47.70)	
Traditionalist	2(0.90)	1(0.90)	1(0.90)	
Ethnicity				
Yoruba	215(96.40)	108(96.40)	107(96.40)	0.565
Igbo	1(0.40)	0(0.00)	1(0.90)	
Hausa	7(3.10)	4(3.50)	3(2.70)	
Educational level of respondent				
No formal education	14(6.30)	7(6.20)	7(6.30)	0.840
Primary school	42(18.80)	19(17.00)	23(20.70)	
Junior secondary school	9(4.00)	4(3.60)	5(4.50)	
Senior secondary school	72(32.30)	40(35.70)	32(28.80)	
Tertiary	86(38.60)	42(37.50)	44(42.80)	
Respondent's Marital status				
Single	67(30.00)	37(33.0)	30(27.00)	0.099
Married	148(66.40)	68(60.70)	80(72.10)	
Divorced/separated	1(0.40)	1(0.90)	0(0.00)	
Widowed	7(3.10)	6(5.40)	1(0.90)	
Respondent's Primary Occupation				
Civil servant	41(18.40)	19(17.00)	22(19.80)	0.321
Farmer	5(2.20)	3(2.70)	2(1.80)	
Self-employed	10(4.50)	6(5.40)	4(3.60)	
Business owner/trader	86(38.60)	40(35.70)	46(41.40)	
Artisan	36(16.10)	18(16.10)	18(16.20)	
Professional	7(3.10)	5(4.50)	2(1.80)	
Others*	38(17.04)	21(18.80)	17(15.30)	
Primary source of energy				
No electricity	10(4.50)	4(3.60)	6(5.40)	0.804
Personal generator	28(12.60)	13(11.60)	15(13.50)	
Electricity board	6(2.70)	3(2.70)	3(2.70)	
IBEDC	178(79.80)	91(81.20)	87(88.60)	
Solar energy	1(0.40)	1(0.90)	0(0.00)	
Primary source of water				
Spring/river	1(0.40)	0(0.00)	1(0.90)	0.432
Well	92(41.30)	42(37.50)	50(45.00)	
Borehole	96(43.00)	54(48.20)	42(37.80)	
Pipe borne	31(13.90)	14(12.50)	17(15.30)	
Others**	3(1.30)	2(1.80)	1(0.90)	
Type of toilet				
Bush	12(5.40)	3(2.70)	9(8.10)	0.300
Pit latrine	77(34.50)	42(37.50)	35(31.50)	
VIP latrine	10(4.50)	6(5.40)	4(3.60)	
Water system	122(54.70)	60(53.60)	62(55.90)	
Others***	2(0.90)	1(0.80)	1(0.90)	
Monthly income(₦)				
<10,000	50(22.40)	20(17.90)	30(27.00)	0.345
10,000-20,000	57(25.60)	31(27.70)	26(23.40)	
21,000-30,000	33(14.80)	19(17.00)	14(12.60)	
31,000-40,000	18(8.10)	7(6.20)	11(9.90)	
41,000-50,000	20(9.00)	12(10.70)	8(7.20)	
>50,000	45(20.20)	23(20.50)	22(19.80)	

Others: retirees, others*: retirees, students, others**: tap water, others***: river

Table 2: Diet Quality Index-International (DQI-I) Scores and Components

Component	**Score ranges (points)**	**Overall (n=223)**	**Rural (n=112)**	**Urban (n=111)**	***P*-value**
		Mean±SD	Mean±SD	Mean±SD	
Overall variety	0-15	7.79±3.81	7.79±3.89	7.78±3.34	0.983
Within variety	0-5	2.51±1.47	2.51±1.59	2.50±1.35	0.982
Variety	**0-20**	11.68±3.18	11.56±3.61	11.80±2.70	0.576
Vegetable group	0-5	0.74±1.24	0.73±1.36	0.74±1.12	0.968
Fruit group	0-5	0.24±0.94	0.18±0.79	0.30±1.07	0.347
Fibre group	0-5	3.86±1.40	3.54±1.50	4.18±1.22	0.001*
*R/G/T	0-5	4.75±0.64	4.81±0.64	4.69±0.63	0.163
Vitamin C	0-5	1.57±1.42	1.71±1.44	1.41±1.39	0.115
Iron	0-5	4.65±0.58	4.64±0.60	4.65±0.57	0.941
Calcium	0-5	2.22±1.06	2.39±1.04	2.05±1.06	0.017*
Protein	0-5	2.88±1.40	2.80±0.60	2.95±0.34	0.021*
Adequacy	**0-40**	20.90±3.66	20.81±3.74	20.98±3.60	0.730
Total fat	0-6	3.52±2.92	3.05±2.93	4.00±2.84	0.015*
Saturated fat	0-6	3.48±2.92	3.05±2.93	3.92±2.85	0.027*
Cholesterol	0-6	5.27±1.67	5.28±1.67	5.27±1.68	0.977
Sodium	0-6	5.49±1.45	5.49±1.39	5.49±1.51	0.981
Empty calorie	0-6	4.18±2.36	3.86±2.43	4.51±2.25	0.037*
Moderation	**0-30**	21.96±8.52	20.73±8.42	23.19±8.48	0.031*
Macronutrient ratio	0-6	0.00±0.00	0.00±0.00	1.20±1.48	***
Fatty acid ratio	0-4	1.06±1.42	0.00±0.00	0.92±1.34	0.144
Overall balance	**0-10**	1.06±1.42	1.20±1.48	0.92±1.34	0144
Diet quality score	**0-100**	55.59±8.81	54.30±9.48	56.89±7.90	0.028*

*R/G/T: Roots/Grains/Tubers

Table 3: Association between DQI category and socio-demographic characteristics of the respondents

Variables	DQI Low (n=1)	Medium (n=201)	High (n=21)	p-value
Sector				
Rural	0(0.00)	99(49.30)	13(61.90)	0.328
Urban	1(100.00)	102(50.70)	8(38.10)	
Gender				
Male	0(0.00)	104(51.70)	8(38.10)	0.297
Female	1(100.00)	97(48.30)	13(61.90)	
Age group (yrs)				
20-30	0(0.00)	84(42.00)	13(61.90)	0.101
31-40	0(0.00)	43(21.50)	5(23.80)	
41-50	1(100.00)	52(26.00)	0(0.00)	
51-60	0(0.00)	21(10.50)	3(14.30)	
Religion				
Christian	0(0.00)	113(56.20)	9(42.90)	0.563
Islam	1(100.00)	86(42.80)	12(57.10)	
Traditional	0(0.00)	2(1.00)	0(0.00)	
Ethnicity				
Yoruba	1(100.00)	194(96.50)	20(95.20)	0.987
Igbo	0(0.00)	1(0.50)	0(0.00)	
Hausa	0(0.00)	6(3.00)	1(4.80)	
Education				
No formal education	0(0.00)	10(5.00)	4(19.00)	0.078
Primary	1(100.00)	35(17.40)	6(28.60)	
Junior secondary	0(0.00)	8(4.00)	1(11.10)	
Senior secondary	0(0.00)	69(34.30)	3(14.30)	
Tertiary	0(0.00)	79(39.30)	7(33.30)	
Marital status				
Single	0(0.00)	64(31.80)	3(14.30)	0.433
Married	1(100.00)	131(65.20)	16(76.20)	
Divorced/separated	0(0.00)	1(0.50)	0(0.00)	
Widowed	0(0.00)	5(2.50)	2(9.50)	
Occupation				
Civil servant	0(0.00)	33(16.40)	8(38.10)	0.357
Farmer	0(0.00)	5(2.50)	0(0.00)	
Self-employed	0(0.00)	10(5.00)	0(0.00)	
Business owner/trader	0(0.00)	76(37.80)	10(47.60)	
Artisan	0(0.00)	34(16.90)	2(9.50)	
Professional	0(0.00)	7(3.50)	0(0.00)	
Others	1(100.00)	36(16.90)	1(4.80)	
Monthly income				
<10,000	1(100.00)	46(22.90)	3(14.30)	0.868
10,000-20,000	0(0.00)	50(24.90)	7(33.30)	
21,000-30,000	0(0.00)	31(15.40)	2(9.50)	
31,000-40,000	0(0.00)	15(7.50)	3(14.30)	
41,000-50,000	0(0.00)	19(9.50)	1(4.80)	
>50,000	0(0.00)	40(19.80)	5(23.80)	
BMI				
Overweight	1(100.00)	127(63.20)	12(57.10)	0.640
Obese	0(0.00)	74(36.80)	9(42.90)	

Table 4: Mean adult Diet Quality Index – International (DQI-I) score by socio-demographic and socio-economic variables (N=223)

Variables	DQI-I score, mean±SD[a]	*P* value[b]
Gender		0.046*
Male	53.7±8.8	
Female	57.5±8.5	
		0.011*
Age (years)		
= 30	56.4±8.9	
31 - 40	55.9±9.2	
41 - 50	54.2±7.5	
51 – 60	54.9±10.5	
		0.057
Education		
No formal education	61.5±7.5	
Primary	57.7±9.3	
JSS[c]	55.1±10.4	
SSS[d]	53.5±8.3	
Tertiary	55.4±8.5	
		0.052*
Marital status		
Single	52.7±8.6	
Married	56.9±8.5	
Divorced/seperated	62.0±0.0	
Widowed	53.6±11.6	
		0.014*
Monthly income		
<? 10,000	56.1±8.5	
? 10,000 - ? 20,000	55.6±8.8	
? 21,000 - ? 30,000	57.0±9.0	
? 31,000 - ? 40,000	54.1±10.4	
? 41,000 - ? 50,000	53.3±9.2	
? 51,000 - ? 100,000	56.3±8.4	
>? 100,000	54.8±8.5	
		0.013*
BMI[e] (kg/m^2)		
Overweight	54.8±8.8	
Obese	56.9±8.8	

[a]SD- Standard Deviation
[b]Analysis of variance for difference in means
[c]JSS-Junior Secondary School
[d]SSS- Senior Secondary School
[e]BMI- Body Mass Index

Discussion

This study aimed to assess the cross-sectional association between diet quality and adults that are overweight or obese in Southwestern Nigeria. Majority of the participants being overweight than obese is consistent with the national report (36). The diet of the participants in this study were similar to what has been reported about most adults not meeting the recommendations for calcium, fruits, vegetables and vitamin c (37-39). Diet quality was greater in this study, 56 compared to 38 in a nationally representative sample of overweight and obese adults (40) but consistent with Onyeji and Sanusi (15). This is suggestive of a healthy diet, although the mean score indicated diet quality might need some improvements. These participants were consistent with previous studies as a few met the recommendation for fruits and vegetables (41-42). Fruits and vegetables consumption, as well as calcium and vitamin C-rich foods, should be increased, while sodium and saturated fat consumption should be reduced. Conversely, a higher proportion of participants met the recommendations for protein, indicating that animal-based food are consumed which have high protein quality (43).

A very weak correlation was found between gender, BMI and diet quality of participants in this study (r= 0.05; 0.07) than no association as reported in previous studies (16, 18, 24, 44). However, there were significant differences in the proportions of participants that met the recommendations for some components in the DQI-I score. The differences found between the percent of participants meeting the recommendations might relate

to food consumption in separate environments, as well as differences in food preferences among participants.

These results indicate that participants in this study regardless of their monthly income did not attain high quality diet. Although the association between education and diet quality score was not significant, i.e., participants with informal education had higher DQ scores than those with tertiary education. This suggests that with the current minimum wage, healthy foods can be purchased and consumed. However, there is continued need for intervention through nutrition education programmes that minimize disparities, particularly in the face of poor diet quality and low income in order to achieve high diet quality and health. Physical activity level was not measured in this study; this can be investigated in future studies. Further research is needed to understand the comparability of these findings with prospective associations with obesity. The method used to assess dietary intake was similar to that used by Sanusi (2010), Onyeji and Sanusi (2018); Ebrahimi *et al*., (2020) and Ebrahimi *et al*., (2021) (40, 45-46). Hence the methodology is consistent with these studies.

The strengths of this study included application of DQI-I in assessing diet quality. This diet quality index captured a variety of nutrients and food groups and have a continuous and proportional score approach, which is a more effective scoring system compared to cut-off scores (47). One of the limitations of this study is lack of information on physical activity level of the participants so we cannot discount confounding. Also, the possibility of under-or over-reporting foods during the 24-hour dietary recalls because of social desirability bias.

Participants might have been more likely to report foods considered healthy, such as fruits and vegetables, and/or to under-report foods considered unhealthy, such as candy and fried foods. However, the dietary analyses still showed very low intake of fruits and vegetables. Another limitation is that this study is cross-sectional and is susceptible to reverse causality when assessing associations between diet quality and obesity. Moreover, evidence suggests that individuals with overweight and obesity are more likely to under-report food intakes (48).

Conclusion

The present study identified that diet quality had a very weak association with higher BMI among adults in Southwestern, Nigeria. Although, overall diet quality of adults with overweight and obese were associated with gender, age, marital status, monthly income and BMI, significant differences were found between the proportions of the participants meeting the recommended intake for vegetables, fibre, calcium, as well as total and saturated fats. Adults with overweight and obesity should increase consumption of fruits, vegetables, and decrease consumption of saturated fat. The findings from this study has contributed to the understanding of the quality of diet among adult with overweight and obesity. This also provides pointers toward future interventions in planning nutrition education for this target population. Continued recommended fruit and vegetable intake with reduction in calories is also important, as these continue to be areas needing improvement.

Acknowledgement

The authors are grateful to the participants and research assistants who worked on this study.

References

1. World Health Organization. Obesity and overweight. World Health Organization; 2016 [2021 June 9th]. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
2. Lim, S.S., Vos, T., Flaxman, A.D., Danaei, G., Shibuya, K., Adair-Rohani, H., et al. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. Dec 15; 380(9859):2224-60. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4156511/pdf/nihms589916.pdf
3. Capodaglio, P., and Liuzzi, A. (2013). Obesity: a disabling disease or a condition favoring disability?. Eur J Phys Rehabil Med. 2013 June; 49(3): 395–398. Available from: https://pubmed.ncbi.nlm.nih.gov/23736901/
4. Blüher, M. (2019). Obesity: Global epidemiology and pathogenesis. Nat. Rev. Endocrinol. May; 15(5): 288–298. Available from: https://pubmed.ncbi.nlm.nih.gov/30814686/
5. Kelly, T., Yang, W., Chen, C. S., Reynolds, K., and He, J. (2008). Global burden of obesity in 2005 and projections to 2030. Int J Obes (Lond). Jul 8; 32(9): 1431–1437. Available from: https://pubmed.ncbi.nlm.nih.gov/18607383/
6. Popkin, B. M., and Slining, M. M. (2013). New dynamics in global obesity facing low and middle income countries. Obes Rev. Aug 14; 14(02): 11-20. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4074506/pdf/nihms585444.pdf
7. World Health Organization. (2017). Overweight and obesity in the Western Pacific Region: an equity perspective. Regional Office for the Western Pacific.

Available from:
https://apps.who.int/iris/handle/10665/255475.
8. Lazarou, C. and Newby, P. K. (2011). Use of dietary indexes among children in developed countries. Adv Nutr. July. 2(4): 295-303. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3125679/
9. Wong, J.E., Parnell, W.R., Howe, A.S., Black, K.E., and Skidmore, P.M.L. (2013). Development and validation of a food-based diet quality index for New Zealand adolescents. BMC Public Health. Jun 8; 13(1):562-571. Available from: https://pubmed.ncbi.nlm.nih.gov/23759064/
10. Kim, S., Haines, P. S., Siega-Riz, A. M., and Popkin, B. M. (2003). The Diet Quality Index-International (DQI-I) provides an effective tool for cross-national comparison of diet quality as illustrated by China and the United States. J Nutr. Nov 01; 133(11): 3476–3484. Available from: https://pubmed.ncbi.nlm.nih.gov/14608061/
11. Burggraf, C., Teuber, R., Brosig,S., and Meier, T. (2018). Review of *a priori* dietary quality indices in relation to their construction criteria. Nutr Rev. Oct 1; 76(10):747-764. Available from: https://pubmed.ncbi.nlm.nih.gov/30053192/
12. Bibiloni, M.D., Pons, A., and Tur, J.A. (2015). Diet quality of Mediterranean adolescents evaluated by Mediterranean adaptation of the Diet Quality Index-International (DQI-I): socioeconomic, anthropometric, lifestyle and body image determinants. *J. Clin Nutr Diet*. Nov 18 01(01):5-13. Available from: https://clinical-nutrition.imedpub.com/diet-quality-of-mediterranean-adolescents-evaluated-by-mediterranean-adaptation-of-the-diet-quality-indexinternationadqi-isocioeconomic-anthropometric-lifestyle-and-body-image-determinants.php?aid=7531
13. Fransen, H.P., and Ocke, M.C. (2008). Indices of diet quality. *Current Opinion in Clinical Nutrition and Metabolic Care.* Sept 01; 11(5): 559-565. Available from: https://europepmc.org/article/med/18685450
14. Ponce, X., Rodríguez-Ramírez, S., Mundo-Rosas, V., Shamah, T., Barquera, S., and De Cossio, T. (2013). Dietary quality indices vary with socio-demographic variables and anthropometric status among Mexican adults: A cross-sectional study. Results from the 2006 National Health and Nutrition Survey. *Public Health Nutr.* Oct 14; 17(8): 1717-1728. Available from: https://pubmed.ncbi.nlm.nih.gov/24124890/
15. Onyeji, G. N., and Sanusi, R. A. (2018). Diet quality of women of childbearing age in South-east Nigeria. *Nutrition and Food Science*. Feb 12; 48(2): 348-64. Available from: https://www.emerald.com/insight/content/doi/10.1108/NFS-06-2017-0134/full/html
16. Tardivo, A. P., Nahas-Neto, J., Nahas, E. A., Maesta, N., Rodrigues, M. A. and Orsatti, F. L. (2010). Associations between healthy eating patterns and indicators of metabolic risk in postmenopausal women. *Nutr J.* Dec 8. 9(1):1-9. Available from: https://link.springer.com/article/10.1186/1475-2891-9-64
17. Drewnowski, A., Fiddler, E. C., Dauchet, L., Galan, P. and Hercberg, S. (2009). Diet quality measures and cardiovascular risk factors in France: applying the Healthy Eating Index to the SU.VI.MAX study. *J Am Coll Nutr*. Oct 25, 28(1): 22–29. Available from: https://pubmed.ncbi.nlm.nih.gov/19571156/
18. Fung, T. T., McCullough, M. L., Newby, P. K., Manson, J. E., Meigs, J. B., Rifai, N., Willett, W. C. and Hu, F. B. (2005). Diet quality scores and plasma concentrations of markers of inflammation and endothelial dysfunction. *Am J Clin Nutr.* Jul 1; 82(1): 163–173. Available from: https://academic.oup.com/ajcn/article/82/1/163/4863349?login=true
19. Tande, D. L, Magel, R. and Strand, B. N. (2010). Healthy Eating Index and abdominal obesity. *Public Health Nutr*. Feb; 13(2): 208–214. Available from: https://pubmed.ncbi.nlm.nih.gov/19650960/#:~:text=Abdominal%20obesity%20risk%20decreased%20for,lower%20risk%20for%20abdominal%20obesity.
20. Guo, X., Warden, B. A., Paeratakul, S. and Bray, G. A. (2004). Healthy Eating Index and obesity. *Eur J Clin Nutr*. Dec; 58(12):1580–1586. Available from: https://pubmed.ncbi.nlm.nih.gov/15162130/
21. Schroder, H., Fito, M., Estruch, R., Martinez-Gonzalez, M.A., Corella, D., and Salas-Salaverria, I. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. *J Nutr*. 141(6): 1140–1145. Available from: https://pubmed.ncbi.nlm.nih.gov/21508208/
22. McCullough, M.L., Feskanich, D., Rimm, E.B., Giovannucci, E.L., Ascherio, A., and Variyam, J.N. (2000). Adherence to the Dietary Guidelines for Americans and risk of major chronic disease in men. Am J Clinl Nutr. 2000[2000 Nov]; 72(5): 1223–1231. Available from: https://pubmed.ncbi.nlm.nih.gov/11063453/
23. Nicklas, T.A., O'Neil, C.E., and Fulgoni, V.L. (2012). Diet quality is inversely related to cardiovascular risk factors in adults. J Nutr. Dec; 142(12): 2112–2118. Available from: https://pubmed.ncbi.nlm.nih.gov/23077187/
24. Asghari, G., Mirmiran, P., Rashidkhani, B., Asghari-Jafarabadi, M., Mehran, M. and Azizi, F. (2012). The association between diet quality indices and obesity: Tehran Lipid and Glucose Study. Arch Iran Med. Oct; 15(10): 599–605. Available from: https://pubmed.ncbi.nlm.nih.gov/23020534/
25. de Koning, L., Chiuve, S.E., Fung, T.T., Willett, W.C., Rimm, E.B. Hu, F. B. (2011). Diet-quality scores and the risk of type 2 diabetes in men. Diabetes care. Apr 20;

34(5): 1150–1156. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3114491/
26. McCullough, M.L, Feskanich, D., Stampfer, M.J., Giovannucci, E.L., Rimm, E.B., Hu, F.B. (2002). Diet quality and major chronic disease risk in men and women: moving toward improved dietary guidance. *Am J Clin Nutr*. Dec; 76(6): 1261-1271. Available from: https://pubmed.ncbi.nlm.nih.gov/12450892/
27. Drenowatz, C., Shook, R.P., Hand, G.A., Herbert, J.R., and Blair, S.N. (2014). The independent association between diet quality and body composition. Sci Rep. May 12; 4: 4928. Available from: https://www.nature.com/articles/srep04928
28. Sundararajan, K., Campbell, M.K., Choi, Y.H., and Sarma, S. (2014). The relationship between diet quality and adult obesity: evidence from Canada. *J Am Coll Nutr.* Feb 1; 33(1): 1–17. Available from: https://www.tandfonline.com/doi/abs/10.1080/07315724.2013.848157
29. Zamora, D., Gordon-Larsen, P., Jacobs, D.R., Jr, and Popkin, B.M. (2010). Diet quality and weight gain among black and white young adults: the Coronary Artery Risk Development in Young Adults (CARDIA) Study (1985-2005). *Am J Clin Nutr.* Oct 1; 92(4): 784–793. Available from: https://pubmed.ncbi.nlm.nih.gov/20685947/
30. Boynton, A., Neuhouser, M.L., Sorensen, B., McTiernan, A., and Ulrich, C. M. (2008). Predictors of diet quality among overweight and obese postmenopausal women. *J Acad Nutr Diet*. Jan 1;108(1): 125–130. Available from: https://www.jandonline.org/article/S0002-8223(07)02040-8/fulltext
31. Wolongevicz, D.M., Zhu, L., Pencina, M.J., Kimokoti, R.W., Newby, P.K., and D'Agostino, R.B. (2010). Diet quality and obesity in women: the Framingham Nutrition Studies. *Br J Nutr.* Apr; 103:8 1223–1229. Available from: https://pubmed.ncbi.nlm.nih.gov/19930766/
32. Sundararajan, K. (2004). The Relationship between Diet Quality and Obesity in Canadian Adults: Evidence from the Canadian Community Health Survey. Electronic Thesis and Dissertation Repository. 372. Available from: https://ir.lib.uwo.ca/etd/372/
33. Gomes, A.P., Soares, A.L., and Gonçalves, H. (2016). Low diet quality in older adults: a population-based study in southern Brazil. Cien Saude Colet. Nov; 21(11): 3417–3428. Available from: https://pubmed.ncbi.nlm.nih.gov/27828575/
34. Livingstone, K. M. and McNaughton, S.A. (2016). Diet quality is associated with obesity and hypertension in Australian adults: a cross sectional study. *BMC Public Health*. Dec; 16(1): 1037-1046. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-016-3714-5
35. Harrell, F. (2015). Regression modeling strategies: with applications to linear models, logistics and ordinal regression, and survival analysis. New York: Springer; Aug 14. Available from: https://link.springer.com/book/10.1007/978-3-319-19425-7
36. Adeloye, D., Ige-Elegbede, J.O., Ezejimofor, M., Owolabi, E.O., Ezeigwe, N., and Omoyele, C. (2021). Estimating the prevalence of overweight and obesity in Nigeria in 2020: a systematic review and meta-analysis. Ann Med. Dec; 53(1), 495–507. Available from: https://pubmed.ncbi.nlm.nih.gov/33783281/
37. Afolabi, W.A.O., Olayiwola, I.O., Sanni, S.A., Oyawole, O. (2018). Nutrient intake and nutritional status of the aged in low income area of southwest, Nigeria. JAR Life. Nov 3(6): 125-135. Available from: https://www.jarlife.net/938-nutrient-intake-and-nutritional-status-of-the-aged-in-low-income-areas-of-southwest-nigeria.html
38. Mekonnen DA, Trijsburg L, Achterbosch T, Brouwer ID, Kennedy G, Linderhof V. Food consumption patterns, nutrient adequacy, and the food systems in Nigeria. 2021[2021 Jun 8]; 9(1):1-21. Available from: https://doi.org/10.1186/s40100-021-00188-2
39. Oladoyinbo, C.A., Bamidele, A.B., Omoniyi, B.D., and Akinbule, O.O. (2021). Nutrient Intake Adequacy among Older Adults in Rural Communities of Obafemi Owode Local Government Area, Ogun State. Ajol. Oct 30; 42(1): 30-39. Available from: https://www.ajol.info/index.php/njns/article/view/216759
40. Ebrahimi, S., Leech, R.M., McNaughton, S.A., Abdollahi, M., Houshiarrad, A., and Livingstone, K.M. (2021). Associations between diet quality and obesity in a nationally representative sample of Iranian households: A cross sectional study. *Obes Sci Pract*. Aug 6; 8(1):12–20. Available from: https://pubmed.ncbi.nlm.nih.gov/35127119/
41. Su, Y., Du, S., Yang, M., Wu, J., Lu, H., Wang, X. (2021). Socioeconomic Determinants of Diet Quality on Overweight and Obesity in Adults Aged 40–59 Years in Inner Mongolia: A Cross-Sectional Study. *Int J Public Health*. Nov 8; 66:16041107. https://pubmed.ncbi.nlm.nih.gov/34819829/
42. Jia, L., Lu, H., Wu, J., Wang, X., Wang, W., and Du, M. (2020). Association between diet quality and obesity indicators among the working-age adults in Inner Mongolia, Northern China: a cross-sectional study. *BMC Public Health*. Jul 25; 20(1):1165 https://doi.org/10.1186/s12889-020-09281-5
43. de Vries-Ten Have, J., Owolabi, A., Steijns, J., Kudla, U., and Melse-Boonstra, A. (2020). Protein intake adequacy among Nigerian infants, children, adolescents and women and protein quality of commonly consumed foods. *Nutr Res Rev.* Jun; 33(1): 102–120.

https://doi.org/10.1017/S0954422419000222
44. López-Olmedo, N., Popkin, B.M., Mendez, M.A, and Taillie, L.S. (2019). The association of overall diet quality with BMI and waist circumference by education level in Mexican men and women. *Public Health Nutr.* Oct; 22(15):2777-2792. Available from: https://pubmed.ncbi.nlm.nih.gov/31190677/
45. Sanusi, R.A. (2010). An assessment of dietary diversity in six Nigerian States. Ajol. Sept; 13(3):161 -167. Available from: https://www.ajol.info/index.php/ajbr/article/view/95212#:~:text=Overall%2C%20mean%20dietary%20diversity%20score,varied%20significantly%20among%20the%20states.
46. Ebrahimi, S., McNaughton, S.A., Leech, R.M., Abdollahi M., Houshiarrad, A. and Livingstone, K.M. (2020). A comparison of diet quality indices in a nationally representative cross-sectional study of Iranian households. *Nutr J*. Dec 5; 19(1):132-142. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7719237/
47. Waijers, P.M., Feskens, E.J., Ocke, M.C. (2007). A critical review of predefined diet quality scores. *Br J Nutr.* Feb; 97(2):219-231. Available from: https://pubmed.ncbi.nlm.nih.gov/17298689/
48. Wehling, H, and Lusher, J. (2019). People with a body mass index ≥30 underreport their dietary intake: A systematic review. *J Health Psychol*. Dec; 24(14):2042-2059. Available from: https://pubmed.ncbi.nlm.nih.gov/28810493/

Publication of the Faculty of Public Health, College of Medicine, University of Ibadan, Nigeria.
Volume 1 June, 2022 - pp 55-66

Discoveries in Public Health