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Research

Diet quality of in-school adolescents in Abeokuta, Nigeria based on the diet quality index–international: A cross-sectional study

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Background

Adolescence is a critical period for growth and a second window of opportunity for catch-up growth after the first growth spurt that occurs during the first 1000 days of life. During adolescence, activities to build healthy nutrition may confer significant long-term benefits.

Objective

This cross-sectional study assessed dietary intake, nutrient adequacy, and diet quality of 303 public secondary school students in Abeokuta, Ogun State.

Methods

Respondents' anthropometry was measured and WHO Anthroplus was used to calculate the height-for-age and body mass index for-age z-scores. Dietary intake was assessed using a 24-hour diet recall questionnaire, and the Diet Quality Index-International (DQI-I) questionnaire was used to determine diet quality.

Results

Excessive intake of carbohydrates was observed among all respondents while inadequate intakes of calcium, vitamin C, and fibre were observed among 80.8%, 100%, 95.4%, and 66.2% of the respondents, respectively. The total mean score for diet quality was 58.7±6.73 out of 100. Compared to the total score of the DQI-I domains, the highest mean performance was in the moderation category (79.5%), followed by variety (72.8%), and adequacy (45.8%), with the lowest performance in the overall balance category (19.7%).

Conclusions

In conclusion, these adolescents had lower than the cut-off score for a good diet quality. Inadequacies in vegetables and fruit groups below the recommended levels contributed to low mean scores and likely to some of the deficient nutrient intakes. Interventions including regulating the food sold by vendors and nutrition education to encourage better consumption of fruits and vegetables are recommended in schools.

INTRODUCTION

Adolescence is a phase characterized by significant growth and body changes, physical, emotional, and cognitive development, and a feeling of self-awareness which can affect dietary habits (Tang et al., 2024). It is marked by increased autonomy and a transition from spending the majority of time with parents to away from home with peers (Casey et al., 2010; Pfeifer and Berkman, 2018). While parents still guide certain matters, peers assert more influence on superficial concerns, especially as adolescents enter their teenage years. This influence concerning eating

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behaviours may be linked to the desire to fit into a particular peer group, among other factors.

This period of life is associated with increased socioeconomic pressures and schooling, meal skipping, increased intake of refined and convenience foods, and decreased consumption of fruits and vegetables (Otovwe et al., 2021). Food habits formed during adolescence may also persist into adulthood, hence, it is a period during which activities to build healthy nutrition may confer significant long-term benefits (Bibiloni et al., 2016). Indeed, appropriate physical and mental growth during this phase depends on the adequacy of nutrient intake.

The increasingly growing world population, urbanization, and rising income have rapidly changed dietary patterns from traditional to Westernized diets in developing countries (Charlton, 2016). Studies in different regions of Nigeria have shown inadequacies in fruit and vegetable consumption with excess calories from processed foods and sweets among adolescents and inadequacies in micronutrients especially iron and calcium (Gabriel et al., 2024; Omuemu and Oko-Oboh, 2015; Onabanjo and Balogun, 2014). Olatona et al. (2023) reported daily consumption of snacks among 69.6%, of carbonated drinks (46.8%) while less than 10% consumed the recommended daily intake of fruits and vegetables. The nationwide prevalence of thinness and anaemia among adolescent girls was 15.1% and 41% respectively (National Food Consumption and Micronutrient Survey, 2021).

Improvements in dietary diversification have been identified as a cost-effective and sustainable way of improving malnutrition (Durst and Bayasgalanbat, 2014). Diet quality is a metric used to measure the adequacy of healthy nutrients and foods in a diet and its moderation/limitation of unhealthy nutrients and foods (Kim et al., 2003). Strong and growing evidence supports the role of diet quality and physical activity in preventing and reducing the progression of non-communicable diseases (Gil et al., 2015; Caprara, 2021; Fedacko et al., 2022). Dietary diversity is often used as a proxy to assess diet quality; the few studies that have used indicators that measured other aspects of the diet aside from variety have focused on other age groups with little focus on the diet quality of adolescents (Onyeji and Sanusi, 2018; Oladoyinbo et al., 2017). The Diet Quality Index-International (DQI-I) is a diet quality indicator developed to evaluate diet quality in terms of variation in the diet, adequacy, and moderation of specific nutrients associated with health risks, as well as balance in the proportionality of food components. It is a composite individual-level diet quality indicator for cross-cultural diet quality comparisons. It allows comparisons between countries concerning an overall measure of diet quality, and enables the identification of dietary aspects that need to be improved or restricted (Kim et al., 2003).

The DQI-I has been used previously as a measure of dietary quality in Canada (Setayeshgar et al., 2017), Korea (Kim and Bae, 2010), the USA and China (Kim et al., 2003), and in Southeast Nigeria (Onyeji and Sanusi, 2018). However, such research is lacking in the southwest of the country. The present study was conducted to assess the diet quality of adolescents in Abeokuta, a city in southwest Nigeria.

MATERIALS AND METHODS

STUDY SETTING

The study was conducted in Abeokuta city of Ogun State, Southwestern Nigeria. Abeokuta is the largest urban area and capital of Ogun State. It is built in the centre of the Lagos-Ibadan extended urban region and forms part of the larger metropolitan economic area (UN-Habitat Global Future Cities Programme, 2018). It consists of two local governments, Abeokuta-South and Abeokuta-North, with a total of 38 public secondary schools. The State government funds all the schools via the State Education Board. Although these students spend an average of six to seven hours in school, there is no school feeding program for secondary schools in the state. Students are given a lunch break and are at liberty to bring food and snacks from home; all the schools however have food vendors who sell a variety of items including cooked meals and snacks.

STUDY DESIGN

This study employed a cross-sectional, descriptive study design. Respondents were adolescents between 10 and 19 years of age attending public secondary schools in the study area.

SAMPLING TECHNIQUE

A multi-stage sampling technique was employed in selecting 303 respondents. The list of all public secondary schools in the two local governments (20 schools in Abeokuta-South and 18 schools in Abeokuta-North) was obtained from the State education board. The first stage involved the selection of 6 schools from each local government area using a simple random sampling technique. Stratification by classes was done, followed by a random selection of two classes (one junior and one senior class) in each school. The number of eligible students per class, obtained using probability proportional to size, based on calculated sample size, was randomly selected using the class register as sampling frame.

DATA COLLECTION

Data were collected by trained interviewers who were graduates of nutrition and dietetics. A semi-structured questionnaire was used to obtain information on respondents' socioeconomic and demographic characteristics. The anthropometric measurements of the respondents were taken following standard procedures (Centre for Disease Control, 2020). The respondents' height was measured using an heightometer while respondents were barefoot and standing erect, with heels together, arms at each side, and shoulders relaxed. The measurement was made to the nearest 0.1cm. The weight of the respondents was measured with the aid of a digital scale; respondents wore only light clothes and no shoes. The measurement was taken to the nearest 0.1kg.

Body mass index-for-age z-score was calculated using the WHO AnthroPlus software version 1.0.4. BMI-for-age > 2 Standard Deviations (SD) above the WHO growth standard median was considered obese; Overweight was defined as having a BMI > 1 SD above the median, whereas thinness was defined as having a BMI < 2 SD below the median. A height-for-age index less than two standard deviations below the median was considered stunting.

Dietary intake information was obtained from two non-consecutive 24-hour dietary recalls (FAO, 2018) and converted to nutrient intake using Nutrisurvey 2007 software. The 24-hour recalls were collected by trained interviewers using the multiple pass technique. Each respondent was asked to recall all foods, snacks, and beverages consumed the previous day from the time he/she woke up to the time they went to bed without much description. The respondent was then prompted to ensure no meal, snack or drink was forgotten. Further details on ingredients and recipes were then obtained. Food models, measuring cups, spoons, or prices of food items were used to estimate the amount of food consumed which was later converted to weight equivalents.

The nutrient intake adequacy ratio, based on the RDA, was calculated and categorized as intake < 60% - low intake; intake between 60% - 80% - adequate intake and intake >80% as excess intake as described by Schaetzel (2012).

$$NAR = \frac{Nutrient\ intake}{Recommended\ intake} \text{ x } 100$$

Diet quality was assessed with the DQI-I questionnaire as described by Kim et al. (2003) with data obtained from the 24-hour dietary recalls. The DQI-I focuses on key areas of a high-quality and healthy diet such as variety, adequacy, moderation, and overall balance (Setayeshgar et al., 2017). Each of the four categories of the DQI-I has specific sub-components of the diet which are scored to generate scores for the four major components which are then summed to generate a total DQI-I score ranging between zero and 100.

VARIETY: This category of the DQI-I is further broken into two categories -- overall variety within food groups and variety within protein sources to evaluate intake across and within food groups. A respondent receives the perfect overall variety score of 15 if at least one serving of food from each of the five food groups (meat, poultry, fish, eggs; dairy products, beans; grains; fruits and vegetables) is consumed per day, while the maximum variety score is reduced by three points for each food group missing. An intake of over fifty percent of the serving size per day drawn from at least 3 different sources of protein daily is given the highest score of 5 points to measure variety within protein sources. When the number of sources is reduced to 2, 1, and 0, respectively, the scores are similarly reduced to 3, 1, and 0.

ADEQUACY: To measure risk of undernutrition, this category assesses the consumption of key dietary components in amounts large enough to ensure a healthy diet. There are eight components in this category, and scores for each component are assigned based on the percentage attainment of the recommended intakes, ranging from 0 for 0% to 5 for 100% with 40 as the maximum obtainable score for the category. The recommended intake of fruit, vegetables, grains, and fibre is based on energy intake. A diet that contains two to four servings of fruit and three to five servings of vegetables, depending on levels of energy intake, 1700 kcal, 2200 kcal, and 2700 kcal, are given the highest score of five points. Daily intakes of six, nine, and eleven servings from the grain group and more than 20, 25, and 30 g of fibre for the three energy intake categories are given the highest score for the grain and fibre components. Protein intake is considered adequate when the proportion of total energy from protein is greater than 10%. The level of intake that defines the highest score for adequacy of iron, calcium, and vitamin C is derived from the recommended daily intakes according to age and gender.

MODERATION: This category assesses the consumption of foods and nutrients, such as levels of total fat, saturated fat, cholesterol, sodium, and empty calorie items that may require restriction due to their links to chronic diseases. According to the degree of impact on health, three categories of intake were listed. The lowest intake category, which corresponds to intake levels below which a healthy person would not demonstrate any evidence of harmful effects, is given the greatest rating of 6 points, and the highest intake category, which equates to levels of consumption that may result in chronic health outcomes, is given the lowest score of 0, and intakes falling in the middle are given a score of 3. The highest possible score for this category is 30.

OVERALL BALANCE: This subcategory looks at the entire diet's proportionality of energy sources and fatty acid content. To get the highest possible score of 10 for this category, proportionality in energy sources and fatty acid composition contributes 6 and 4 points to the overall DQI-I.

ETHICAL APPROVAL

Ethical approval was obtained from the Department of Planning, Research and Statistics, Ogun State Ministry of Education, Science and Technology (Reference Number: PL.545/VOL iv/72). Approvals of the zonal coordinators, and the heads of the selected schools were also obtained. Parent/Guardian consent forms were sent home through the students, the purpose of the study was clearly communicated to the students, and their written informed consent was also obtained before their participation. Code numbers were used in place of participant names to ensure anonymity, and confidentiality was strictly maintained.

STATISTICAL ANALYSIS

The Statistical Package for Social Sciences (SPSS) version 20 was used for data analysis. Data were descriptively summarized and presented using the mean and standard deviation, frequencies, and percentages. T-test and Chi-square test were used to compare means and to determine the associations between variables.

RESULTS

The respondents were mostly females (54.8%), older adolescents, and 15-19 years old (76.9%). The mean age was 15.68±1.88 years with 63.0% of the respondents from monogamous homes. Most of the parents were secondary school leavers (52.1% of mothers and 48.8% of fathers). The mean height of the respondents was 159.65±8.84 cm and the mean weight was 50.55±8.07 kg. As shown in Table 1, 13.2% of the respondents were stunted, 4% were thin and the majority (93.0%) were within the normal BMI category. The prevalence of stunting was higher ($p<0.05$) among males (9.2%) than females (4.0%).

Table 1. Anthropometric characteristics of the respondents

	Total n (%)	Male n (%)	Female n (%)	X	Df	P-value
Height-for-age						0.01
Stunted	40 (13.2)	28 (9.2)	12 (4.0)	11.43	1	
BMI-for-age						0.04
Thin	12 (4.0)	11 (3.6)	1 (0.3)	13.45	3	
Over-weight	6 (2.0)	2 (0.7)	4 (1.3)			
Obese	3 (1.0)	0(0)	3(1.0)			
Normal	282 (93.1)	124(40.9)	158(52.1)			

The median values for calcium and vitamin C were far lower than their respective RDAs among both the younger and older adolescents (Table 2). In the younger age group, the girls came closer to meeting their RDA for fibre than the boys did.

Table 2a. Estimated Median Nutrient Intake of the Respondents (10-14 years old)

	Male			Female				Total
	Median (Range)	**RDA**	**% Met**	**Median (Range)**	**RDA**	**% Met**	**p-values**	**Median (Range)**
Energy intake (kcal/d)	1441.4 (845.9, 2528.6)	1800	80.1	1579.9 (766.4, 5284.7)	1800	87.8	0.32	1549.7 (766.4,5284.7)
Carbohydrate (g/d)	251.7 (179.9, 392.3)	130	193.6	287.7 (153.9, 470.4)	130	221.3	0.79	249.1 (153.9,470.4)
Protein (g/d)	39.5 (15.4, 60.8)	34	116.2	44.9 (2013, 86.6)	34	131.9	0.09	41.6 (15.4,86.6)
Fat (g/d)	32.49 (4.6, 58.6)	70	46.4	34.8 (10.4, 68.3)	70	49.7	0.09	34.6 (4.63,68.3)
Calcium (mg/d)	173.8 (43.8, 488.9)	1300	13.4	135.3 (55.3, 471.7)	1300	10.4	0.92	158.7 (43.8,488.9)
Iron (mg/d)	7.63 (4.63, 13.5)	8	95.4	8.20 (6.51, 14.6)	8	102.5	0.70	7.74 (4.63,14.6)
Vitamin C (mg/d)	6.74 (0.10, 34.9)	45	14.9	9.07 (0.17, 64.83)	45	20.2	0.17	8.59 (0.10,64.8)
Fibre	7.84 (4.20, 20.8)	25.2	31.1	17.8 (3.24, 27.12)	22.4	79.5	0.01	12.1 (3.24,27.1)

Table 2b. Estimated Median Nutrient Intake of the Respondents (15-19 years old)

	Male			Female				Total
	Median (Range)	**RDA**	**% Met**	**Median (Range)**	**RDA**	**% Met**	**p-values**	**Median (Range)**
Energy intake (kcal/d)	1527.5 (968.5, 3802.8)	2800	54.5	1519.7 (873.8,2865.9)	1800	84.4	0.49	1519.7(873.8,3802.8)
Carbohydrate (g/d)	262.2 (147.3, 524.5)	130	201.7	255.4 (160.5, 442.1)	130	196.5	0.41	259.7 (147.3,524.5)
Protein (g/d)	46.64(20.0, 86.6)	52	89.7	48.30 (22.5, 90.1)	46	105	0.96	47.8 (20.0,90.1)
Fat (g/d)	26.8 (12.8, 73.7)	108.9	24.6	31.8 (11.0, 89.1)	70	45.4	0.15	29.9 (11.0,89.1)
Calcium (mg/d)	143.4 (42.4, 513.4)	1300	11.0	148.3 (34.0,485.6)	1300	11.4	0.86	143.9 (34.0,513.4)
Iron (mg/d)	9.03 (4.0, 14.9)	11	82.1	8.86 (3.2, 17.7)	15	59.1	0.57	8.97 (3.20,17.7)
Vitamin C	4.21 (0.1, 68.0)	75	5.6	5.44 (0.03, 47.4)	65	8.37	0.59	4.33 (0.03,68.0)
Fibre	11.4 (2.53, 49.3)	30.8	36.9	12.1 (2.24, 34.1)	25.2	47.8	0.77	11.7 (2.24,49.3)

Excess caloric intake was observed among 40.7% of the respondents; all respondents consumed carbohydrates in excess while none had up to the recommended allowance for calcium (Table 3).

Table 3. Nutrient Intake Adequacy Distribution of Respondents

	Inadequate < 60% (%)	**Adequate** 60 - 80% **(%)**	**Excess** >80% **(%)**
Energy	33.3	26	40.7
Carbohydrate	0	0	100
Protein	7.3	18.7	74
Fat	80.8	8.6	10.6
Vitamin C	95.4	2.6	2
Calcium	100	0	0
Iron	25.2	24.5	50.3
Fibre	66.2	19.2	14.6

The mean (SD) diet quality score of the respondents was 58.70 (6.73) (Table 4). Based on the proportion of the total mean score to the maximum possible score in each of the subcategories of the DQI-I, the highest score percentage was in the moderation category (79.5%), followed by variety (72.8%), and adequacy (45.8%), with the lowest performance in the overall balance category (19.7%).

Table 4. Mean Diet Quality Scores of the respondents

Components		**Score Ranges**	Mean	SD
DQI-I		0–100 points	58.70	6.73
Variety		0–20points	14.56	3.44
	Overall food group variety	0–15 points	10.06	2.789
	Within-group variety for	0–5 points	4.5	1.09

Table 4. continues

	protein source			
Adequacy		0–40 points	18.32	3.15
	Fruit group	0–5 points	0.47	1.24
	Vegetables group	0–5 points	0.90	0.83
	Grain Group	0–5 points	4.28	1.21
	Fibre	0–5 points	2.91	1.17
	Protein	0–5 points	4.81	0.59
	Iron	0–5 points	2.93	1.02
	Calcium	0–5 points	1.00	0.00
	Vitamin C	0–5 points	1.02	0.52
Moderation		0–30 points	23.86	2.78
	Total fat	0-6 points	3.49	1.15
	Saturated fat	0-6 points	5.62	1.26
	Cholesterol	0-6 points	5.82	0.79
	Sodium	0-6 points	5.87	0.78
	Empty calories	0-6 points	3.07	1.65
Overall balance		0–10 points	1.97	2.34
	Macronutrient ratio	0-6 points	1.54	2.02
	Fatty-acid ratio	0-4 points	0.43	0.97

There were however no significant differences in total DQI-I or in DQI-I components between gender or age groups except that male participants had significantly ($p<0.05$) higher variety scores than females (Table 5). Low mean scores in the fruit, vegetable, calcium, and vitamin C sub-domains contributed to the low mean score in the adequacy domain.

Figure 1 shows the proportion of respondents with less than sixty percent of the maximum score for each DQI-I domain.

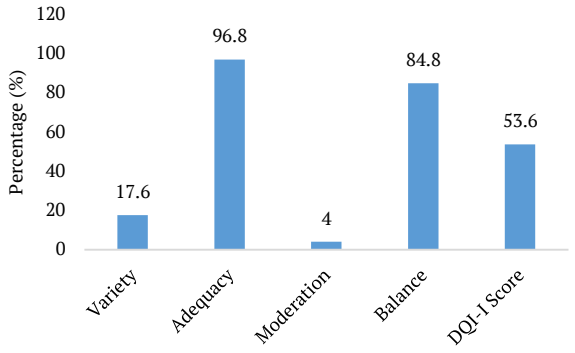

Figure 1. Distribution of individuals with ⩽ 60% of the maximum score for the DQI-I components.

Table 5. DQI-I component scores by demographic characteristics

	Variety (0-20) Mean (SD)	Adequacy (0-40) Mean (SD)	Moderation (0-30) Mean (SD)	Overall balance (0-10) Mean (SD)	Total DQI-I (0-100) Mean (SD)
Sex					
Male	15.4* (2.94)	18.3 (3.25)	23.98 (2.11)	2.00 (2.44)	59.68 (6.29)
Female	13.7 (3.69)	18.8 (3.08)	23.75 (3.28)	1.94 (2.63)	57.81 (7.05)
Age group (years)					
10-14	14.2 (2.99)	17.8 (3.29)	24.37 (2.34)	2.52 (2.69)	58.91 (7.06)
15-19	14.6 (3.58)	18.5 (3.11)	23.72 (2.88)	1.82 (2.23)	58.65 (6.68)
Maternal Education					
No education	15.4 (3.85)	18.8 (1.99)	24.50 (1.85)	3.25 (3.19)	61.94 (6.38)
Primary Education	14.5 (3.18)	18.2 (2.99)	23.88 (3.06)	1.68 (2.14)	58.24 (6.18)
Secondary Education	14.6 (3.77)	18.7 (3.26)	23.6 (3.08)	1.82 (2.22)	58.8 (6.91)
Tertiary Education	14.1 (2.72)	17.2 (3.22)	24.4 (1.64)	2.33 (2.55)	58.1 (7.08)
Others	17.0	16.0	22.00	0.00	55.0
Paternal Education					
No education	15.3 (3.28)	18.4 (2.34)	24.0 (2.67)	2.25 (2.92)	59.9 (7.32)
Primary Education	14.1 (4.37)	17.2 (4.07)	24.3 (3.19)	2.53 (2.88)	58.2 (7.53)
Secondary Education	14.6 (3.7)	18.8 (3.13)	23.7 (3.06)	1.71 (2.01)	58.9 (6.80)
Tertiary Education	14.6 (2.63)	17.9 (2.97)	23.8 (2.21)	2.22 (2.57)	58.7 (6.26)
Others	13.3 (4.04)	17.3 (1.53)	24.7 (2.31)	0.67 (1.16)	56.0 (2.65)
Family Structure					
Monogamous	14.8 (3.35)	18.2 (3.29)	23.8 (3.09)	2.00 (2.39)	58.8 (6.51)
Polygamous	14.2 (3.58)	18.5 (2.95)	23.9 (2.25)	1.92 (2.28)	58.6 (7.11)

* significant difference at $p < 0.05$

DISCUSSION

This study assessed the nutrient intake and diet quality of in-schooling adolescents using the DQI-I, a composite measure for cross-country comparison of diet quality. The 13% prevalence of stunting reported in this study is comparable to 10% prevalence reported by Omigbodun et al. (2010) among in-school adolescents in south-western Nigeria and 12.1% by Omotoso et al. (2022) but lower than the 47.4% reported by Tariku et al. (2019) in Southern Ethiopia, 40.3% from Obafemi Owode, Nigeria (Adenuga et al., 2017) and 60%–83% reported by Otekunrin and Otekunrin (2023) among adolescents in rural farm households in Southwestern Nigeria.

The majority of the study participants were within the normal category of BMI with few cases of overweight and obesity. Globally, the prevalence of stunting and thinness estimated using data from the Global School-Based Student Health and Health Behavior in School-Aged Children (12–15 years) study conducted in 57 low- and middle-income countries between 2003 and 2013, was 10.2% and 5.5% respectively (Caleyachetty et al., 2018). The findings of this study are also consistent with and the 1.6% and 3.0% prevalence of obesity and overweight reported by Tassy et al., (2021) but differ from the 12.6% prevalence of thinness reported by Otekunrin and Otekunrin (2023). The variations may be ascribed to the different study locations (urban versus rural). Urban dwellers are also more likely to have better access to information on appropriate eating practices coupled with minimal workload which may contribute to their physical well-being.

Inadequacies in nutrient intakes were observed compared to recommendations, this is consistent with the findings of previous studies of in-school adolescents (Tassy et al., 2021; Sanusi et al., 2022; Abubakar et al., 2024). Tassy et al. (2021) found that 84% of children 9-13 years in nearby Ibadan exceeded the acceptable macronutrient distribution range (AMDR) for carbohydrates, while over 90% had intakes lower than the recommendations for calcium and iron. They found protein intake to be generally adequate, while fat intakes were largely below the AMDR, which is also consistent with the findings of this study.

According to earlier research conducted in Nigeria, a significant percentage of children did not receive the recommended amounts of iron, calcium, and vitamin C, which is in line with the results of this study (Onabanjo and Balogun, 2014; Oladoyinbo et al., 2017; Ayogu, 2019). Inadequate consumption of food sources of these nutrients, such as fruits, green leafy vegetables and dairy, is reflected in the DQI-I result. These inadequacies may have significant health impacts.

High consumption of carbohydrates may be associated with the high snacking and fast-food consumption habits of adolescents in Nigeria (Gabriel et al., 2024), which may also be responsible for displacing other nutrient-dense foods. The nutrition transition characterized by the proliferation of restaurants designed to provide socially appealing atmospheres for this age group coupled with the low cost and convenient nature of highly processed and fast foods may be important contributory factors.

The average DQI-I score (58.7±6.73) found in the present study can be compared to the total DQI-I score of 58 reported by Setayeshgar et al. (2017) among children in the Quebec Adipose and Lifestyle Investigation in Youth cohort study, and the 61 and 62 reported by Veugelers et al. (2005) and Ferland et al. (2014) respectively for grade 5 students in the Canadian provinces of Nova Scotia and Alberta. Kim and Bae (2010), however, reported higher scores of 67 for elementary students in Korea and 59 and 60 for nationally represented samples of individuals in the United States and China (Kim et al., 2003). On the other hand, our mean DQI-I is higher than the 52 found among Mediterranean adolescents (Ferranti et al., 2016), 50 among Portuguese adolescents (Silva et al., 2020) and 47 among adolescents in Balearic Island (Del Mar Bibiloni et al., 2015).

Parents, especially mothers', eating behaviour significantly influences children's diet even in adolescence (Scaglioni et al., 2018). Social norms and peer influence affects adolescent food choices (Rice and Klein, 2019; Chung et al., 2021). Girls are more likely to restrict certain food groups due to social pressures around body image leading to a more restricted diet variety in the diet compared to boys (Shankar-Krishnan et al., 2021). This may explain the gender difference in the DQI-I variety score observed in this study.

More than half of our respondents scored less than the 60% proposed for a good-quality diet (Kim et al., 2003). Onyeji and Sanusi (2018) recorded the highest performance in moderation and the lowest in overall balance, similar to the findings of this study. The lowest performance in the overall balance category compared to the other categories is consistent with the findings of Setayeshgar et al. (2017) and Kim et al. (2003).

Inadequacies in vegetables and fruit groups contributed to a low mean score in adequacy; this reflects consumption below the recommended level, which could pose a public health risk. Similar studies reported low consumption of fruits and vegetables among adolescents attributable to inadequate knowledge about their benefits, family practice of insufficient fruits and vegetable intake, and taste dislike of some fruits (Olatona et al., 2023; Georgina et al., 2024). Interventions such as School-Based food and nutrition education (Medeiros et., 2022) and short-term gamified intervention (Yoshida-Montezuma et al., 2020) have shown favourable results in improving fruits and vegetable intake among adolescents.

The highest mean percentage within the DQI-I sub-domains was observed in the moderation category. Although some studies reported Nigerian foods are high in total fat, cholesterol, triacylglycerol, and free fatty acids (Onabanjo and Balogun, 2014), a more recent study on standardized Nigerian soups and dishes reported lower contents of total fat, cholesterol, triacylglycerol, and free fatty acids compared to previous findings (Akinbule et al., 2022). Akinbule et al. (2022) found that meals such as boiled rice and fish stew, boiled yam and garden egg sauce, *ila alasepo*, and chicken stew had higher hypocholesterolemic index values when compared to hypercholesterolemic index values, suggesting that their habitual consumption may have a beneficial effect on coronary health. In addition, fat intake inadequacy was observed among the most of our respondents, consistent with previous studies' findings (Tassy et al., 2021; Sanusi et al., 2022; Abubakar et al., 2024). The dietary pattern of adolescents in Nigeria is characterized by a lower intake of animal-source foods than plant-based

sources (Sanusi et al., 2022; Abubakar et al., 2024) may contribute to the high moderation score.

In the current study, diet quality was assessed considering diet as a whole, rather than single nutrients or foods, which better reflect the dietary patterns of a population (Richter et al., 2012). To the best of our knowledge, this is the first study to describe the diet quality of southwestern Nigerian adolescents according to the DQI-I.

The results of this study should be considered in light of some limitations. Participants were recruited from only a single area of Nigeria and did not include adolescents no longer in school. The dietary recall method may be affected by recall bias and respondents may underestimate or overestimate their regular food intake. Regardless of these issues, this study provided insights into the inadequacies of the usual diet adopted by in-school adolescents in Nigeria. Low intake of fruits and vegetables, inadequate intake of calcium and vitamin C, and imbalance in proportionality of macronutrients in the diet are some of the nutrition concerns. The results of this study provide insights that can be useful for public health experts to develop intervention programs focused on the weaknesses observed. Nutrition education is essential to promote nutrient-dense foods. Policies such as the home-grown school feeding program in public primary schools may be extended to secondary schools to provide nutritious food to adolescents.

CONCLUSION

The study provides insights into the diet quality of a representative sample of schooling adolescents in Ogun State, Nigeria. The study also provided information on nutrient intake adequacy and measured key areas of the diet - variety, adequacy, moderation, and overall balance to measure the overall diet quality. The findings provide information on areas of the adolescent diet contributing to poor diet quality which can inform and guide interventions.

AUTHOR CONTRIBUTIONS

All authors participated in the concept and design of the study. Abdussalaam R.O. and Popoola B.I. collected data for the study, analysis, and interpretation of data and drafting of the manuscript were done by Abdussalaam R.O. All authors reviewed and approved the final draft of the manuscript

CONFLICT OF INTEREST

The authors declare no conflict of interest

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