



ORIGINAL ARTICLE

Association between dietary patterns and lipid profile of older adults in Kogi State, Nigeria

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ABSTRACT

Background: Older adults require proper dietary and lifestyle modification to reduce the risk of age-related disorders. **Aims:** The study assessed the dietary pattern in relation to the lipid profile of older adults (≥ 65 years) in Dekina LGA of Kogi State. **Subjects and Methods:** This cross-sectional study design employed multi-stage random sampling to select 150 older persons. Ethical approval for the study was obtained from the Kogi State Ministry of Health Lokoja, Kogi State (MOH. /KGS/1376/1/96). Food frequency questionnaire was used to elicit information on the frequency of food consumption, food consumption pattern was grouped into high-risk food and low risk foods. Lipid profile was assessed and categorized using standard procedure. All analysis were done using IBM SPSS Version 21. **Results:** Results revealed the frequent (> 5 times / week) consumption of staple crops across the various food groups by a good number of the respondents; maize (52.7 %), sorghum (34.0), millet (38.0 %), fish (81.4 %), crayfish (25.5 %), beans (22.7 %) bamabara nut (27.4 %), mango (31.3 %), cashew (27.4 %), orange (23.3 %), amarantus 'alefo' leaf (22.1 %) and palm oil (91.4 %). There was no significant relationship between high-risk foods consumed by the respondents and all the lipid profile parameters. A negative non-significant relationship ($p > 0.01$) existed between all lipid parameters and low risk foods consumed by the respondents except for triglycerides. **Conclusion:** The respondents' dietary intake of low-risk foods is protective of nutrition related disorders. Improved nutrition education geared towards improving the consumption of low-risk foods and rear intake of high risk (processed) foods should be encouraged.

Keywords: Dietary pattern, lipid profile, high/low risk foods, older persons, nutrition related diseases.

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1 Introduction

Studies have shown that older persons are proposed to surpass the total population of children by 2047 ¹. Presently about two thirds of the world's older persons live in developing countries and by 2050, nearly 8 in 10 of the world's older population will live in the less developed regions of the world including those in Africa ¹.

The population of older persons in Nigeria has also increased over the years and it was shown that 9.5 % individuals were aged 50 years and above and 4.3 % individuals aged 65 years and above as at 2006 census ².

The dietary pattern of most individuals has moved from eating homemade food to consumption of convenience and processed foods (Western diet) and this diet is high in saturated fat thus

resulting to several chronic diseases ³. According to the American Heart Association (AHA), maintaining adequate diet and good lifestyle offers the greatest potential among all the identified approaches for reducing the risk for cardiovascular diseases (CVD) in the general public ⁴.

The older persons require adequate and satisfactory nutrition to maintain a functional lifestyle. Good eating habits in addition to adequate nutrition are key constituents anticipated for healthy aging. However, several older persons are at risk of malnutrition ⁵. Healthy diet is very important as it supports the well-being of an individual throughout lifetime. It is imperative to assess the dietary pattern of the older persons as the information gotten from dietary pattern is very useful in predicting cardiovascular disease risk ⁶.

Recent studies which examined the association between dietary patterns and lipid profiles considered adults or sick individuals in other countries ⁷⁻¹², evidence is however lacking amongst the elderly population as well as in Nigeria and other developing countries. Therefore, this study is aimed at assessing the dietary pattern of older persons and its relationship with their lipid profile.

2 Subjects and Methods

2.1 Study design

The study was cross-sectional in design and focused mainly on older persons (≥ 65 years) who had lived in Dekina local government for at least a year. The reason for limiting to a year is to reduce bias that could occur as a result of people who are visitors and have just migrated to the community.

2.2 Study settings

Dekina Local Government Area in Kogi State was used for the study. Dekina Local Government is found in Kogi East Senatorial District of Kogi State. Its headquarters is in the town of Dekina. The elderly in the community are predominantly farmers who practice agriculture on a subsistence scale. Their main produce includes food crops such as maize, guinea corn, cassava and cash crops including cashew, oil palm and kola nut.

2.3 Study Population

The population of the study comprises of older persons (≥ 65 years) residing in Dekina Local Government Area.

2.4 Sampling and sampling techniques

The study sample was 150 respondents and was generated using the Fishers formula ¹³.

The formula is stated as follows:

$$n = \frac{Z^2 PQ}{d^2}$$

Where n= sample size, Z = Z statistic for a level of confidence, P= prevalence of the attribute or proportion of the population having the characteristics being measured, d= precision (the level of accuracy desired or sampling error), Q= proportion of the population that does not have the characteristics (1-P). Therefore, Z = 95 % (1.96), P = 3 % (0.03), d = 5 % (0.05), Q = (1-P) = (1 - 0.03) = (0.97).

$$n = \frac{1.96^2 * 0.03(1-0.03)}{0.05^2}$$

$$n = 44.716224$$

$$n \approx 45$$

To take care of attrition that may occur in the study, 10 % error was allowed.

$$10 / 100 \times 45 = 4.5 + 45 = 49.5 \approx 50.$$

The sample size derived for this study was 45. The sample size was further increased by 10 % to account for drop outs which provided a total sample size of 50.

A multi-stage random sampling technique was used to select the respondents. Dekina Local Government is grouped into three administrative districts, that is Birdu, Dekina, and Okura Egume. Fifty (50) subjects were taken from each of the districts of Dekina Local Government Area of Kogi State, making a total of 150 subjects.

2.5 Ethical approval

Ethical approval for the study was obtained from the Kogi State Ministry of Health Lokoja, Kogi State (MOH. /KGS/1376/1/96). Written informed consent was obtained from the subjects and only those who consented were used for the study. Information obtained from the subjects was treated confidentially and used strictly for the purpose of the study.

2.6 Data collection

A structured, validated, pre-tested, interviewer administered questionnaire (food frequency questionnaire) was used to collect data. The questionnaire was designed by researchers and validated by professionals in the field of nutrition and dietetics. The content of the questionnaire was translated into the local language (Igala). Data was collected by the researcher and trained research assistants after obtaining an informed consent from the subjects. The research assistants were trained. The training of interviewers and translation of the contents of the questionnaire to local language provided the opportunity for proper understanding, easy interpretation, and administration of the questionnaire. Blood sample (finger prick method) was collected from each volunteer by a medical laboratory scientist and was used to test for lipid profile. Lipid Pro kit was used for the estimation of total cholesterol (TC), triglyceride (TG) and high-density lipoprotein cholesterol (HDL-C).

Each questionnaire was checked for completeness, missed values and unlikely responses were manually cleaned up. Data was coded and cross checked for consistency and accuracy.

2.7 Statistical analysis

Descriptive statistics (such as frequencies and percentages) were used in presenting the dietary pattern. The food consumption pattern was grouped into high-risk food (which comprises of refined carbohydrates, processed foods, saturated and trans fats) and low risk foods (which comprises of whole grains, nuts, seeds, fruits, vegetables, legumes). The grouping was done according to the relationship of the foods to nutritional diseases. Eight foods each that had the highest consumption pattern among the respondents were selected from the two groups. The grouped food consumption pattern (high risk food and low risk foods) was then correlated with

the lipid profile of the respondents, significance judged at $p < 0.05$. All statistical analysis was performed using SPSS version 21 for statistical analysis.

Table 1. Dietary pattern of the respondents

Variables	Frequency (N = 150)	Percent (%)
Lack of money to purchase food		
- Sometimes	92	61.3
- Always	37	24.7
- Never	21	14.0
Drinking water source		
- Pipe born water	21	14.0
- Bottled water	1	0.7
- Borehole water	61	40.7
- Stream water	61	40.7
- Packaged water	4	2.7
- Well water	1	0.7
- Rainwater	1	0.7
Frequency of daily meal consumption		
- One meal/day	3	2.0
- Two meals/day	22	14.7
- Three meals/day	107	71.3
- More than three meals/day	18	12.0
Frequency of skipping meals		
- Everyday	13	8.7
- Once a week	15	10.0
- Twice a week	7	4.7
- More than twice a week	12	8.0
- Never skipped meals	103	68
Reasons for skipping meal		
- Lack of appetite	26	17.3
- Lack of time	4	2.7
- No food	11	7.3
- Fasting	6	4.0
- Never skipped meals	103	68
Meal skipped		
- Breakfast	22	14.7
- Lunch	17	11.3
- Dinner	8	5.3
- Never skipped meals	103	68
Frequency of snacking		
- Everyday	15	10.0
- Once a week	24	16.0
- Twice a week	16	10.7
- Rarely took snacks	95	63.3
Type of snacks eaten		
- Pastries	70	46.7
- Fruits	37	24.7
- Nuts	10	6.7
- Vegetable	33	22.0

3 Results

Table 1 shows the dietary pattern of the respondents. A high percentage of the respondents (61.3 %) lacked money to buy food sometimes while (24.7 %) always lacked money to buy food and (14.0 %) has never lacked money to buy food. Water from the stream (40.7 %) and borehole water (40.7 %) were the main sources of drinking water for the respondents. Most (71.3 %) of the respondents ate three meals daily, few (14.7

%) consumed two meals daily while (12.0 %) ate more than three meals daily.

Table 1 also reveals that the most (68.7 %) of the respondents did not skip meals while 8.7 % skipped meals daily. The majority (71.3 %) of the respondents who ate three meals daily account for the bulk (68.7 %) of the respondents who did not skip meals. Few respondents skipped meals. Lack of money, appetite, food, time, and fasting are correlative with the few respondents who skipped meals. Different reasons were provided for skipping meals by those who did. The reasons included lack of appetite (17.3 %), lack of food to eat (7.3 %), fasting (4.0 %) and lack of time to eat (2.7 %). Information on the meal skipped revealed that (14.7 %) skipped breakfast while 11.3 % skipped lunch and 5.3 % skipped dinner. Most (63.3 %) of the respondents rarely took snacks while (10.0 %) had snacks daily. Varieties of snacks consumed by the respondents include pastries (46.7 %), fruits (24.7 %), vegetables (22.0 %) and nuts (6.7 %).

Table 2 summarizes the frequency of consumption of starchy foods, roots / tubers, and cereals of the respondents. More than half of the respondents (60.0 %) consumed rice 2 – 4 times weekly and (2.7 %) never consume rice or consume it less than once per month. Most (52.7 %) consumed maize daily and (19.3 %) consumed maize 5 – 6 times per week. Few of the respondents (22.0 %) ate sorghum less than once monthly or did not consume it at all while (23.3 %) ate it 2 – 4 times weekly. Less than 20 % rarely consumed millet while (23.3 %) consumed it daily. About 44.7 % of the respondents consumed yam 1 – 3 times per month while 4.0 % consumed yam 5 – 6 times a week. The respondents (38.0 %) consumed cassava less than once a month or did not consume cassava while 14.0 % consumed cassava 2 – 4 times weekly. Plantain was consumed by (24.0 %) of the respondents once weekly and (23.3 %) consumed plantain 2 – 4 times weekly. Table 2 also revealed that (28.7 %) consumed bread 2 – 4 times weekly and 21.3 % consumed it once a week. Most (70.7 %) of the respondents did not consume macaroni or ate it less than once in a month and only 16.0 % consumed it 1 – 3 times monthly. Similarly, less than half (47.3 %) of the respondents never or rarely consumed spaghetti while 16.7 % consumed it once a week. Correspondingly (70.0 %) of the respondents did not consume noodles or ate noodles less than once monthly while (16.7 %) consumed it 1 – 3 times monthly. Consumption of pasta and noodles in the study population was relatively low.

The result of the frequency of consumption of some traditional sauces, meat and meat alternatives, nuts and legumes is shown in Table 3. A greater percentage (43.3 %) of the respondents ate okra sauce, beans sauce (38.7 %) and melon sauce (54.0 %) 2 – 4 times weekly while others ate tomato stew (32.7 %) once weekly and sesame sauce was not eaten or eaten less than once a month by most (51.3 %) of the respondents. Majority (76.0 %) consumed chicken and 36.7 % ate beef 1 – 3 times

Table 2. Food consumption pattern of the respondents (starchy foods, roots/tubers, and cereals)

	Frequency of consumption						
	Never or less than once / month	1 – 3 times / month	Once / week	2 – 4 times a week	5 – 6 times a week	Once a day	2 – 3 Times a day
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Rice	4(2.7)	14(9.3)	15(10.0)	90(60.0)	11(7.3)	16(10.7)	-
Maize	12(8.0)	2(1.3)	3(2.0)	24(16.0)	29(19.3)	79(52.7)	1(0.7)
Sorghum	33(22.0)	22(14.7)	9(6.0)	35(23.3)	14(9.3)	33(22.0)	4(2.7)
Millet	24(16.0)	26(17.3)	17(11.30)	26(17.3)	16(10.7)	35(23.3)	6(4.0)
Yam	18(12.0)	67(44.7)	33(22.0)	23(15.3)	6(4.0)	3(2.0)	-
Sweet Potatoes	87(58.0)	51(34.0)	6(4.0)	4(2.7)	2(1.3)	-	-
Cassava	57(38.0)	43(28.7)	20(13.30)	21(14.0)	4(2.7)	4(2.7)	1(0.7)
Plantain	24(16.0)	43(28.7)	36(24.0)	35(23.3)	11(7.3)	1(0.7)	-
Bread	22(14.7)	42(28.0)	32(21.3)	43(28.7)	9(6.0)	2(1.3)	-
Macaroni	106(70.7)	24(16.0)	14(9.3)	4(2.7)	2(1.3)	-	-
Spaghetti	71(47.3)	40(26.7)	25(16.7)	11(7.3)	3(2.0)	-	-
Noodles	105(70.0)	25(16.7)	10(6.7)	7(4.7)	3(2.0)	-	-

Table 3. Food consumption pattern of the respondents (traditional sauce, meat/meat alternatives, nuts, and legumes)

	Frequency of consumption						
	Never or less than once / month	1 – 3 times / month	Once / week	2 – 4 times a week	5 – 6 times a week	Once a day	2 – 3 Times a day
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Sesame sauce	77(51.3)	22(14.7)	23(15.3)	28(18.7)	-	-	-
Okra sauce	38(25.3)	6(4.0)	16(10.7)	65(43.3)	23(15.3)	2(1.3)	-
Melon sauce	9(6.0)	12(8.0)	23(15.3)	81(54.0)	19(12.7)	-	-
Beans sauce	17(11.3)	41(27.3)	31(20.7)	58(38.7)	3(2.0)	-	-
Tomato stew	5(3.3)	35(23.3)	49(32.7)	44(29.3)	12(8.0)	5(3.3)	-
Beef	33(22.0)	55(36.7)	26(17.3)	25(16.7)	6(4.0)	5(3.3)	-
Chicken	28(18.7)	114(76.0)	4(2.7)	3(2.0)	1(0.7)	-	-
Fish	10(6.7)	2(1.3)	7(4.7)	9(6.0)	67(44.7)	55(36.7)	-
Crayfish	79(52.7)	16(10.7)	4(2.7)	13(8.7)	13(8.7)	17(11.3)	8(5.3)
Egg	73(48.7)	64(42.7)	12(8.0)	1(0.7)	-	-	-
Beans	7(4.7)	17(11.3)	28(18.7)	64(42.7)	30(20.0)	4(2.7)	-
Groundnut	37(24.7)	50(33.3)	37(24.7)	20(13.3)	4(2.7)	2(1.3)	-
Bambara nut	7(4.7)	21(14.0)	14(9.3)	67(44.7)	22(14.7)	19(12.7)	-

monthly. Conversely, (44.7 %) of the respondents ate fish 5 – 6 times weekly. The consumption of crayfish (52.7 %) and egg (48.7 %) was low as majority did not eat them or ate them less than once monthly. The rate of consumption of legumes and nuts by the respondents was high as some of them ate beans (42.7 %) and bambara nut (44.7 %) 2 – 4 times weekly while others (33.3 %) consumed groundnut 1 – 3 times monthly. Table 4 presents the frequency of consumption of fruits and vegetables by the respondents. Some fruits and vegetables were not consumed by the respondents because they were not available in the locality and even when they were, the

respondents were not familiar with them. Fruits and vegetables like cucumber (86.7 %), avocado pear (77.3 %), apples (75.3 %), watermelon (46.0 %), pineapple (62.0 %), guava (57.3 %), cabbage (90.7 %) and sherry (96.0 %) were not consumed or consumed less than once monthly. Some fruits like coconut (48.7 %) and pawpaw (40.0 %) were available but were eaten just 1 – 3 times monthly by most of the respondents. However, mango (31.3 %), banana (34.7 %), orange (30.0 %), and cashew (39.3 %) were available in most households and were eaten 2 - 4 times weekly by some of the respondents.

Table 4. Food consumption pattern of the respondents (fruits and vegetables)

	Frequency of consumption						
	Never or less than once / month	1 – 3 times / month	Once / week	2 – 4 times a week	5 – 6 times a week	Once a day	2 – 3 Times a day
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Mango	12(8.0)	27(18.0)	17(11.3)	47(31.3)	38(25.3)	4(2.7)	5(3.3)
Banana	9(6.0)	31(20.7)	46(30.7)	52(34.7)	12(8.0)	-	-
Cabbage	136(90.7)	9(6.0)	4(2.7)	-	1(0.7)	-	-
Sherry	144(96.0)	4(2.7)	2(1.3)	-	-	-	-
Coconut	39(26.0)	73(48.7)	29(19.3)	8(5.3)	1(0.7)	-	-
Guava	86(57.3)	41(27.3)	14(9.3)	6(4.0)	3(2.0)	-	-
Cashew	19(12.7)	15(10.0)	16(10.7)	59(39.3)	31(20.7)	9(6.0)	1(0.7)
Pawpaw	49(32.7)	60(40.0)	13(8.7)	18(12.0)	8(5.3)	2(1.3)	-
Pineapple	93(62.0)	45(30.0)	6(4.0)	2(1.3)	4(2.7)	-	-
Water melon	69(46.0)	51(34.0)	22(14.7)	7(4.7)	1(0.7)	-	-
Apple	113(75.3)	27(18.0)	8(5.3)	2(1.3)	-	-	-
Avocado pear	116(77.3)	25(16.7)	7(4.7)	2(1.3)	-	-	-
Orange	11(7.3)	17(11.3)	42(28.0)	45(30.0)	30(20.0)	5(3.3)	-
Cucumber	130(86.7)	13(8.7)	3(2.0)	4(2.7)	-	-	-
Bitter leaf	10(6.7)	22(14.7)	35(23.3)	64(42.7)	10(6.7)	9(6.0)	-
Alefo leaf	9(6.0)	19(12.7)	32(21.3)	57(38.0)	28(18.7)	4(2.7)	1(0.7)
Ugu leaf	10(6.7)	11(7.3)	19(12.7)	81(54.0)	23(15.3)	6(4.0)	-
Moringa leaf	98(65.3)	21(14.0)	19(12.7)	10(6.7)	2(1.3)	-	-

Table 5. Food consumption pattern of the respondents (milk and dairy products, fats and oil)

	Frequency of consumption						
	Never or less than once / month	1 – 3 times / month	Once / week	2 – 4 times a week	5 – 6 times a week	Once a day	2 – 3 Times a day
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Milk	57(38.0)	53(35.3)	19(12.7)	18(12.0)	2(1.3)	1(0.7)	-
Yoghurt	139(92.7)	8(5.3)	2(1.3)	1(0.7)	-	-	-
Cheese “wara”	138(92.0)	9(6.0)	1(0.7)	2(1.3)	-	-	-
Sour milk “nono”	127(84.7)	14(9.3)	7(4.7)	2(1.3)	-	-	-
Margarine	146(97.3)	3(2.0)	1(0.7)	-	-	-	-
Butter	140(93.3)	8(5.3)	2(1.3)	-	-	-	-
Vegetable oil	33(22.0)	70(46.7)	23(15.3)	16(10.7)	5(3.3)	3(2.0)	-
Palm oil	1(0.7)	2(1.3)	2(1.3)	8(5.3)	46(30.7)	91(60.7)	-

Table 5 shows the frequency of consumption of milk and dairy products, fats, and oil by the respondents. The result showed that most of the respondents did not take dairy products or took them less than once in a month while few took milk less than once monthly. This low consumption could be because it has not been part of their diet from adulthood. This is shown as 92.7 % for yoghurt, 92.0 % for cheese “wara”, 84.7 % for sour milk “nono” and 38.0 % for milk. Butter (93.3 %) and margarine (97.3 %) were not taken or taken less than once

monthly by most respondents. Majority (60.7 %) of the respondents used palm oil in cooking once daily while vegetable oil (46.7 %) was used just 1-3 times monthly by some of the respondents.

Table 6 presents the correlation of lipid profile and high-risk foods consumed by the respondents. There was no significant relationship between high-risk foods consumed by the respondents and all the lipid profile parameters. A negative

Table 6. Correlation of lipid profile and high-risk foods consumed by the respondents

	HRFS	TC	HDL	LDL	TG
HRFS	1	.039	.012	.060	-.093
TC		1	.324**	.619**	.214**
HDL			1	-.419**	-.097
LDL				1	-.110
TG					1

Abbreviations: HRFS = high risk factor foods, TC= total cholesterol, HDL= high density lipoprotein, LDL= low density lipoprotein, TG = triglyceride, **. Correlation is significant at the 0.01 level (2-tailed).

relationship existed between high risk factor foods and triglycerides.

Correlation of lipid profile and low risk foods consumed by the respondents is shown in Table 7. A negative non-significant relationship ($p > 0.05$) existed between all lipid parameters and low risk foods consumed by the respondents except for triglycerides that had a positive relationship ($r = 0.004$), but the relationship was not significant.

Table 7. Correlation of lipid profile and low risk foods consumed by the respondents

	TC	HDL	LDL	TG	LRFS
TC	1	.324**	.619**	.214**	-.063
HDL		1	-.419**	-.097	-.011
LDL			1	-.110	-.057
TG				1	.004
LRFS					1

Abbreviations: LRFS = low risk factor foods, TC= total cholesterol, HDL= high density lipoprotein, LDL= low density lipoprotein, TG = triglyceride, **. Correlation is significant at the 0.01 level (2-tailed).

4 Discussion

The observed regular meal intake (3 times daily) may be attributed to the fact that apparently healthy older adults were involved in this study, hence the chances of having respondents with loss of appetite from chronic health conditions which affects meal consumption are diminished¹⁴. The result in this study is similar to the result obtained by Afolabi et al.¹⁵ which reported that the elderly in their study regularly (three times) consumed meals daily, and snacks or between meals were not common. As expected, most of the respondents did not skip meals. A similar report has been found in a study conducted by Winter et al.¹⁶ where usual dietary pattern involved three meals

daily, with skipping meals a rare occurrence. The habit of not skipping meals by the respondents is an advantage as good feeding can minimize the ill-health associated with aging.

Lack of appetite (17.3 %) dominated the reason for skipping meals amongst the respondents. The change in taste could be the reason for lack of appetite as it has been reported that there is decreased taste bud/taste activity in older persons which reduces their ability to discriminate between subtle differences in taste¹⁴.

Lack of time in the morning may be responsible for high skipping of breakfast meals when compared to other meals. Sun et al.¹⁷ reported that lack of time and habit were some of the reasons behind breakfast skipping most of the time. Habits and preferences formed during childhood and youthful stage are difficult to change in adult life therefore dietary intake is often similar to what older persons grew up with¹⁸. Snack consumption of the elderly was reportedly high in this study, particularly pastries. Snacking can result to high energy intake among the respondents. Eating snacks has been revealed to extensively add to nutrient intake, better diet quality and an increased likelihood of meeting selected food recommendations¹⁹. However, Amin et al.²⁰ reported that snacks have been shown to be high in fat, carbohydrates, and refined sugars and these are important risk factors for obesity and cardiovascular diseases.

The mild intake of fruit, vegetables and nuts as snacks should be improved. Studies suggest that Mediterranean-style diets as well as limited intake of red meat and high cereal-fiber consumption reduce cardiovascular disease and cancer in older people, suggesting that eating a diet that is high in fruits, vegetables, nuts, cereals and low in red meat is healthy²¹.

Rice was frequently consumed by majority of the respondents while half of the elderly consumed maize daily. Rice and maize are major staples produced and consumed in different varieties and form within this study location. The distribution of the consumption of sorghum and millet varied from that of rice and maize because rice is mostly accepted by majority of the population and maize is used to make different foods. Consumption of sorghum and millet was majorly in the form of gruel and drinks (“*obiolo*”). Topping²² reported that cereals provide non-starch polysaccharide (NSP) to diets which serve as effective laxative, lowers plasma cholesterol and reduce the risk of heart diseases.

The consumption of yam was low because only few farmers cultivate it in Dekina local government on subsistence scale and the time the study was conducted was not the season for yam which made it expensive in market. The consumption of cassava was low (14 % - twice / week) because foods made from cassava like bolus meals (“*garri / eba, akpu*”) was not commonly consumed in the communities.

Plantain was moderately consumed because they are not commercially produced. Evidence has shown that starchy roots, cereals, and legume are commonly consumed foods in Nigeria. This explains why the older persons consume cereals and tuber-based diet ^{23,24}. Roots and tubers such as yam and cassava are staple foods which provide calories in West African diets but are poor in other nutrients ²⁵.

The sweet potato consumption was low as more than half of the elderly (58.0%) eat sweet potato less than once monthly. Arubi ²⁵ reported that sweet potato is a root crop which has been shown to make significant contribution to the diet of people in the tropics. Yet among the respondents it is not popular as weekly consumption was very low.

The low consumption of ultra-processed bread and cereal food products strengthens the evidence that older adults are familiar with intake of diet of home-cooked dishes made from locally produced ingredients.

The less frequent consumption of beef and chicken could be because of preference which is an advantage as high intake is linked to cardiovascular diseases. It has been reported that there is a positive relationship between red and processed meat intake and the risk of cardiovascular disease and mortality which is as a result of their connection to saturated fat ²⁶. A study conducted by Siri-Tarino et al. ²⁷ shows that saturated fats may possibly increase low-density lipoprotein cholesterol (LDL-C) concentrations and cause the selective uptake of cholesterol in the arterial wall, thus increasing the risk of atherosclerosis and cardiovascular disease.

Conversely, (44.7 %) of the respondents ate fish 5 – 6 times weekly. Studies have shown that eating fish twice weekly (240 g weekly) lower risk for heart attack than individuals who rarely eat fish ²⁸. Eating fish over a long term was linked to lower levels of total cholesterol, blood triglycerides, fasting blood sugar and systolic blood pressure ²⁹. The low consumption of crayfish could be because most of the respondents were not familiar with it. Consumption of egg was low and could be due to low economic status. Consuming egg frequently may perhaps be linked with intake of cholesterol and consequently diabetes ³⁰. Furthermore, eggs are rich in cholesterol and an egg yolk contains about 210 mg of cholesterol, it is recommended that foods rich in cholesterol (organ meats, egg yolks and dairy fats) should be limited in the diet because they may increase blood cholesterol in some people if they are consumed in abundant amounts ²⁸. Consumption of animal protein was low in the diet of the respondents which is in contrast with the study carried out in Ondo state, Nigeria where their diets were high in animal protein ³¹.

Beans and Bambara nut were the predominant legumes and nuts consumed in this study. The source of protein consumed by the respondents in this study was mostly plant-based protein and this may be due to loss of denture.

Okra, beans, and melon were popular in the communities because they are grown and therefore available and this could be the reason for the high frequency of consumption. Consumption of these traditional sauce 2 – 4 times weekly by some of the respondents can reduce their risk of cardiovascular disease. Okra contains soluble fibers which reduce cholesterol and, therefore, decreases the chance of cardiovascular disease ³². Ha et al. ³³ reported that beans can significantly reduce LDL cholesterol (bad cholesterol), which in turn can reduce the risk of heart disease. Tomatoes were grown by few farmers on a subsistence scale, and this could be the reason for the low consumption of tomato stew. Conversely, sesame was available in the study area, yet it was consumed by few respondents. The reason could be due to their preference for the soup. The low consumption of this soup is not encouraging as tomatoes contain high levels of lycopene which has been shown to lower bad cholesterol ³⁴. When sesame seeds are high in cholesterol-lowering phytosterols and also polyphenol that can improve lipid profiles and balance cholesterol levels ³⁵.

The fruits often consumed 2 – 4 times weekly were mango (31.3 %), banana (34.7 %), orange (30.0 %) and cashew (39.3 %) considered as naturally soft. This could be explained by the poor dentition that may limit food choices to such soft foods ¹⁴. Some fruits were consumed less in quantity and frequency because their availability during seasons. Fruits are important sources of both digestible and non-digestible carbohydrates ³⁶. The result also revealed that some of the respondents preferred vegetables which are rich sources of fiber. It is well established that fibers play a vital role in human health; it combines different substances as well as cholesterol and makes them insoluble for absorption. Vegetables such as bitter leaf (42.7 %), “Alefo leaf” *Amaranthus spinosus* (38.0 %) and “ugu leaf” *Telfairia occidentalis* (54.0 %), were consumed 2 – 4 times weekly except for *Moringa oleifera* that was not common /available in the locality. Chan et al. ³⁷ found that adequate fruit and vegetable intake was associated with lower risk of compromised cognition. Wang et al. ³⁸ established that intake of fruits and vegetables were related with reduced risk of mortality.

The very low consumption of milk and dairy products of various forms is not encouraging as it has been reported that insufficient intake of essential nutrients such as calcium, magnesium, protein and phosphorus which are abundantly rich in milk and dairy products may cause bone fracture ³⁹.

The seldom consumption of margarine and butter is indicative of low intake of other food combinations such as bread which are consumed alongside margarine / butter. Palm oil, which is an excellent source of tocotrienols, was consumed frequently by the respondents. Mukherjee and Mitra ⁴⁰ reported that tocotrienols through its action on the liver enzymes lowers

blood cholesterol without reducing HDL-C. Oils from plants are known to contain unsaturated fatty acids mainly ranging from 73 to 94% of total fats ²⁷.

The non-significant relationship between high-risk foods and lipid parameters could be due to low consumption. The high-risk foods which were mainly fats, carbohydrate and meat were consumed by few respondents. It has been reported that dietary factors, particularly habitual dietary fat consumption and the amount and type of fat in a meal are major determinants of postprandial lipemic response ⁴¹. Consumption of saturated fatty acids induces hyperlipidemia causing progression of atherosclerosis compared to unsaturated fatty acids ⁴². Trans fatty acids raise low density lipoprotein cholesterol and also decrease high density lipoprotein cholesterol ⁴³. Very high carbohydrate intake is accompanied by a reduction in HDL-C and a rise in triglyceride ⁴⁴. Elevated triglyceride and decreased HDL-C serum levels are both risk factors for developing coronary heart disease ⁴⁵.

The negative relationship between low-risk foods and these lipid parameters is an indication that increase in consumption of the low-risk foods will result to a reduction of the lipid parameters. The low-risk foods comprise of whole grains, nuts, legumes, fruits, and vegetables. These foods are plant based and are rich in fiber and other nutrients. Consumption of fruits and vegetable-based diets, rich in fiber, folic acid, antioxidants, and phytochemicals are associated with lower serum cholesterol ⁴⁶. This is because vegetable diets contain less saturated fat and cholesterol, and greater amounts of dietary fiber, their consumption therefore helps to lower the level of serum cholesterol ⁴⁶. There is evidence that soluble fibers lower cholesterol and insoluble fibers increase stool weight ⁴⁷.

Whole grain foods are rich sources of vitamins, minerals, phytochemicals, and dietary fiber ^{48, 49}. Whole grain consumption has been shown to improve lipid profiles ⁵⁰. Some studies have found that intake of whole grains decreases both LDL cholesterol and total cholesterol ^{50, 51}.

5 Conclusions

The present study assessed the dietary pattern in relation to the lipid profile of older adults (≥ 65 years) in Dekina LGA of Kogi State in Nigeria. The study reported a commendable intake of low-risk foods and low consumption of high-risk foods. Although significant association between dietary pattern and lipid profile was not established in this study, the direction of the relationship suggests that low risk foods consumption may be attributed to optimal lipid profile of the elderly. Nutrition education should be introduced to further strengthen the consumption of low-risk foods (whole grains, nuts, seeds, fruits, vegetables, legumes) and also discourage consumption of high-risk foods (unsaturated fats, saturated and trans fats) amongst the elderly.

Limitations of the study: The study subjects were older persons. Even though we incorporated a useful food frequency questionnaire, they might not have remembered all the foods consumed as a result of memory loss associated with the age group.

Author Contribution: N.O.C. conceived and designed the study. E.B.B. did literature research, data acquisition, data analysis and statistical analysis. I.G.O prepared, reviewed and drafted the manuscript. All authors approved the final version before submission. All authors have read and agreed to the published version of the manuscript.

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