Serum Cholesterol Dietary Pattern and Fiber of a Group of Elderly Yoruba in Ibadan, Nigeria

Olayiwola IO*, Fadupin GT*, SO Agbato¹ and Soyewo DO¹

Abstract

This cross sectional descriptive, study assessed serum cholesterol, fiber and dietary characteristics of 240 elderly subjects in Ibadan, Nigeria. All respondents filled out appropriate questionnaires in regard to dietary pattern and blood was drawn from 120 subjects for biochemical analysis.

The 240 respondents ranged in age from 60 to 95 years and included 114 (47.5%) men and 126 (52.5%) women. Their diets were high in roots and tubers, moderate in legumes and low in fruits and animal proteins and fats. Mean fiber intake was 16 g/day; Energy ranged from 6136-8368 kJ/day and protein ranged from 28-50 g/day. Zinc, vitamin A, and B vitamin were low. The blood pressures both diastolic systolic relate significantly with age.

Assessments of their lipid profiles showed that most women (80%) had normal total cholesterol (TC) concentrations but less than half (47%) men had normal TC.

HDL-C concentrations ranged from 33-39.74 mg%, with 69% of men and 35% of women having normal HDL-C.

In addition, there is a significant different between male and female TC, LDL and HDL. Fiber intake correlated with Vitamin A (r=0.30; p<0.05), Vitamin B1 (r=0.41; p<0.05) and Zinc (0.40; p<0.05) but no correlation with serum cholesterol (p>0.05). In all, half of these subjects had normal TC, with dietary intake low in fiber, vitamins A, B and Zinc.

Keywords

Cholesterol diets; Elderly; Fiber; Nigeria

Introduction

Serum cholesterol is the term that includes the total level of cholesterol that found in the blood streams. Over time, the breaking down the various component of total cholesterol identified different types, which include High Density Lipoproteins (HDL) and Low Density Lipoprotein (LDL). The measurement of these levels of cholesterol helps to provide a complete picture of lipids and proteins currently present in this study. The serum cholesterol measurement helped to identify a number of potential health problems and administer treatment before they become critical.

High cholesterol concentrations were associated with the development of atherosclerosis and cardiovascular disease [1]. High blood concentrations of cholesterol can result in cholesterol deposition on blood vessels wall. Accumulation of these deposits, termed plaques, can cause vessel walls to become more stringent, narrowing their openings and constricting blood flow. Higher blood concentrations of HDL-C can reduce plaque risk in elderly individuals by removing excess cholesterol from blood [2]. Major risk factors for high cholesterol include lifestyle, gender, age, hypertension (blood pressure ≥ 140/90 mmHg or taking high blood pressure medication) and family history [2,3]. Although high cholesterol is a well-documented risk factor for coronary heart disease (CHD) among middle-aged and ‘young elderly’ (age 60–70 years) individuals, no optimal cholesterol concentration has been identified in persons aged ≥ 80 years in developed countries [4].

In many African populations little is known about the prevalence of risk factors for some non communicable diseases (NCD), including lipid concentrations, resulting in large gaps of knowledge about the health of elderly African subjects, especially those living in rural areas. In Nigeria, for example, little is recognized about nutrition and overall health of elderly individuals. The prevalence of Non Communicable Diseases such as Cardio Vascular Diseases (CVD), hypertension is on the increase even in rural communities of Nigeria [5]. In general, the prevalence of NCD increases with age, suggesting the need to determine nutrition in elderly subjects, especially regarding risk factors such as lipids. Elevated HDL-C concentration may have a greater impact on longevity than TC or LDL-C [6]. Since lipids affect nutritional status, lipid profiles in other countries have been measured in conjunction with diet and nutrient intake [6] and to be strongly associated with lipid profile and CVD in adults [2,3]. The lipid study of elderly subjects was found to be influenced by dietary pattern and other lifestyle factors, such as alcohol consumption and physical exercise [6]. However a healthy lifestyle in elderly persons can reduce disease and promote longevity. This lifestyle may be enhanced by effective nutrition education especially for intake of dietary fiber for improving health and normalising blood lipid concentrations.

The importance of dietary fiber to elderly nutrition is enormous; increases stool bulk and frequency of bowel movements. The water holding property of fiber helps to softens stool, increases fecal bulk reduces intra-colonic pressures; reduces the need to strain, prevents constipation, haemorrhoids, diverticulosis, and at times prevents colon cancer.

Promotion of a healthier lifestyle in elderly subjects, including education about the interactions between serum cholesterol, fiber and other nutrient intake requires the establishment of baseline data. This cross sectional descriptive, study, therefore, assessed demographic characteristics of 240 elderly subjects in Ibadan, Nigeria, including serum cholesterol, dietary patterns and fiber.

Subject and Methods

Study design

This study was carried out in Ibadan the capital town of Oyo state in the idikan community of the Ibadan North-West local government.
area. The post independence history revealed that Ibadan has served as the capital of Southern Nigeria and Western Region, divisions that existed in Nigeria before the development of demarcated states.

Ibadan is the most populated Yoruba-speaking state in the southwestern region of Nigeria, inhabited mostly by individuals of the Yoruba tribe [7]. Their occupations range from large scale businesses to small trading. Some are involved in agricultural practices, such as vegetable farming (especially yams, cassava, maize, and plantains) and raising poultry and livestock, especially small ruminant animals.

This investigation was performed according to the guidelines of the Declaration of Helsinki, and all procedures involving human subjects [8] were approved by the Ethical Review Committee of the University of Ibadan and the University College Hospital and conformed to the international guidelines of the ethical review of epidemiological studies. Informed verbal consent was obtained from all subjects with witnesses present and was formally recorded.

**Determination of sample size**

The sample size was determined using the formula [9]

\[ N = Z^2 \left( \frac{pq}{d^2} \right) \]

Where \( N \) is the sample size; \( Z \) is the standard normal variable for a 95% confidence level; \( p \) is the prevalence of the attribute (using an underweight \( p \) value of 15% [7]; \( q \) is 1-\( p \), and \( d \) is precision, which was set at 0.05. Using this formula, we calculated \( N \) as

\[ 1.96^2 \times \frac{0.15 \times 0.85}{0.05^2} = 196 \]

Thus, to estimate the prevalence of poorly nourished elderly individuals with a 95% confidence interval and a precision of 5%, a total of 196 elderly people would be needed. An additional 20% was added to account for non-responses [10], yielding a total of 234, which rounded up to 240.

**Target population**

All subjects lived in an urban area of Ibadan, which is characterized by poor socioeconomic status and low educational levels. The main occupation was petty trading. All subjects were at least 60 years of age. Subjects who had a serious illness, or who were immobile or institutionalized, were excluded.

**Sampling procedure**

The 240 subjects were selected using random sampling procedure from 10 wards in the Idikan community area of Ibadan. Houses were randomly selected from each ward, and subjects were asked to participate in the study until consent was obtained from 24 houses in each ward. To be eligible for inclusion, each prospective respondent must have resided at the study location for at least 5 years. To contact the 240 subjects, the authors made home visits with the assistance of local aides. In each household, the oldest person (male or female) was selected. If there was more than one elderly resident, and they were of the same age, a ballot was used to select one participant. The health benefits of participating, including enhanced information about foods that promote good health, were explained to each participant, and verbal and/or written consent was obtained from each prior to participation.

**Data collection instruments**

Three instruments were used: a questionnaire about demographic and non demographic characteristics, a food frequency questionnaire and food intake records, anthropometry and a biochemical analysis of blood lipid profile.

**Questionnaire about sociodemographic characteristics and health status:** To standardise the questionnaire and verify the validity of the actual exercise, a pre-test exercise was carried out in another Location which is outside of the study area. The demographic items include age, sex, marital status and household size. The non demographic items include blood pressure, health and food habits.

This questionnaire was designed by us for use in this study. It’s Cronbach’s alpha was 0.80.

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**Food frequency Questionnaire to estimate Dietary pattern:** The food frequency questionnaire (FFQ) is one of the instruments of measuring dietary pattern in food consumption studies of an individual group or a population. The design is such that foods are listed and rate of consumption identified either as daily weekly or 2-4 times a week and occasionally. This format gives an overview of the rate/frequency at which various food groups are consumed [9].

**Questionnaire about dietary intake and direct weighing of food intake:** Food consumed by subjects was determined during visits made by the authors and other field assistants at meal times on three consecutive days. Food intake was estimated by direct weighing of food about to be eaten using a kitchen Salter scale, with the local name of the food item entered into the coded form [9]. The nutrient levels in these foods were determined using the food composition tables of the Food and Agriculture Organization for Africa and Total Dietary Assessment software.

**Biochemical assessment of lipid profile:** Blood sample were obtained, in the morning after an overnight fast, venous blood (10 ml) was collected from the subjects using a sterile needle and syringe [9].

Total Cholesterol, LDL-C, HDL-C and Triglyceride, concentrations were measured using a chromatographic enzymatic method in a semiautomatic analyzer RA-50 [11]. The following cut-off points indicated normal status: LDL-C, <130 mg/dl; HDL-C, >40 mg/dl; Total cholesterol (TC), <200 mg/dl; Triglycerides (TG), <150 mg/dl.

**Blood Pressure Assessment:** Blood pressure of the subjects was measured with OMRON digital automatic blood pressure sphygmomanometer (Model HEM-712C) following American Heart Association procedure and reference standard [12].

**Data analysis**

All data were analyzed using Excel and SPSS Version 16 (www.spss.com) for simple and inferential statistics.

**Limitation**

The inability to achieve full lipid profile intake due to insufficient information on the content of lipid in the traditional diet may have affected the correlation of lipids intake. Furthermore, the elderly nutrient requirement in African is yet to be determined, thus, study use extrapolation from the adult standards hence the use of estimated

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average requirement.

Results

The 240 subjects varied in age from 60 to 96 years and included 114 (47.5%) men and 126 (52.5%) women. One hundred (41.7%) lived in households with monogamous couples and 140 (58.3%) in households with polygamous couples. Of these subjects, 150 (62.5%) did not have any formal education, and only 32 (13.3%) had completed primary school. In addition, 208 (86.7%) were of low socioeconomic status, and only 28 (11.7%) categorized as having poor health status. The most common ailment reported by these subjects was body pain (33.3%). The prevalence of high blood pressure was 8.3%, diabetes 5.8%, constant malaria 15% and rheumatism 1.5%.

Assessment of the dietary patterns and food habits of these elderly Yoruba showed that 160 (66.7%) ate three times per day, although the largest source of these foods was food vendors. The food purchased is cooked food mostly cassava products. Forty-three percent avoided certain foods, mainly tubers or vegetables, for various reasons, including health concerns, parental instructions and religion. Assessment of overall food consumption patterns showed low consumption of fruits, moderate consumption of legumes, and high consumption of roots and tubers, such as cassavas and yams. The majority of respondents (69%) ate tubers daily as pastes and porridges. The animal protein sources like meat are low in consumption majority eat meat occasionally like once in a month. Fish consumption is higher than meat because of economic reasons.

Blood samples were obtained from only 120 subjects (50%). The mean distribution of serum cholesterol is as presented in Table 1a. Assessment of their lipid profiles showed that 53% of the men and 70% of the women had normal LDL-C concentrations. HDL-C concentrations ranged from 33-39.74 mg/dl, with 69% of men and 35% of women having normal HDL-C levels. TC concentrations ranged from 139–175.6 mg/dl, with 47% of men and 80% of women having normal TC concentrations. Triglyceride concentrations ranged from 76–117 mg/dl, with 60% of men and 75% of women having normal triglyceride levels (Table 1b). Further analysis of LDL-C concentrations showed that they were optimal in 46% of men and 70% of the women had normal LDL-C concentrations. HDL-C >40 mg/dl * 53 47 70 30

*p<0.05 for males vs. Females **Normal ranges as in Gibson [9].

Table 1a: Mean Distribution of Serum Lipid and Blood Pressure in the Elderly Group.

<table>
<thead>
<tr>
<th>S/N</th>
<th>VARIABLES</th>
<th>MEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MALE SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T-test P values</td>
</tr>
<tr>
<td>1</td>
<td>Age</td>
<td>70.08 06</td>
</tr>
<tr>
<td>2</td>
<td>Total Cholesterol (mg/dl)</td>
<td>169.00 48</td>
</tr>
<tr>
<td>3</td>
<td>High density lipoprotein (mg/dl)</td>
<td>39.13 7</td>
</tr>
<tr>
<td>4</td>
<td>Low density lipoprotein (mg/dl)</td>
<td>109.80 32</td>
</tr>
<tr>
<td>5</td>
<td>Triglyceride (mg/dl)</td>
<td>109.40 64</td>
</tr>
<tr>
<td>6</td>
<td>Systolic Blood Pressure</td>
<td>118.20 13</td>
</tr>
<tr>
<td>7</td>
<td>Diastolic Blood Pressure</td>
<td>84.40 6</td>
</tr>
</tbody>
</table>

*p<0.05 **P<0.01 ***P>0.05

Table 1b: Serum Cholesterol and Triglycerides of the elderly.

<table>
<thead>
<tr>
<th>MEALS</th>
<th>FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDL-C, 60-130 mg/dl *</td>
<td>53</td>
</tr>
<tr>
<td>HDL-C &gt;40 mg/dl *</td>
<td>40</td>
</tr>
<tr>
<td>Total cholesterol, &lt;200 mg/dl</td>
<td>47</td>
</tr>
<tr>
<td>Triglycerides, 10-150 mg/dl</td>
<td>60</td>
</tr>
</tbody>
</table>

*p<0.05 for males vs. Females **Normal ranges as in Gibson [9].

Table 2: Fiber and Nutrient intake of elderly.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Males (Range)</th>
<th>Females (Range)</th>
<th>% below requirement* (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber (g/day)</td>
<td>9-31</td>
<td>9-25</td>
<td>78-80%</td>
</tr>
<tr>
<td>Calories (kcal/day)</td>
<td>6136-8368</td>
<td>6550-6833</td>
<td>21%</td>
</tr>
<tr>
<td>Protein (g/day)</td>
<td>3-50</td>
<td>28-44</td>
<td>22-29%</td>
</tr>
<tr>
<td>Fat (g/day)</td>
<td>18-38</td>
<td>16-35</td>
<td>48-53</td>
</tr>
<tr>
<td>Minerals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron (mg/day)</td>
<td>14-28</td>
<td>14-32</td>
<td>---</td>
</tr>
<tr>
<td>Calcium (mg/day)</td>
<td>331-735</td>
<td>443-687</td>
<td>50-53</td>
</tr>
<tr>
<td>Zinc (mg/day)</td>
<td>2-10</td>
<td>1-9</td>
<td>30-37</td>
</tr>
<tr>
<td>Phosphorus (mg/day)</td>
<td>232-480</td>
<td>199-477</td>
<td>44-52</td>
</tr>
<tr>
<td>Vitamins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A (μg/day)</td>
<td>269-487</td>
<td>147-535</td>
<td>55-60</td>
</tr>
<tr>
<td>Vitamin B1 (mg/day)</td>
<td>0.2-0.82</td>
<td>0.38-0.78</td>
<td>47-57</td>
</tr>
<tr>
<td>Vitamin B2 (mg/day)</td>
<td>0.2-0.82</td>
<td>0.2-0.6</td>
<td>40-60</td>
</tr>
<tr>
<td>Vitamin B3 (mg/day)</td>
<td>0.35-0.91</td>
<td>0.1-0.92</td>
<td>60-65</td>
</tr>
<tr>
<td>Vitamin B6 (μg/day)</td>
<td>0.51-0.91</td>
<td>0.23-0.99</td>
<td>70-75</td>
</tr>
<tr>
<td>Vitamin C (mg/day)</td>
<td>24.8-42.8</td>
<td>32.4-34.4</td>
<td>55-60</td>
</tr>
<tr>
<td>Folic acid (μg/day)</td>
<td>179-352</td>
<td>106-238</td>
<td>49-57</td>
</tr>
</tbody>
</table>

*p<0.05 for males vs. Females **Normal ranges as in Gibson [9].

Relative to the Estimated Average Requirement [24].

We also found that the fiber correlated significantly with age and nutrient intake. For example, fiber was significantly correlated with increased Age (r=-0.44; p<0.05), Protein (21; p<0.05), Energy (0.24; p<0.05) Zinc (0.40; p<0.05) vitamin A (30; p<0.05) Vitamin B (41; p<0.05) phosphorus (24; p<0.05) and Iron (44; p<0.05) (Table 3). There were significant positive correlations between HDL-C and TC (r=0.48; p<0.05) and HDL-C/LDL-C and TC (0.74; p<0.05) concentrations. Diastolic blood pressure correlated with LDL-C (r=-0.37; p<0.05) and HDL-C (r=-0.31; p<0.05) concentrations, and systolic blood pressure correlated with HDL-C concentration (r=-0.31; p<0.05).

Table 3 put on view the correlation coefficient of serum cholesterol and dietary pattern. There is no clear significant association observed expect with protein, and HDL-C (r=0.38; p<0.05) and energy versus

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### Discussion

This study evaluated the cholesterol level and diet of elderly Yoruba living in the Idikan community of Ibadan in southwest Nigeria. Their lipid profiles indicate that most of these subjects were in a normal healthy state, although a few were classified as at risk of CHD because of their TC/HDL-C and LDL-C/HDL-C ratios. The HDL-C/LDL-C should be kept above 0.3, ideally above 0.4 [12], although the ability of this ratio to predict CHD is unclear. Abnormal lipid levels in elderly individuals can cause other pathological problems. The pathophysiology of the metabolic syndrome associated with abnormal lipid concentrations reduced HDL-C and increased LDL-C concentrations [13]. The average adult TC concentration is 200 mg/dl, which is a borderline high risk for heart disease (CVD). Dyslipidemia is considered a primary risk factor for cardiovascular disease (CVD), which is more frequent in older than in younger individuals [3,14].

Many elderly individuals, however, are unaware of their lipid profile status, with many not having access to adequate treatment [15,16]. The higher values of TC and LDL observed in male than female (p<0.05) paints an unpleasant picture. More investigation should be done on health implications for men and women. The male exposure to TC and LDL may be due to higher intake of energy, protein and fat in male than female (p<0.05). Meanwhile, there are no significant differences in the fiber intake of male and female (p>0.05).

The diet of these subjects consists mainly of plants, and their fiber intake is within normal range. Many epidemiological and clinical studies have shown that the incidence of atherosclerosis related CVD correlated with changes in dietary pattern, lipid level and age [2,14,17].

Major risk factors for CVD include lifestyle, diet, gender, age and hypertension (blood pressure ≥ 140/90 mm Hg or taking high blood pressure medication) and family history [18]. High cholesterol concentration is a well-documented risk factor among middle-aged and ‘young elderly’ (60–70 years) individuals, however, the optimal cholesterol concentration has not yet been determined in subjects aged ≥ 80 years in developed countries [19,20].

Analysis of the foods consumed by these elderly subjects revealed that the intake of calories and protein was lower than the estimated requirement in both males and females, although intake was not significantly related to lipid profile. The low calorie intake may be related to the quantity and variety of consumed foods. Some of the respondents consumed only soft foods, such as pap (fermented cereal), and only in small quantities, whereas some had food preferences causing them to avoid certain foods, which reduced the variety and diversity of their diets. Moreover, their low calorie intake may be a reflection of their low fat intake, which ranged from 21 to 39 g/day. Conversely, this low fat intake may have accounted for the healthy lipid profile in more than half of the elderly subjects. Low calorie intake has also been observed in elderly individuals in other countries [21,22], including other parts of Nigeria [7] and Switzerland and Canada [23].

We found that age affected the lipid profiles and general health of these elderly subjects. Age is associated with decreased lipid concentrations, especially HDL-C, and decreased energy intake, increased systolic and diastolic blood pressure. These changes may have implications for the risks of CHD [18], artery damage, dementia, transient ischemic attack (TIA), kidney scarring and glomerulosclerosis [16].

We also found that the fiber correlated significantly with age and nutrient intake. This may be due to food habit of very old people in Nigeria where indigenous food are roots and cereals. Although the correlation was significant on serum cholesterol level and energy as well as protein.

Serum total cholesterol correlated positively with HDL and diastolic blood pressure. Serum cholesterol relates significantly with fruit and vegetable consumption (X²=40.63; p<0.05). The interaction of fruit and vegetable intake as well as serum cholesterol calls for more work.

Also, further proof of the value of fiber, serum cholesterol and dietary intake in predicting health risks will require additional longitudinal studies. However, this study of serum cholesterol offers an opportunity, to target individuals at highest risk, thus maximising the benefits of public health intervention in Nigeria. In all, this study substantiates serum cholesterol level, dietary pattern and fiber intake of the elderly as well as the significant correlation of protein intake and HDL-C.

### Conclusion

This study has shown that about half of elderly people in Ibadan, Nigeria had healthy TC levels, and that two-thirds had normal triglyceride concentrations. The diet of these people was primarily based on plants, mostly roots and tubers. The majority has low fiber intake. The higher values of TC and LDL observed in male than female (p<0.05) paints an unpleasant picture. More investigation should be done on health implications for men and women. The male exposure to TC and LDL may be due to higher intake of energy, protein and fat in male than female (p<0.05). Meanwhile, there are no significant differences in the fiber intake of male and female (p>0.05).

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### Acknowledgement

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