



Dietary Pattern and Biochemical Status of the Elderly in Ondo State, Nigeria

Cecilia Abiodun Olarewaju¹, Delana Ajao Adelekan²,
Ibiyemi Olasunbo Olayiwola², Oluwasanmi Moses Arigbede³
and Ayodeji Akinwumi Akinbodewa^{4*}

¹Department of Home Economics, Adeyemi College of Education, Ondo State, Nigeria.

²Department of Nutrition and Dietetics, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

³Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

⁴Department of Medicine, Kidney Care Centre, Ondo State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors CAO and IOO designed the study. Authors DAA and CAO performed the statistical analysis. Authors OMA and CAO wrote the protocol, and wrote the first draft of the manuscript. Author CAO collected data on-field. Authors CAO and IOO managed the analyses of the study. Authors AAA and CAO managed the literature searches and did the final editing of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims:

- (i) To determine the dietary pattern of the elderly in Ondo State, Nigeria;
- (ii) To determine the biochemical status of the respondents; and
- (iii) To determine the correlation between dietary pattern and blood levels of Vitamins A, C, D, E, calcium, phosphorus and selenium.

Study Design: A descriptive, cross-sectional study.

*Corresponding author: E-mail: ayoakinbodewa@yahoo.com;

Place and Duration of Study: Six Local Government Areas in Ondo State.

Methodology: Two hundred elderly men and two hundred elderly women were selected from six of the eighteen Local Government Areas (two from each of the three senatorial zones) in the State. Data was collected on dietary pattern and frequency of consumption of food items from the various food groups. We measured systolic and diastolic blood pressure of five randomly selected elderly patients attending the government hospital in each Local Government Area. Blood samples were obtained from the 30 elders and analyzed for Vitamins A, C, D, E, calcium, phosphorus and selenium contents. Food frequency scores were derived from consumption data and arranged into quartiles.

Results: Most of the subjects (77%) ate three meals daily. Animal proteins were consumed daily by 73.8% while 7.3% and 6.8% consumed vitamin A rich foods and dairy products respectively. Those with minimum of secondary education were 2.5 times (95% CI: 1.4 to 4.5) and 28.0 times (95% CI: 2.9 to 246.6) more likely to have upper half dietary pattern scores in fruits consumption and dairy products consumption.

Mean Selenium serum level was lower than normal in all elders while Vitamin E and Calcium serum levels were lower than normal in female elders only.

Conclusion: The elderly in Ondo State were of low nutrition and socio-economic status. It was suggested that health care institutions should promote dietary plans such as provision of vitamin and mineral supplements and education for them at the community level.

Keywords: Dietary pattern; nutritional status; biochemical status; elderly; Ondo State.

1. INTRODUCTION

Elderly population is increasing in all countries of the world and this is due to several factors which include decline in fertility, improvement in public health and increase in life expectancy [1]. Decline in fertility was brought about by more wide spread acceptability of family planning while increase in life expectancy is attributed to improved medical care brought about by technological advancement. According to a published US Bureau Bulletin of the Census and Database on Ageing in 2015, the world's total population is growing at a rate of 1.7% per year. The population aged 55 years and above is increasing by 2.2 percent per year; and the number of persons aged 65 years and over, is rising by 2.8% annually. The bulletin shows further that every month, the net balance of the World's population (55 years and over) increases by 1.2 million persons [1]. It is expected that this demographic pattern will continue.

The number of elderly people who are vulnerable in developing countries and Africa now approach and will exceed those in developed countries making the health and aging a global problem [2]. For instance, in 1995 the number of people aged 60+ years increased by more than 12 million people-nearly 80% of this increase took place in developing countries [2]. In Nigeria, the present population of elderly is over 5 million which is perhaps the largest concentration of elderly in Africa. As a result of projection in

Nigeria, the population of the elderly will be 16 million by 2030 and 47 million by year 2060 [3].

Ageing is an important issue in developed and developing countries. The unprecedented demographic trend which is being witnessed today shows a rapid increase in the older segment of the population in both absolute and relative terms. In other words, not only are there many more elderly people today than ever before, but the proportion of older people in the general population is rising. What is more disturbing is the fact that in a large number of developing countries, the population aged 60 years and over is increasing at a faster rate than the population as a whole. Thus, between 1980 and 2020, the total population of developing countries is expected to increase by 95% whereas the elderly population will probably rise by almost 240%. Not only is the aged population increasing in the developing world, but the elderly population is itself getting older, as more and more people survive longer [4]. It is projected that, by 2020, there will be one billion elderly persons (≥ 65 years) in the world, 71% of whom will live in low-income countries [5].

According to the United Nations, "an advanced age society" is one where the percentage of the population over 65 is higher than 7% [6]. A healthy and nutritious diet can prevent disease and improve health conditions leading to an improved quality of life for older people. Food faddism is one among many influencing factors on elderly food choices [7]. For older persons,

some dietary restrictions may be due to culture and some due to physiological states. There is much greater recognition today that people can help themselves and their families to reduce the risk of disease and maintain their health and well-being through a healthy lifestyle, including a healthy diet. There is ongoing support for the important role of foods such as fruit and vegetables and wholegrain cereals in disease prevention [8].

The increasing number of elderly people in industrial as well as developing countries makes the elderly population an especially interesting one. Possible changes in nutritional demands in old age due to altered physical activity; the ageing processes and the frequent occurrence of sickness make the elderly vulnerable to malnutrition [9].

In many developing countries including Nigeria, there is a dearth of information as well as epidemiological data on the dietary pattern and biochemical status. Studies on children particularly infants and preschool children appears to be more common than studies on the aged who are equally as vulnerable as young children to changes in social and economic conditions. Before this study there was no data on the dietary pattern and biochemical status among the elders in Ondo State. This study was carried out to fill this gap. It is expected that the study will further bridge the information gap and promote the care of the aged population. Specifically, the study determined the:

- (iv) Dietary pattern of the elderly in Ondo State, Nigeria;
- (v) The biochemical status of the respondents; and
- (vi) The correlation between dietary pattern and blood levels of Vitamins A, C, D, E, calcium, phosphorus and selenium.

2. METHODOLOGY

2.1 Design of the Study

This study employed descriptive survey research design. The descriptive survey research design involves the study of the large population by selecting a representative sample to discover relative incidence distribution and interrelations of variables. It involves the collection, organization and analysis and description of the variables as they exist in natural setting without interference. The result of the representative sample can be inferred or generalized [10].

2.2 Population of the Study

The study population was all elders in six local government areas in Ondo State. There are two hundred and one thousand and sixteen (201,016) elders (60 years and above) in Ondo State [3].

2.3 Sample and Sampling Technique

Yaro Yamane formula was used to determine the sample for the descriptive survey research [11]. Four hundred elders constituted the sample for the study.

2.4 Research Instrument

Open ended and structured questionnaire was used to collect data for this study. The questionnaire consisted of two sections: Section A consisted of items that sought information on demographic and socio-economic status of respondents while section B consisted of items that determined their meal pattern and food frequency. Four hundred copies of the questionnaires were self-administered through personal contact by the researcher and research assistants. Five research assistants assisted the researcher in data collection. The questionnaire was personally distributed to the literate respondents but filled for the non literate ones.

The questionnaire was validated by three experts in human nutrition. They were validated so that it was the right one for gathering data, measuring the variables; that the items covered the objectives of the study and removed (or reframed) ambiguous words that would have confused the respondents. Test re-test methods were used to determine the stability and consistency of the instrument. The validated questionnaire was administered and analyzed to ensure that elders understood the items in the questionnaire. Cronbach's coefficient alpha was 0.80.

2.5 Method of Data Collection

The validated questionnaires (four hundred) were administered through personal contact to the selected elders in the selected areas. 5 ml of blood each was taken from five elders selected in each of the six Specialists Hospitals in each of the six selected local government areas using sterile 5 ml needle and syringe into 5ml Ethylene Di-amine Tetra-acetic Acid (EDTA) bottles. The blood samples were gently shaken in the EDTA

bottles immediately after collection, wrapped in nylon papers and put in ice bucket before transferring to freezer and stored at -4°C prior to analysis. Blood samples were transported in ice buckets within 2 weeks of collection to Institute of Agriculture Research and Training (IAR & T), Ibadan where they were analyzed for Vitamins A, C, D, E, Calcium, Phosphorus and Selenium.

2.6 Method of Data Analysis

The data were analyzed using SPSS (Statistical Package for Social Sciences) version 17. Frequency counts and Percentage, Mean (\bar{X}), Standard Deviation (SD), Cross Tabulation, Chi square Statistics, Stepwise Binary and Multivariate logistic regression analysis, Pearson Test of Correlation, Odds Ratio and Confidence Interval, One Way Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) were used to analyse the data. Blood samples were analyzed for Vitamin A, C, D, E, Calcium and Selenium using Atomic Absorption Spectrophotometer. Samples were analyzed for inorganic phosphate in Serum using Colorimetric method.

3. RESULTS

Table 1 showed that there were more males (52.0%) than female (48.0%) elders. The highest

percentage of elders (49.5%) was from the 60-69 years age group. The least (21.5%) was from the 80years+ age group. 81.3% were married while 18.9% were widowed or separated. Most (83.3%) were Christians, 14.0% Muslims and 2.8% engaged in traditional religion.

Table 2 shows the dietary patterns of the elderly. Most of the elders (81%) ate three or more times per day. About 24% ate between meals, 21% skipped meals, 87% had favourite food and 39% avoid certain foods in all the zones with variations within each zone.

Table 3 shows that 76.8% earned less than N30,000 per month and 23.2% earned between N31,000 and N60,000 per month. About a third (31%) claimed that they had enough money to buy food, 69.0% said they did not have enough money to buy food. 48.8%, 41.4% and 9.8% rated themselves as low, moderate and high economically respectively. 76.5% coped by daily contributions, 23.5% by cooperative societies. 57.3%, 25% and 12.8%, responded that their immediate need was medical care, food and money respectively. 57% had no formal education, 22% had secondary education, 19.5% primary and 1.5% tertiary education. Highest percentage of respondents (54.0%) were farmers followed by petty/traders and civil servants (28.0% and 10.75% respectively).

Table 1. Demographic characteristics of the respondents

| Demographic characteristics variables | Ondo South Zone | | Ondo Central Zone | | Ondo North Zone | | Total | | P-value |
|---------------------------------------|-----------------|------|-------------------|------|-----------------|------|-------|------|---------------------|
| | N | % | N | % | N | % | N | % | |
| Gender | | | | | | | | | |
| Male | 76 | 53.1 | 67 | 49.3 | 65 | 53.7 | 208 | 52.0 | 0.731 ^{NS} |
| Female | 67 | 46.9 | 69 | 50.7 | 56 | 46.3 | 192 | 48.0 | |
| Total | 143 | 100 | 136 | 100 | 121 | 100 | 400 | 100 | |
| Age | | | | | | | | | |
| 60-69 years | 57 | 39.9 | 81 | 59.6 | 60 | 49.6 | 198 | 49.5 | 0.028* |
| 70-79 years | 49 | 34.3 | 32 | 23.5 | 35 | 28.9 | 116 | 29.0 | |
| 80 yrs + | 37 | 25.9 | 23 | 16.9 | 26 | 21.5 | 86 | 21.5 | |
| Total | 143 | 100 | 136 | 100 | 121 | 100 | 400 | 100 | |
| Marital status | | | | | | | | | |
| Married | 123 | 86.0 | 101 | 74.3 | 101 | 83.5 | 325 | 81.3 | 0.032* |
| Widowed/separated | 20 | 14.0 | 35 | 25.7 | 20 | 16.5 | 75 | 18.9 | |
| Total | 143 | 100 | 136 | 100 | 121 | 100 | 400 | 100 | |
| Religion | | | | | | | | | |
| Christianity | 127 | 88.8 | 113 | 83.1 | 93 | 76.9 | 333 | 83.3 | 0.002** |
| Islam | 8 | 5.6 | 22 | 16.2 | 26 | 21.5 | 56 | 14.0 | |
| Traditional | 8 | 5.6 | 1 | 7 | 2 | 1.7 | 11 | 2.8 | |
| Total | 143 | 100 | 136 | 100 | 121 | 100 | 400 | 100 | |

*significant at P<0.05, **significant at P<0.01, ^{NS}not significant

Table 2. Gender-based dietary pattern of the elderly living in the three senatorial zones of Ondo State

| No. of meals eaten per day | Total | | % | P-value |
|------------------------------|-------|--------|--------|---------------------|
| | Male | Female | | |
| Once | 6 | 6 | 3.00 | |
| Twice | 46 | 20 | 16.50 | |
| ≥ thrice | 159 | 165 | 81.00 | 0.009** |
| Total | 208 | 192 | 100.00 | |
| Ate-in-between meals | | | | |
| Yes | 44 | 50 | 23.50 | |
| No | 164 | 142 | 76.50 | 0.249 ^{NS} |
| Total | 208 | 192 | 100.00 | |
| Skipped meals | | | | |
| Yes | 49 | 35 | 21.00 | |
| No | 159 | 157 | 79.00 | 0.191 ^{NS} |
| Total | 208 | 192 | 100.00 | |
| Had favourite food | | | | |
| Yes | 190 | 158 | 87.00 | |
| No | 18 | 34 | 13.00 | 0.007** |
| Total | 208 | 192 | 100.00 | |
| Avoided certain foods | | | | |
| Yes | 77 | 79 | 39.00 | |
| No | 131 | 113 | 61.00 | 0.34 ^{NS} |
| >7 hours | 19 | 13 | 8.00 | |
| Total | 208 | 192 | 100.00 | |

*significant at $P<0.05$, **significant at $P<0.01$, ^{NS} Not significant

Table 3. Socio-economic characteristics of the respondents

| Socio economic variables | Ondo South Zone | | Ondo Central Zone | | Ondo North Zone | | Total | | P-value |
|----------------------------------|-----------------|-------|-------------------|-------|-----------------|-------|-------|--------|---------------------|
| | N | % | N | % | N | % | N | % | |
| Income per month | | | | | | | | | |
| < N30,000 | 116 | 81.1 | 114 | 83.8 | 77 | 63.6 | 307 | 76.8 | |
| N31,000 – N60,000 | 27 | 18.9 | 22 | 16.2 | 44 | 36.4 | 93 | 23.2 | 0.005** |
| Total | 143 | 100.0 | 136 | 100.0 | 121 | 100.0 | 400 | 100.00 | |
| Enough money to buy food? | | | | | | | | | |
| Yes | 43 | 30.1 | 60 | 44.1 | 21 | 17.4 | 124 | 31.0 | 0.001** |
| No | 100 | 69.9 | 76 | 55.9 | 100 | 82.6 | 276 | 69.0 | |
| Total | 143 | 100.0 | 136 | 100.0 | 121 | 100.0 | 400 | 100.0 | |
| **Economic rating | | | | | | | | | |
| High | 4 | 2.8 | 26 | 19.1 | 9 | 7.4 | 39 | 9.8 | |
| Moderate | 45 | 31.5 | 67 | 49.3 | 54 | 44.6 | 166 | 41.4 | 0.002** |
| Low | 94 | 65.7 | 43 | 31.6 | 58 | 47.9 | 195 | 48.8 | |
| Total | 143 | 100.0 | 136 | 100.0 | 121 | 100.0 | 400 | 100.0 | |
| Coping strategy | | | | | | | | | |
| Cooperative societies | 27 | 18.9 | 38 | 27.9 | 29 | 24.0 | 94 | 23.5 | |
| Daily contributions | 116 | 81.1 | 98 | 72.1 | 92 | 76.0 | 306 | 76.5 | 0.202 ^{NS} |
| Total | 143 | 100.0 | 136 | 100.0 | 121 | 100.0 | 400 | 100.0 | |

**Economic rating: Respondents rated themselves economically compared to others

* Significant at $P<0.05$; ** Significant at $P<0.01$; NS: Not significant

Table 4 shows the dietary pattern of the respondents. Daily consumption of all nutrients except animal protein (73.8%) was generally low 34.3%, 9.8%, 11.3%, 17.8%, 6.8%, 15.8% and 7.3% consumed tubers, legumes, cereals, fruits, dairy, green vegetables and vitamin A rich food daily respectively.

Table 5 shows that male elderly were in stage 1 hypertension group while the females were in pre hypertension stage according to National Heart, Lung and Blood Institute (US) [12].

Table 6 shows that females were 2.5 times (95% CI: 0.94 to 3.5) more likely to consume cereals than males.

Table 7 shows that those with secondary/tertiary education compared with no formal education were 2.5(95% CI: 1.4 to 4.5) times more likely to have upper half dietary pattern scores in fruit consumption. Farmers compared with civil servants were 0.5(95% CI: .28 to 1.2) times more likely to have upper dietary pattern scores in fruit consumption. Artisans compared with civil servants were 1.1(95% CI: .22 to 6.1) times more likely to have upper dietary pattern scores in fruit consumption. This means they were likely to consume fruits as much as those who were civil servants, indicating there was no difference in the fruit consumption pattern between the two categories of occupation. Primary education compared with no formal education were 2.3 (95% CI: 1.2 to 4.4) times more likely to upper dietary pattern scores in dairy products consumption, while those who had higher education (secondary and tertiary education levels) were 28.0 (95% CI: 2.9 to 246.6) times more likely to have upper dietary pattern scores in dairy products consumption.

Table 8 shows that there is a statistically significant negative correlation between phosphorus (P) and cereals consumption ($r = -0.43$; $p < 0.05$) and also between vitamin C level and cereals consumption ($r = -0.36$; $p < 0.05$) of the elderly. This indicates that as consumption of cereals increases, the levels of phosphorus (P) and vitamin C decrease.

Table 9 shows that there is a statistically significant positive correlation between the levels of selenium in the elderly and their consumption of fruits ($r = 0.42$; $p < 0.05$).

4. DISCUSSION

This research work has provided an overview of the demographic/socioeconomic characteristics,

dietary pattern and biochemical status of respondents aged greater than or equal to 60 years in Ondo State.

Male gender was predominant among the elderly in Ondo State. The peculiarity of our finding may be related to variations in environmental and social factors such as human migration and adaptability to the ageing process among others.

Our study revealed that most of the subjects were married. This finding is similar to results of other studies in Nigeria where two-thirds of all persons aged 60 years and above are currently married with the percentage decreasing with age [13]. The incidence of widowhood increases with age, with women being more likely to be widowed than men [3].

More than three quarters of respondents of this study ate three or more meals per day and had favourite foods. Olasunbo and Ayo reported that two thirds and almost all their respondents ate three meals per day and had favourite foods respectively [14].

Very few elders in this study ate between meals and avoided certain foods. The major foods avoided were 'garri' (cassava) cooked yam or flour, rice, okro soup, beans and 'fufu' (cassava flour product). In their study of the pattern of dietary carbohydrate intake among urbanized adult Nigerians, Akarolo-Anthony et al. [15] discovered that the main carbohydrate food eaten was rice (48.6%) followed by 'fufu' (30.5%) and bread (13.1%). Afolabi et al. [13] reported that the elders in their study ate three meals per day; snacks or between meals were not common. Two thirds of respondents (63%) in Olasunbo and Ayo study also ate thrice daily, 35% skipped meals, 19% drank alcohol and 4.5% were smokers [14]. In this study 21% skipped meals, 26% drank alcohol and 3% were smokers.

Despite the fact that elders in this study claimed that they consumed three or more meals per day, daily consumption of all nutrients except animal protein was generally low. These individuals had diets high in animal protein, moderate in tubers, legumes, cereals and green vegetables but low in fruits, dairy and vitamin A rich food. These findings indicate that education, occupation and health play significant roles in dietary patterns. A positive correlation between food habit scores and educational level has been observed among elderly Yorubas [16]. Food habits have been found to predict health and nutritional status [17].

Table 4. Dietary pattern of respondents in Ondo State

| Levels | LGA | | | | | | | | | | | | Total | | |
|----------------|---------------------|----|-------------|----|----------|----|-------|----|------|----|--------|----|-------|-----|------|
| | Ondo West | | Akure North | | Akoko SW | | Irele | | Owo | | Odigbo | | F | % | |
| | F | % | F | % | F | % | F | % | F | % | F | % | | | |
| Animal protein | Once/day | 88 | 22 | 37 | 9.3 | 40 | 10 | 53 | 13.3 | 13 | 3.3 | 64 | 16 | 295 | 73.8 |
| | 1-3 times/week | 2 | 0.5 | 5 | 1.3 | 11 | 2.8 | 1 | 0.3 | 47 | 11.8 | 16 | 4 | 82 | 20.5 |
| | 4-6 times/week | 4 | 1.0 | 0 | 0.0 | 6 | 1.5 | 0 | 0 | 0 | 0 | 9 | 2.3 | 19 | 4.8 |
| | <once/week or never | 0 | 0.0 | 0 | 0.0 | 3 | 0.8 | 0 | 0 | 1 | 0.3 | 0 | 0 | 4 | 1 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |
| Tuber | Once/day | 29 | 7.3 | 18 | 4.5 | 18 | 4.5 | 39 | 9.8 | 13 | 3.3 | 20 | 5 | 137 | 34.3 |
| | 1-3 times/week | 27 | 6.8 | 18 | 4.5 | 29 | 7.3 | 14 | 3.5 | 43 | 10.8 | 53 | 13.3 | 184 | 46 |
| | 4-6 times/week | 38 | 9.5 | 1 | 0.3 | 11 | 2.8 | 1 | 0.3 | 2 | 0.5 | 15 | 3.8 | 68 | 17 |
| | <once/week or never | 0 | 0.0 | 5 | 1.3 | 2 | 0.5 | 0 | 0 | 3 | 0.8 | 1 | 0.3 | 11 | 2.8 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |
| Legumes | Once/day | 10 | 2.5 | 11 | 2.8 | 9 | 2.3 | 1 | 0.3 | 1 | 0.3 | 7 | 1.8 | 39 | 9.8 |
| | 1-3 times/week | 53 | 13.3 | 23 | 5.8 | 40 | 10 | 33 | 8.3 | 40 | 10 | 57 | 14.3 | 246 | 61.5 |
| | 4-6 times/week | 24 | 6.0 | 2 | 0.5 | 9 | 2.3 | 17 | 4.3 | 2 | 0.5 | 15 | 3.8 | 69 | 17.3 |
| | <once/week or never | 7 | 1.8 | 6 | 1.5 | 2 | 0.5 | 3 | 0.8 | 18 | 4.5 | 10 | 2.5 | 46 | 11.5 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |
| Cereals | Once/day | 11 | 2.8 | 11 | 2.8 | 16 | 4 | 1 | 0.3 | 3 | 0.8 | 3 | 0.8 | 45 | 11.3 |
| | 1-3 times/week | 49 | 12.3 | 16 | 4.0 | 27 | 6.8 | 37 | 9.3 | 30 | 7.5 | 52 | 13 | 211 | 52.8 |
| | 4-6 times/week | 31 | 7.8 | 7 | 1.8 | 10 | 2.5 | 12 | 3 | 7 | 1.8 | 21 | 5.3 | 88 | 22 |
| | <once/week or never | 3 | 0.8 | 8 | 2.0 | 7 | 1.8 | 4 | 1 | 21 | 5.3 | 13 | 3.3 | 56 | 14 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |
| Fruit | Once/day | 13 | 3.3 | 13 | 3.3 | 15 | 3.8 | 3 | 0.8 | 2 | 0.5 | 25 | 6.3 | 71 | 17.8 |
| | 1-3 times/week | 51 | 12.8 | 14 | 3.5 | 20 | 5 | 25 | 6.3 | 13 | 3.3 | 30 | 7.5 | 153 | 38.3 |
| | 4-6 times/week | 10 | 2.5 | 5 | 1.3 | 12 | 3 | 19 | 4.8 | 5 | 1.3 | 28 | 7 | 79 | 19.8 |
| | <once/week or never | 20 | 5.0 | 10 | 2.5 | 13 | 3.3 | 7 | 1.8 | 41 | 10.3 | 6 | 1.5 | 97 | 24.3 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |
| Dairy | Once/day | 6 | 1.5 | 9 | 9.5 | 7 | 1.8 | 0 | 0 | 2 | 0.5 | 3 | 0.8 | 27 | 6.8 |
| | 1-3 times/week | 38 | 4.8 | 15 | 3.8 | 22 | 5.5 | 12 | 3 | 11 | 2.8 | 21 | 5.3 | 119 | 29.8 |
| | 4-6 times/week | 19 | 4.8 | 7 | 1.8 | 7 | 1.8 | 17 | 4.3 | 2 | 0.5 | 13 | 3.3 | 65 | 16.3 |
| | <once/week or never | 31 | 7.8 | 11 | 2.8 | 24 | 6 | 25 | 6.3 | 46 | 11.5 | 52 | 13 | 189 | 47.3 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |

| Levels | LGA | | | | | | | | | | | | Total | | |
|----------------------|---------------------|----|-------------|----|----------|----|-------|----|------|----|--------|----|-------|-----|------|
| | Ondo West | | Akure North | | Akoko SW | | Irele | | Owo | | Odigbo | | F | % | |
| | F | % | F | % | F | % | F | % | F | % | F | % | | | |
| Green vegetable | Once/day | 7 | 1.8 | 16 | 4 | 17 | 4.3 | 12 | 3 | 4 | 1 | 7 | 1.8 | 63 | 15.8 |
| | 1-3 times/week | 49 | 12.3 | 18 | 4.5 | 20 | 5 | 30 | 7.5 | 14 | 3.5 | 59 | 14.8 | 190 | 47.5 |
| | 4-6 times/week | 30 | 7.5 | 4 | 1 | 15 | 3.8 | 1 | 2.8 | 2 | 0.5 | 21 | 5.3 | 83 | 20.8 |
| | <once/week or never | 8 | 2 | 4 | 1 | 8 | 2 | 1 | 0.3 | 41 | 10.3 | 2 | 0.5 | 64 | 16 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |
| Vitamin A rich foods | Once/day | 4 | 1 | 9 | 2.3 | 10 | 2.5 | 0 | 0 | 3 | 0.8 | 3 | 0.8 | 29 | 7.3 |
| | 1-3 times/week | 13 | 3.3 | 13 | 3.3 | 11 | 2.8 | 13 | 3.3 | 7 | 1.8 | 13 | 3.3 | 70 | 17.5 |
| | 4-6 times/week | 5 | 1.3 | 5 | 1.3 | 9 | 2.3 | 8 | 2 | 2 | 0.5 | 29 | 7.3 | 58 | 14.5 |
| | <once/week or never | 72 | 18 | 15 | 3.8 | 30 | 7.5 | 33 | 8.3 | 49 | 12.3 | 44 | 11 | 243 | 60.8 |
| | Total | 94 | 23.5 | 42 | 10.5 | 60 | 15 | 54 | 13.5 | 61 | 15.3 | 89 | 22.3 | 400 | 100 |

Table 5. Blood pressure of the elderly in Ondo State

| Blood pressure variables | Male (n=15) | Min | Max | Female (n=15) | Min | Max | t-value | p-value |
|--------------------------|--------------|--------|--------|---------------|--------|--------|---------|---------------------|
| | Mean ± SD | | | Mean ± SD | | | | |
| Systolic (mmHg) | 157.33±31.04 | 120.00 | 210.00 | 136.00±21.65 | 100.00 | 170.00 | 2.183 | 0.038* |
| Diastolic (mmHg) | 85.53±17.05 | 70.00 | 120.00 | 80.00±16.04 | 60.00 | 100.00 | 0.916 | 0.368 ^{NS} |

* = significant ($p < 0.05$)

NS = Non significant

Table 6. Correlations between dietary patterns and demographic characteristics of respondents living in the in Ondo State (N = 400)

| Variables | Animal protein | Tubers | Legumes | Cereals | Fruits | Dairy products | Green vegetables | Vitamins |
|-----------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|-----------------------|-------------------------|--------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Age | | | | | | | | |
| 60-69 yrs § | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 70-79 yrs | 1.3(0.74-2.3) | 0.90(0.55-1.5) | 0.6(0.29-1.3) | 0.8(0.49-1.4) | 0.8(0.48-1.4) | 1.1(0.59-1.9) | 1.1(0.66-1.8) | 1.1(0.53-2.1) |
| 80 yrs + | 1.4(0.73-2.7) | 1.1(0.63-2.0) | 0.9(0.36-2.4) | 1.0(0.54-1.8) | 1.0(0.56-1.9) | 1.2(0.60-2.4) | 2.6(0.92-5.4) | 1.0(0.43-2.3) |
| p-value | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 |
| Gender | | | | | | | | |
| Male§ | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Female | 1.4(0.82-2.5) | 0.63(0.39-1.0) | 1.1(0.54-2.4) | 2.5(0.94-3.5)* | 1.1(0.65-1.7) | 0.9(0.53-1.7) | 1.1(0.65-1.7) | 1.6(0.85-3.2) |
| p-value | >0.05 | >0.05 | >0.05 | < 0.05 | >0.05 | >0.05 | >0.05 | >0.05 |
| Marital status | | | | | | | | |
| Married§ | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Widowed/Separated | 0.6(0.33-1.1) | 1.1(0.61-1.9) | 1.4(0.54-3.5) | 0.9(0.50-1.6) | 1.2(0.67-2.2) | 1.7(0.89-3.3) | 0.9(0.55-1.7) | 0.7(0.33-1.59) |
| p-value | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 |
| Religion | | | | | | | | |
| Christianity§ | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Islamic | 0.7(0.39-1.3) | 0.68(0.39-1.2) | | 0.9(0.53-1.7) | 1.4(0.80-2.5) | 0.9(0.46-1.7) | 0.82(0.46-1.5) | 0.9(0.42-2.1) |
| p-value | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 | >0.05 |

* $P < 0.05$ §Reference variable. OR = Odds ratio, CI = Confidence interval

Table 7. Correlation between dietary patterns and educational status and occupation of Respondents living in Ondo State (N = 400)

| Variables | Animal protein | Tubers | Legumes | Cereals | Fruits | Dairy products | Green vegetables | Vitamins |
|------------------------------|-----------------------|--------------------|--------------------|--------------------|--------------------|-----------------------|-------------------------|--------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Educational level | | | | | | | | |
| No formal education | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Primary education | 1.50(0.78-2.9) | 1.0(0.58-1.8) | 0.6(.02-1.4) | 0.7(0.36-1.2) | 1.4(0.79-2.6) | 2.3(1.2-4.4)* | 0.9(0.55-1.8) | 0.9(0.41-2.1) |
| Secondary/tertiary education | 1.478 | 0.91(.051-1.6) | 1.6(0.60-4.5) | 1.4(0.77-2.5) | 2.5(1.4-4.5)* | 28.0(2.9-246.6)* | 1.1(0.64-2.0) | 1.5(0.72-3.3) |
| p-value | >0.05 | >0.05 | >0.05 | >0.05 | <0.05 | <0.05 | >0.05 | >0.05 |
| Present occupation | | | | | | | | |
| Civil servant | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Trading | 1.0(0.43-2.3) | 1.4(0.64-2.9) | 0.7(0.18-2.9) | 1.2(.057-2.5) | 0.4(0.21-97) | 1.7(0.65-4.5) | 0.9(0.41-2.1) | 0.79(0.26-2.3) |
| Farming | 4.3E+09(.00, .) | 2.2(1.0-4.6) | 0.7(0.19-2.6) | 1.0(0.17-6.4) | 0.5(0.28-1.2)* | 2.1(0.86-5.2) | 1.6(0.78-3.5) | 0.9(0.32-2.6) |
| Artisan | 0.89(0.25- 3.2) | 0.55(0.09-3.2) | 1.5E+08(.00, .) | 0.4(0.11-1.5) | 1.1(0.22-6.1)* | 1.1(0.10-11.4) | 0.8(0.14-5.1) | 7.6(0.96-60.3) |
| p-value | >0.05 | >0.05 | >0.05 | >0.05 | <0.05 | >0.05 | >0.05 | >0.05 |

* $P < 0.05$ § Reference variable. OR = Odds ratio, CI = Confidence interval

Table 8. Correlation coefficients between dietary pattern score of animal protein, tubers, legumes and cereals and blood nutrient levels of the elderly in Ondo State

| Variable | N | Mean (± SD) | Animal protein | | Tubers | | Legumes | | Cereals | |
|-----------------------|----|---------------|----------------|---------|--------|---------|---------|---------|---------|---------|
| | | | r | P-value | r | P-value | r | P-value | r | P-value |
| Calcium (mg/dl) | 30 | 8.40±0.96 | 0.06 | 0.73 | -0.18 | 0.34 | -0.14 | 0.45 | -0.22 | 0.25 |
| Phosphorus (mg/dl) | 30 | 3.30±0.55 | 0.03 | 0.87 | -0.21 | 0.26 | -0.1 | 0.62 | -0.43 | 0.02* |
| Selenium (mg/dl) | 30 | 1.02±0.41 | 0.04 | 0.84 | -0.14 | 0.47 | -0.04 | 0.83 | -0.17 | 0.38 |
| Vitamin C (mg/100 ml) | 30 | 816.33±137.50 | 0.24 | 0.21 | -0.19 | 0.31 | -0.1 | 0.62 | -0.36 | 0.05* |
| Vitamin A (mg/100 ml) | 30 | 55.38±3.31 | 0.34 | 0.07 | 0.12 | 0.52 | -0.16 | 0.4 | -0.12 | 0.54 |
| Vitamin D (mg/100 ml) | 30 | 4.41±0.59 | 0.12 | 0.52 | -0.06 | 0.28 | -0.25 | 0.18 | -0.12 | 0.53 |
| Vitamin E (mg/100 ml) | 30 | 8.59±1.08 | 0.09 | 0.64 | -0.26 | 0.16 | -0.06 | 0.74 | -0.36 | 0.05 |

r correlation coefficient

** highly significant at P<0.05 level (2-tailed)*

Table 9. Correlation coefficients between dietary pattern score of fruits, dairy products, green vegetables, vitamins and blood nutrient levels of the elderly in Ondo State

| Variable | N | Mean (± SD) | Fruits | | Dairy products | | Green vegetables | | Vitamin A rich foods | |
|-----------------------|----|--------------|--------|---------|----------------|---------|------------------|---------|----------------------|---------|
| | | | r | P-value | r | P-value | r | P-value | r | P-value |
| Calcium (mg/dl) | 30 | 8.40±0.96 | -0.1 | 0.6 | -0.14 | 0.46 | 0.03 | 0.86 | -0.14 | 0.47 |
| Phosphorus (mg/dl) | 30 | 3.30±0.55 | -0.04 | 0.84 | -0.19 | 0.32 | -0.03 | 0.87 | -0.17 | 0.38 |
| Selenium (mg/dl) | 30 | 1.02±0.41 | 0.42 | 0.02* | -0.09 | 0.64 | 0.26 | 0.17 | 0.16 | 0.39 |
| Vitamin C (mg/100 ml) | 30 | 816.33±37.50 | 0.08 | 0.66 | -0.16 | 0.39 | -0.09 | 0.65 | 0.02 | 0.91 |
| Vitamin A (mg/100 ml) | 30 | 55.38±3.31 | 0.23 | 0.23 | 0.17 | 0.37 | 0.13 | 0.48 | -0.03 | 0.89 |
| Vitamin D (mg/100 ml) | 30 | 4.41±0.59 | -0.05 | 0.81 | -0.07 | 0.71 | -0.08 | 0.69 | -0.04 | 0.83 |
| Vitamin E (mg/100 ml) | 30 | 8.59±0.8 | 0.02 | 0.90 | -0.1 | 0.60 | -0.15 | 0.42 | -0.18 | 0.34 |

r correlation coefficient

** highly significant at P<0.05 level (2-tailed)*

Dietary diversity is crucial to the adequacy of certain nutrients in the elderly. In Nigeria, the most available foods are tubers, cereals and legume seeds especially cowpea. It is not unexpected for the elderly to consume cereals and tuber based diet [18]. Although, this diet may not be adequate in micronutrient and that means that the elderly should still continue to take vitamin and mineral supplement. Furthermore, the Nigeria food based dietary recommends that

elderly eat diets that are prepared from a variety of available foods e.g. cereals, tubers, fruits, vegetables, etc; increase consumption of fish and fish-based diets; eat more of fruits and vegetables and eat more frequently. The food habits and dietary pattern observed in Nigeria were similar to those elsewhere in the Africa, as well as in developed countries of elderly subjects in Europe [19].

Low serum calcium level was observed in female elders. This may be due to poor dietary intake of micronutrients. This result is significant because normal serum calcium is critical for normal cell function, neural transmission, membrane stability, bone structure, blood coagulation, and intracellular signaling, especially in the elderly. Elders with low calcium have been found to develop has been linked to sudden cardiac failure in the elderly [20]. Calcium in the presence of vitamin D is known to marginally reduce the risk of total fracture [21]. The Food and Agricultural Organization/World Health Organization Joint Committee recommended that adults and elderly people maintain adequate intakes of minerals [22].

The low intake of vitamin E, calcium and selenium is not limited to elderly Yoruba people, but also found in the elderly from other countries [23]. In the study by Olayiwola *et al.* majority of foods consumed by the elderly were from plants whose micronutrients can be hindered by the presence of phytates, oxalates and method of food preparation (nutrient-nutrient interactions) [24-28]. Other factors that influence the biochemical status of elderly people include food intake, economic situation and health status [24]. Food intake reflects variables that directly affect food preparation, such as regularity of cooking and the availability of fuel and cooking equipments.

To overcome the poor availability of micronutrients, elderly people may have to diversify their diet and take supplements. The results of the present study show that elderly Yoruba people appeared quite malnourished, particularly with regard to their serum selenium, Vitamin E and calcium levels. Our subjects have a less favourable micronutrient status compared to their counterparts in developed countries [27].

5. CONCLUSION

Elders 60 years and above in Ondo State are of low socio-economic status, highly vulnerable and had no formal education. Daily consumption of all nutrients except animal protein was generally low. Their dietary pattern was significantly associated with education level, occupation and gender.

6. RECOMMENDATIONS

Based on the findings of this study, it is recommended that;

- i. Public health intervention programs and health care institutions should promote dietary plans at the community level.
- ii. Dietary patterns may be improved by increasing the economic level of these subjects either by increasing their income or by direct food distribution; provision of vitamin and mineral supplements at the community level.
- iii. Government should organize nutrition education workshops and seminars for elders to encourage consumption of cheap locally available nutritious foods. They should follow a dietary pattern relatively high in vegetables, fruits, whole grains, low fat, dairy products, poultry and fish which are associated with superior nutritional status, quality of life and survival in adults. They are to be advised not to put on too much weight to prevent occurrence of hypertension and diabetes.
- iv. Free medical services should be organized for elders so that they can have free access to their anthropometric and biochemical measurement. Health talks and seminars should emphasize importance of physical activities and consumption of cheap, local foods rich in Vitamins E, Calcium, and Selenium.
- v. The eventual consequences of Vitamin E, Calcium and Selenium deficiencies should be investigated further. There is clearly a need for specific intervention programmes for the elderly in Ondo State to improve their nutritional status through dietary diversification and good food preparation practices.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this paper and accompanying images'.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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