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Lipid Profiles of Urban and Rural Dwellers in Bayelsa State, Nigeria

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Abstract:

This study was carried out on residents of Yenagoa and the following fishing communities Biseni (Yenagoa L.G.A), Okpoma (Brass L.G.A) and Nembe (Nembe L.G.A) as well as residents of farming communities: Kolo, Emeyal, and Otuasega all in Ogbia Local Government area of Bayelsa state. esults of total cholesterol (TC), HDL cholesterol (HDL-C), LDL cholesterol (LDL-C) and triglyceride (TG) concentrations were obtained from 168 subjects, resident in Yenagoa, 147 subjects resident in fishing settlements and 146 residents in farming settlements. Results showed that highest levels of total cholesterol and LDL cholesterol were measured in residents in Yenagoa (urban dwellers) while least values of the two parameters were measured in residents of the fishing communities. The observed differences were significant at $p < 0.05$. The mean HDL-C concentration was highest in people living in fishing communities while least values were recorded in urban dwellers. The observed difference was equally statistically significant. Residents in farming communities had the highest TG levels while fishing residents had the least values. ANOVA showed that the differences in TG levels were significant among urban and fishing residents as well as among farming and fishing residents. ($p < 0.05$). The findings of this study suggest that the probability of occurrence of ischemic heart disease (IHD) might be higher among urban residents in Yenagoa. It also shows that the probability of occurrence of IHD might be lower in residents in fishing and farming communities as they had lower total cholesterol and LDL-C levels but higher HDL-C levels.

Keywords: Ischemic Heart Disease, Total Cholesterol, High Density Lipoprotein Cholesterol, Low Density Lipoprotein Cholesterol, Triglyceride

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I. INTRODUCTION

The city of Yenagoa has been undergoing serious urbanization after it was made a state capital on the 1st of October, 1996. This has resulted in a shift in the life style and feeding habits of the inhabitants as the available lands for farming, ponds and lakes for fishing have been utilized for residential buildings and offices. Also, the activities of oil exploration have equally undermined the availability of fish for consumption, as a result of pollution of the environment [1].

Urbanization tends to increase the propensity to consume commercially prepared foods containing higher amounts to trans and saturated fats which cause elevated triglyceride level and hypercholesterolemia with a raised LDL-C fraction

and a lowered HDL-C fraction [2]. This is therefore a high predisposing factor to coronary heart disease. The predominant occupational activities in the state are farming and fishing and over 80 percent of the labour force depend on these for their livelihood. The economic activities in a particular location are functions of its ecology. Thus, inhabitants within the riverine areas and islands are mostly fishermen and their diets consist mainly of fish. On the other hand, inhabitants in the upland regions being mainly farmers have their diets consisting mainly of produce from the farm.

Yenagoa is the capital city of Bayelsa State. As is typical of most developing cities, inhabitants of Yenagoa are mainly public servants, businessmen and traders. The levels of farming and fishing activities in the state capital are very low.

High triglyceride levels alone or in combination with high LDL-C levels and low HDL-C levels are indeed potent risk factors for heart disease [3]. Research has shown that a high ratio of triglyceride to HDL cholesterol is a more potent risk factor for cardio-vascular disease especially in women than is a high LDL-C to HDL-C ratio [4].

A combination of high triglyceride levels with a high LDL level and LDL-C: HDL-C ratio greater than 5 has been found to increase the risk by a factor of 6. Also, a 1.0mmol/l (88mg/dl) increase in triglyceride levels increased the risk of CVD in men by 30% and 75% in women [5]. Of particular interest is the finding that a high ratio of triglyceride to HDL cholesterol is a powerful risk factor for a major cardiac event even when LDL-C levels are normal [3].

Fish and fish oils contain long-chain polyunsaturated omega-3 fatty acids, more specifically, eicosapentaenoic acid (EPA) and decosahexaenoic acid (DHA). Fish oils are known to be effective in lowering cholesterol and triglyceride levels but concern has been expressed that they may also increase LDL-C levels. A study of fish oil supplementation in diet has indicated a small increase in the LDL-C level, but this was compensated for by a similar increase in the HDL-C level so that the important LDL-C/HDL-C ratio remained unchanged [6].

Based on these facts, it is expected that inhabitants in fishing settlements should have good levels of triglyceride and HDL-C, and consequently good LDL-C/HDL-C as well as HDL-C/TG ratios. This would equally mean a low risk to cardio-vascular diseases. On the other hand, owing to urbanization resulting in reduction in fish consumption and increased consumption of commercially prepared foods containing higher amount of trans-fats and saturated fats, it becomes expedient to evaluate and compare total cholesterol, triglycerides, HDL-C and LDL-C levels in these three study groups:

-Residents in fishing settlements due to fish consumption are expected to have good TG/HDL-C and LDL-C/HDL-C ratios.

-Residents in Yenagoa town due to urbanization may be prone to consuming commercially prepared foods containing high levels of saturated and trans-fats. Trans- fats are known to cause hypercholesterolemia with a raised LDL-C fraction and a lowered HDL-C fraction [2]

-Inhabitants in farming settlements whose diets consist of lesser amounts of fish and also lesser amounts of commercially processed foods.

II. METHODOLOGY

Study Area

1. Residents of Yenagoa
2. Residents of fishing communities (Biseni, Okpoma and Nembe).
3. Residents of farming communities (Kolo, Emeyal and Otuasega)

Sample Collection

Blood samples (3-5ml) were collected into plain dry glass containers.

Sample Handling

The various analytes (triglyceride, total cholesterol, LDL-C and HDL-C) are all stable in whole blood at room temperature for up to 12 hours. They are however stable in serum for up to 72 hours when stored between 2-80C. Thus, after blood samples were collected the serum were separated from the clot by centrifugation and transferred into vials, then stored at 2-80C where analysis could not be carried out promptly.

Total Cholesterol

Total serum cholesterol was assayed using the Randox enzymatic end-point method

High Density Lipoprotein (HDL) Cholesterol

The Randox precipitation method using phosphotungstic acid was used for HDL-C assay.

Low Density Liprotein (LDL) Cholesterol

Randox precipitation method was used

Triglyceride

Triglyceride was measured using the Randox Glycero 1-3- phosphate oxidase-peroxidase aminophenazone method.

Statistical Analysis

Statistical analysis was performed using the computer software Microsoft Office Excel 2015. Computed descriptive statistics included means , ANOVA Z- test analysis. Results were considered to be statistically significant when the P value was less than 0.05 ($P < 0.05$).

III. RESULTS

Figure 1 shows demographic distribution of the study population. The chart shows that 91 (54.17%) of the 168 urban residents were males with a mean age of 51.93 ± 15.23 years while 77 (45.83%) were females with a mean age of 42.87 ± 14.28 years. Out of the 147 participants in fishing communities, 84 (45.83%) were males having a mean age of 47.14 ± 11.86 years while 63 (42.86%) were females with a mean age of 45.86 ± 12.23 years. In the farming communities, 75 (51.37%) of the 146 participants were males with a mean age of 48.44 ± 16.20 years. On the other hand, 71 (48.63%) made up the female population with a mean age of 44.54 ± 13.36 years.

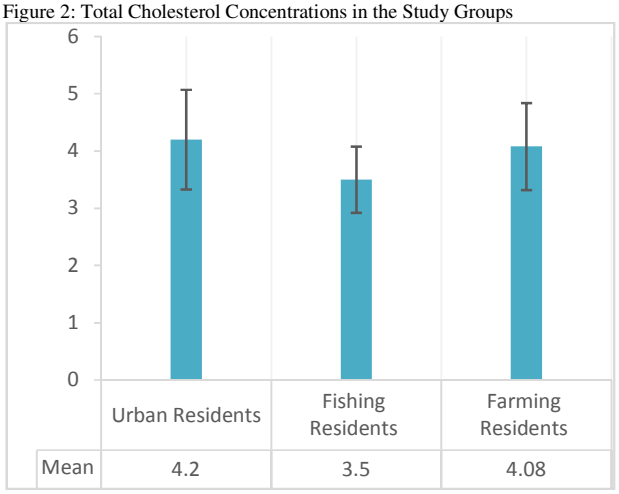
Figure 1: Population of the Study Groups

Total Cholesterol Concentrations in the Study Groups

Figure 2 shows total cholesterol concentrations in the various study groups. Highest mean level of 4.20 ± 0.87mmol/l was measured among urban residents while least mean value (3.50 ± 0.58mmol/l) was observed among residents in fishing settlements. Total Cholesterol concentrations (4.08 ± 0.76mmol/l) in farming settlements were slightly lower than the values recorded in urban residents. ANOVA of the means of the three groups showed that the differences in total cholesterol levels in urban residents and fishing residents were significant ($p<0.05$). There was equally a significant difference between fishing residents and farming residents. However, no

significant difference was observed between urban residents and farming residents.

Figure 2: Total Cholesterol Concentrations in the Study Groups



Effect of Gender on Total Cholesterol Concentrations

The effect of gender on total cholesterol concentrations is presented in table 4.3.It shows that females resident in farming settlements (4.09 ± 0.67mmol/l) had higher total cholesterol levels than males. Males in the urban area (4.41 ± 0.81mmol/l) and those in fishing settlements (3.60 ± 0.53mmol/l) had higher levels than females respectively.Comparison of these means showed a statistically significant difference between males and females in fishing settlements only ($p<0.05$). The gender induced differences in total cholesterol concentrations in the other groups were not statistically significant.

Figure 3: Total cholesterol concentrations in Males and Females.

Effect of Age on Total Cholesterol Concentrations

The effect of age on total cholesterol concentrations is presented in figure 4. It shows that urban residents between 41- 60 years (4.32 ± 0.43mmol/l) had the highest mean total cholesterol levels. This value is slightly higher than those recorded among farming residents 61- 80 years (4.30 ± 0.77mmol/l). The least mean value of 3.22 ± 0.31mmol/l was recorded among fishing residents ≤ 20 years. Comparison of these means showed significant differences among residents in fishing settlements and residents in farming settlements ≤ 20 years at $p < 0.05$.

Figure 4: Total Cholesterol Concentrations in the Various Age Groups

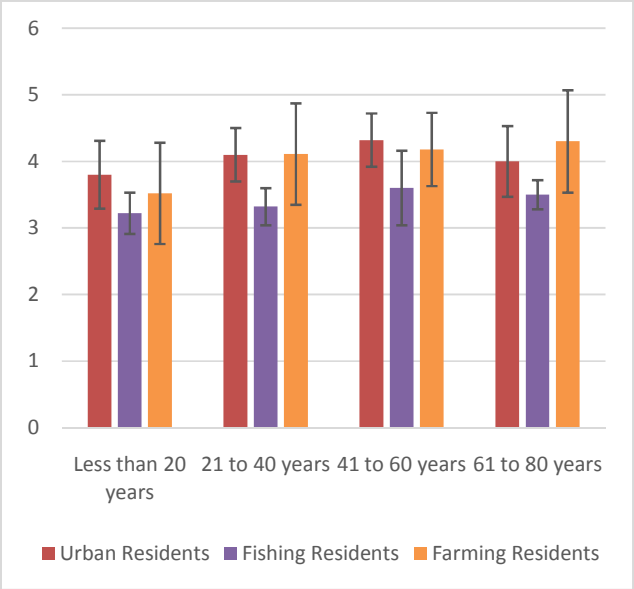
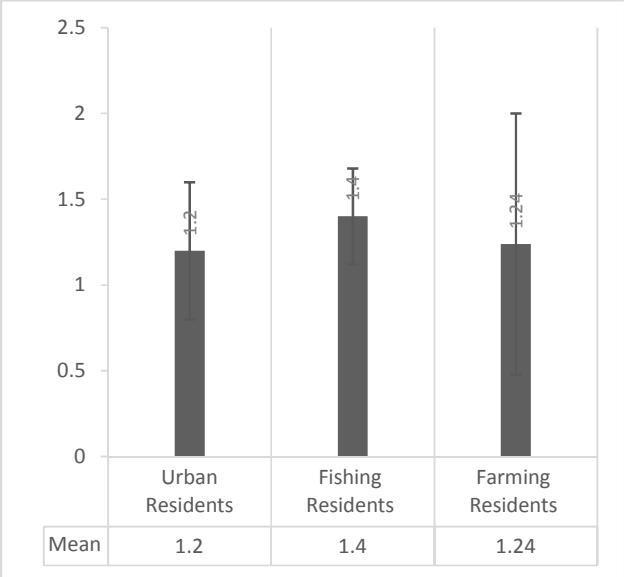


Figure 5: HDL-C Concentrations in the Study Groups



HDL Cholesterol (HDL-C) Levels in the Study Groups

Figure 5 shows HDL-C concentrations measured in the various study groups. Highest levels (1.40 ± 0.28mmol/l) were recorded among fishing residents while least values (1.20 ± 0.40mmol/l) were observed among urban residents. ANOVA showed statistically significant differences between urban residents and fishing residents. Similarly, there was significant difference between urban residents and residents in farming communities.

Effect of Gender on HDL-C Concentrations

The effect of gender on HDL-C concentrations is shown in figure 6. It shows that females resident in the urban area (1.22 ± 0.24mmol/l) and females in farming settlements (1.31 ± 0.70) had higher HDL-C levels than their respective males. Males in fishing settlements (1.44 ± 0.27mmol/l) had higher concentrations of HDL-C than females. Despite these variations, there was no significant difference in HDL-C levels in males and females in the study groups.

Figure 6: HDL-C Concentrations in males and females in the study groups.

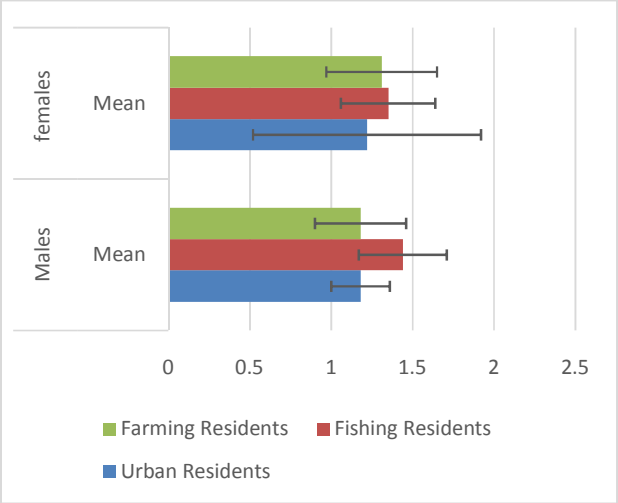
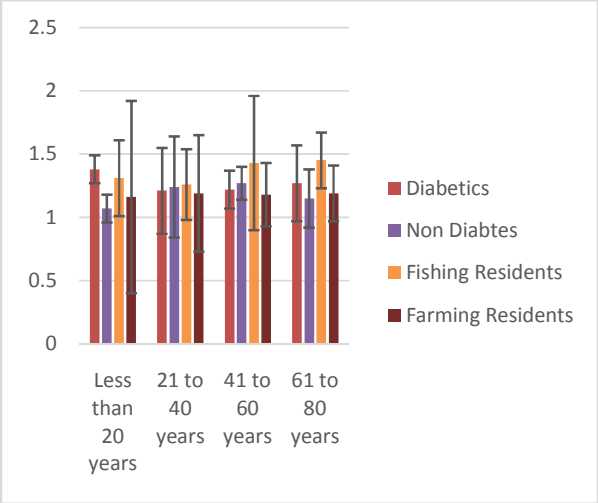


Figure 7 HDL-C Concentrations in the Various Age Groups



Effect of Age on HDL-C Concentrations

The effect of age on HDL-C concentrations is shown in figure 7. It shows that residents in fishing settlements between 61- 80 years (1.45 ± 0.22) had the highest mean HDL-C levels. This value is slightly higher than that recorded among fishing residents 41- 60 years (1.43 ± 0.53mmol/l). The least mean value of 1.07 ± 0.11mmol/l was recorded among urban residents ≤ 20 years. There was significant difference between urban residents and fishing residents that are ≤ 20 years ($p < 0.05$). There were no significant differences between young subjects (21-40 years age group) and old subjects (61-80 years age group).

LDL-Cholesterol (LDL-C) Levels in the Study Groups

LDL-C concentrations in the various study groups are shown in Figure 8. Highest levels of LDL-C (2.71 ± 0.67mmol/l) were recorded among urban dwellers while residents in fishing settlements had the least values (1.80 ± 0.56mmol/l). ANOVA showed that the difference in LDL-C concentrations in urban residents and fishing residents, urban residents and farming residents as well as fishing residents and farming residents were significant ($p < 0.05$).

Figure 8: LDL – C Concentrations in the Study Groups

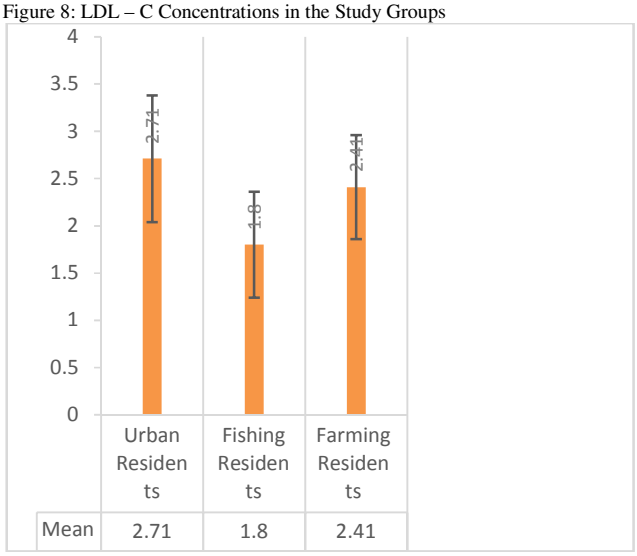
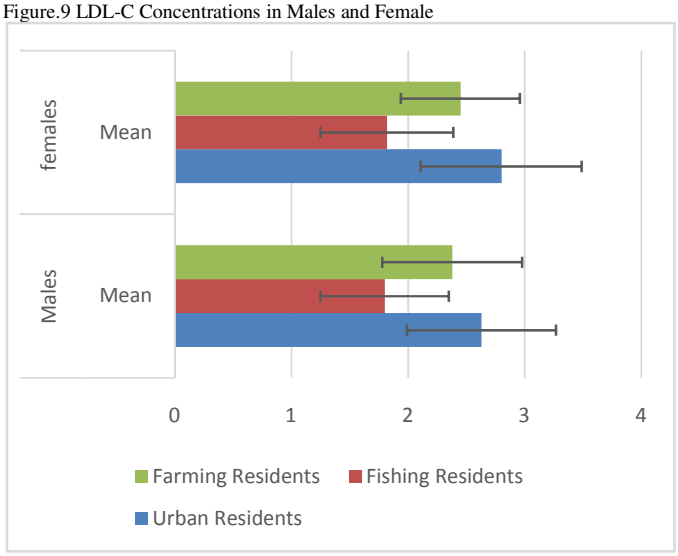


Figure.9 LDL-C Concentrations in Males and Female



Effect of Gender on LDL-C Concentrations

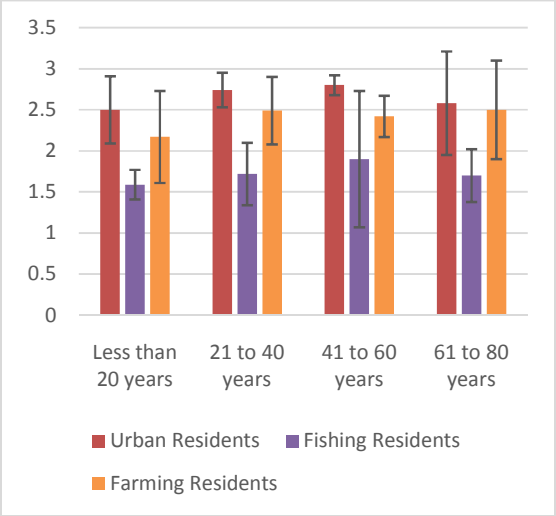
The effect of gender on LDL-C concentrations is presented in Figure 9. It shows that females had higher LDL-C levels than males in the three study groups with females in the urban area (2.80 ± 0.69mmol/l) having the highest levels. Though females had higher LDL-C levels than males, the variations were not statistically significant.

Effect of Age on LDL-C Concentrations

The effect of age on LDL-C concentrations in the various study groups is outlined in Figure 10. It shows that the highest level of LDL-C concentration (2.80 ± 0.12mmol/l) was recorded in urban residents within the age group 41-60 years. A slightly lower level (2.74 ± 0.21mmol/l) was observed among urban residents within the age range of 21-40 years. The least value observed (1.59 ± 0.18mmol/l) was recorded among residents in fishing settlements ≤ 20 years.

These differences in the various age groups were significant among urban and fishing residents ≤ 20years. The differences were also significant between the fishing and farming residents within the age range of 21-40 years ($p < 0.05$).Comparison of the three groups within the age ranges of 41-60 and 61-80 years showed significant differences ($p<0.05$).

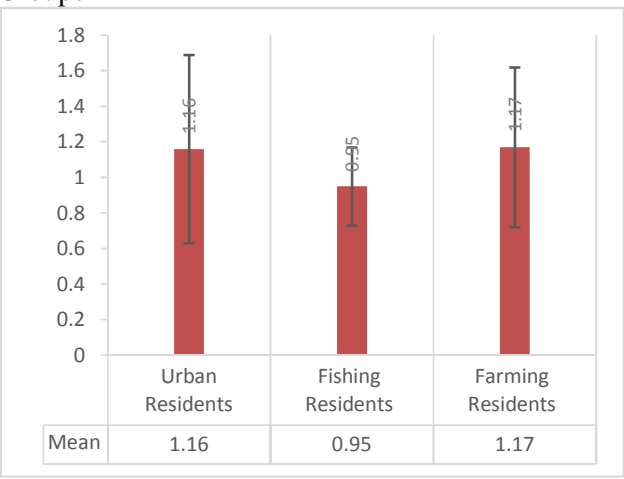
Figure.10: LDL-C Concentrations in the Various Age Groups



Triglyceride (TG) Concentrations in the Study Groups

Figure 11 shows TG concentrations in the various study groups. It shows that residents in farming communities had the highest TG levels (1.17±0.45mmol/l) while fishing residents had the least values (0.95 ± 0.22mmol/l).ANOVA shows that the differences in TG levels were significant among urban and fishing residents as well as among farming and fishing residents. ($p < 0.05$).

Figure 11: Triglyceride Concentrations in the Study Groups



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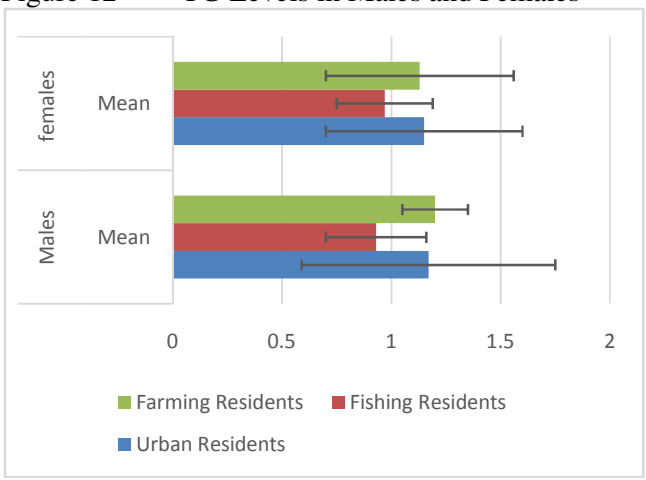
Effect of Gender on Triglyceride Concentrations

The effect of sex on TG concentrations is illustrated in figure 12

It shows that males in the urban area (1.17 ± 0.58mmol/l) and males in farming settlements (1.20 ± 0.15mmol/l) had higher TG levels than females. Females in fishing settlements (0.97 ± 0.22mmol/l) had higher TG values than males. The highest TG concentration recorded (1.20 ± 0.15mmol/l) was among males in farming settlements while males in fishing settlements had the least TG values (0.93 ± 0.23mmol/l). These differences were found to be statistically significant ($p<0.05$) only in the males and females in fishing settlements.

Figure 12 TG Levels in Males and Females

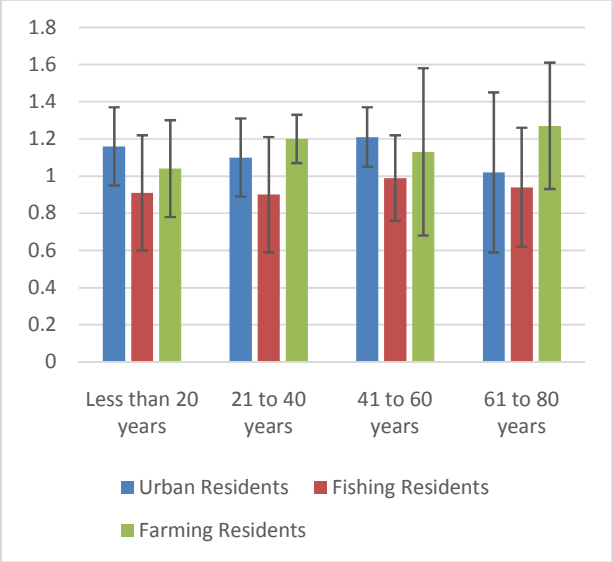


Effect of Age on Triglyceride Concentrations

Figure 13 shows the effect of age on TG concentrations measured in the various study groups. The result shows that the highest TG level recorded (1.27 ± 0.34mmol/l) was among farming residents 61-80 years while the least value recorded (0.90 ± 0.31mmol/l) was among participants in the age range of 21- 40 years resident in fishing settlements. It also shows that residents in farming settlements had the highest TG levels of 1.20 ±

0.13mmol/l in the age range of 21- 40 years and 1.27 ± 0.34mmol/l in the age range of 61- 80 years. Residents in fishing settlements had the least TG values in all the age groups.The differences between urban and fishing residents as well as between farming and fishing settlements in all the age groups were statistically significant ($p<0.05$)

Figure 13: TG Concentrations in the Various Age Groups



IV. DISCUSSION

The observed differences in lipid profile levels with respect to residents in fishing settlements in this study is in agreement with a similar finding by Zibaeenezhad et al which showed that fish and fish oils lowered total cholesterol, triglyceride and LDL levels in study group [7] The effectiveness of fish and fish oil to lower cholesterol levels is because they contain long-chain polyunsaturated omega-3 fatty acids, more specifically, eicosapentaenoic acid (EPA) and decosahexaenoic acid (DHA). A study carried out on effect of fish oil on cholesterol in Tokyo, Japan showed that patients with abnormal cholesterol and triglyceride levels at the beginning of the study showed lower levels at the end of the study [8]. These results show the potential for using fish oils for heart attack patients, thereby reducing their risk for future heart attacks. Taking as little as one gram of fish oil per day may help stabilize the heart muscle and reduce the chance for fatal abnormal heart rhythms [9].

A study of women with coronary vascular disease showed that the formation of coronary plaque in them slowed down when they ate oily fish [10]There is also evidence that fish oils containing omega 3 fatty acids may benefit arterial fibrillation, a potentially deadly heart rhythm.

Researchers equally believe that fish oil's effects on cholesterol levels may be helpful in reducing abnormal heart rhythms [11].

Based on the above, it could be deduced that consumption of fish significantly enhanced the maintenance of good total cholesterol concentrations among the participants. The results of this study support these findings as fishing residents had the lowest total cholesterol levels. This effect is however significant after long time consumption of fish or treatment with fish oil [12]. A group of Dutch researchers conducted an analysis of 60 trials that examined the effects of carbohydrates and various fats on blood lipid levels. In these trials, polyunsaturated and monounsaturated fats were eaten in place of carbohydrates. These good fats decreased levels of harmful LDL-C and increased protective HDL-C. [13]. More recently, a randomized trial known as the Optimal Macronutrient Intake Trial for Heart Health (OmniHeart) showed that replacing a carbohydrate-rich diet with one rich in unsaturated fat, predominantly monounsaturated fats, lowers blood pressure, improves lipid levels, and reduces the estimated cardiovascular risk [14] .

Low or lowered cholesterol level has been shown in numerous studies to reduce cardiovascular morbidity and mortality [15] . The observed levels of total cholesterol and LDL-C among urban residents could be due to urbanization which tends to increase the propensity of the persons to consume commercially prepared foods containing higher amounts of trans and saturated fats which

cause elevated cholesterol levels and hypercholesterolemia [16].

Previous studies have shown that in both men and women, total cholesterol levels start to increase after the age of 20 years.In men, it starts to decrease slightly at the age of about 65. This implies that as one gets older, the risk of heart disease increases dramatically. For instance, a 62 year old man is 500 times more likely than a 22 year old man to die of heart disease the next year [17]. Until the age of 45, men tend to have higher total cholesterol levels than women do, and women tend to have higher HDL-C levels. A study at the National Heart, Lung and Blood Institute in the United States of America showed that men in their 40s are 4 times more likely to die from heart disease than are women of the same age [17]. As years pass, the statistics for women change. After menopause, a woman's LDL level tends to increase and her HDL decreases. They equally tend to have higher LDL levels than do men of the same age [18]. This supports the results obtained in this study as females in all the groups had higher LDL-C levels than males. This implies that a woman's risk of heart disease is higher than that of a man.

HDL-C is known as the 'good cholesterol' or 'healthy cholesterol'. It removes excess cholesterol from the blood and brings it back to the liver to be recycled [19]. HDL-C together with estrogen also helps stimulate the production of nitric oxide, which can relax blood vessels and lower blood pressure. Based on these facts, cardiologists recommend that a high HDL-C level is good for a healthy heart.

Highest levels of HDL-C observed in residents in fishing settlements could be attributed to the effect of omega-3 fatty acids contained in fish. This observation is in line with a similar finding by Luo et al [6]. Urban residents had the lowest HDL-C values. Consumption of foods containing saturated fats and trans-fats having partially hydrogenated vegetable oils could be implicated in this finding as it is a known fact that they lower HDL-C in the body.

With exception of residents in fishing settlements, female subjects had higher HDL-C levels than males. The female sex hormone estrogen tends to raise HDL-C Estrogen replacement therapy has been shown to have a favorable effect on lipid and lipoprotein levels. HDL-C increases of up to 15% and an LDL-C decrease of 15% can be expected with use of oral estrogen. [20]. The production of this hormone is highest during the child bearing years. According to the American Heart Association, this may explain why pre-menopausal women are usually protected from developing heart diseases. A study by Shibata et al [21], suggested a strong association between female hormones and serum lipid metabolism. They inferred from their study that between the ages of 50-70 years, mean total cholesterol level in women exceeds those of men. The possible mechanism is that transport of cholesterol from peripheral tissues to the liver for subsequent catabolism and excretion which is the function of plasma HDL-C is reduced after menopause due to estrogen deficiency. This leads to increased total cholesterol level in postmenopausal women which in turn increase the incidence of coronary heart disease (CHD).

From the foregoing, it is clear that premenopausal women are protected against CHD but this protection is lost after menopause.

V. CONCLUSION

The findings of this study suggest that the probability of occurrence of ischemic heart disease (IHD) might be higher among urban residents in Yenagoa. This is because; the risk of developing IHD is linked to high blood levels of total cholesterol, LDL-C, HDL-C and triglyceride; as observed in the study. The study equally shows that the probability of occurrence of IHD might be lower in residents in fishing and farming settlements as they had lower total cholesterol and LDL-C levels but higher HDL-C levels.

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