Research Article

Serum Lipid Profile of Normotensives and Hypertensives in Abak, Southern Nigeria

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Article History
Received: 05.02.2021
Accepted: 19.02.2021
Published: 25.02.2021

Abstract: Derangements in blood lipids Have always been strongly associated with cardiovascular disorders. The aim of our study was to measure the arterial blood pressure and evaluate the lipid profile. For the purpose of predicting the risk of cardiovascular diseases in Abak, Southern Nigeria. A cross sectional study was conducted involving 710 randomly selected subjects, 367 with elevated blood pressure and 343 with normal blood pressure, attending free medical outreaches Study was carried out in Abak between March to December 2019. The study population was stratified in three different age groups; young adults (18-40 years), middle aged (41-60 years) and elderly (>60 years). Blood pressures, total cholesterol, triglycerides, low density lipoproteins and high density lipoproteins were measured using standard procedures. The results showed that the mean systolic and diastolic blood pressures of normotensive subjects were 124.45 ± 3.03 mmHg and 78.44±2.21 mmHg respectively. The mean serum lipid profiles of normotensives in mg/dl were 189.44±7.36, 149.73±7.16, 75.26±6.50 and 84.15±5.50 for Total Cholesterol, Triglycerides, HDL-Cholesterol and LDL-Cholesterol respectively. The mean systolic and diastolic blood pressures of hypertensive subjects were 162.67±5.01 mmHg and 96.33±3.27 mmHg respectively. The serum lipid profiles of hypertensives in mg/dl were 216.32±29.97, 238.27±29.92, 39.55±2.01, 155.60±21.91, for Total Cholesterol, Triglycerides, HDL-Cholesterol and LDL-Cholesterol respectively. We concluded that whereas there was no derangement in the serum lipid profile of normotensives evaluated, while most hypertensive persons had some coexisting dyslipidaemias, which predicted varying degree of cardiovascular and cerebrovascular complications among hypertensives the population.

Keywords: Hypertension, Lipid profile, dyslipidaemia, cardiovascular disease.

INTRODUCTION

Hypertension and other cardiovascular diseases contribute majorly to morbidity and mortality in Nigeria. The disease is regarded as a multifactorial condition with a myriad of physiological and biochemical mechanisms identified to participate in elevation and maintenance of blood pressure (Kaplan, N. M. 1994; & Beevers, G. et al., 2001).

Despite reported high prevalence of hypertension in developing countries (Iyalomhe, G. B. S. et al., 2008), routine check of blood pressure is not a common Practice in this regions. Hence, a lot of Nigerians at different stages of hypertension are not even aware of their blood pressure status. The prevalence keeps rising (Beevers, G. et al., 2001; & Iyalomhe, G. B. S. et al., 2008) and is associated with mass migration from rural to urban areas, uptake of ‘Western’ lifestyles including consumption of fast food, processed foods (high in fats and salt), alcohol, and tobacco amongst others.

Multiple risk factors have been shown to play a role in the rising prevalence of hypertension (Lewington, S. et al., 2016). It is strongly associated with mass migration from rural to urban areas, uptake of ‘Western’ lifestyles such as consumption of fast food, processed foods that are high in fats and salt, alcohol and tobacco consumption, and high Body Mass Index (BMI) among others (Ajayi, I. O. et al., 2016; Hansen, H. S., & Larsen, M. L. 2009; & Feldstein, C.A. 2010). Hypertension and dyslipidaemia are major risk factors for cardiovascular disease (CVD), which is the leading cause of disability and death worldwide and account for more than 80% of deaths and disability in low- and middle-income countries (Kaplan, N. M. 1994; & Lewington, S. et al., 2016).
Dyslipidaemias is a major factor in the development of atherosclerosis and other health disorders such as metabolic syndrome and type 2 diabetes mellitus (Noubiap, J. J. et al., 2018; & SBC, 2007). Global Burden of Disease study showed that high concentrations of total cholesterol caused about 4-4 million deaths and 93-8 million disability-adjusted life-years (DALYs), representing the seventh and eighth leading risk factors in terms of attributable DALYs globally for women and men, respectively (GBD, 2016). There is broad variation in serum lipid profile levels reported among different populations worldwide (Noubiap, J. J. et al., 2018). Age and gender has been shown to influence total cholesterol, LDL, HDL, and triglycerides level in Iraqi population (Al-Obaidy, A. H. 2007). Limbu et al., observed that due to the increasing number of older population in the regions of developing economy the increasing prevalence of dyslipidaemia is becoming an issue of a major concern for the prevention of coronary artery disease (Limbu, Y. R. et al., 2008) Moreover, rapid urbanisation and adoption of unhealthy lifestyles are believed to contribute to the rising cases of dyslipidaemia reported across Africa. The World Health Organization reported that substantial changes in population health are occurring in Africa, marked by the rising burden of cardiovascular diseases (CVDs), which are set to overtake infectious diseases as the leading cause of death by 2030 (WHO, 2014). The need for measurement of blood pressure and lipid profile at regular intervals has been advocated as modalities to prevent cardiovascular disease, stroke, and other comorbidities (Choudhury, K. N. et al., 2014).

Like most regions of Africa, information on the lipid profiles of normotensives and hypertensives in the Nigerian Niger delta settlements are generally scarce. Our present study assessed the lipid profile of both normotensive and hypertensive individuals in Abak, an urban settlement in Southern Nigeria. The aim was to provide data that may be useful in predicting the extent of risk and the predisposition of the population to cardiovascular and related diseases.

**Materials and Methods**

Abak is local government headquarters of Abak Local Government Area, located about 18 kilometres from Uyo metropolis, the capital city of Akwa Ibom State in the Niger Delta region of Nigeria. The city has a land mass of about 304 square kilometers, with a total population of 139,090 people comprising of 73,578 males and 65,512 females (NPCN. 2006). Although the people predominantly speak Annang natively, English is the official language of communication. The people are predominantly local miners of gravel, clay and sand, subsistent farmers and sundry traders, while many are into pottery, weaving and commercial motorcycle riding.

The health care delivery system in Abak operates through integrated primary health care services and secondary health care strategies (Egwu, I. N. 1996). Abak has about nine primary health care services deployed to carry out preventive health care measures, health education, maternal care, infant and child care and immunization, mass screening, social work and environmental and occupational health. Two general hospitals provide secondary health care delivery to inhabitants of Abak (Atser, J., & Akpan, P. A. 2009). The nearest tertiary health facility is the University of Uyo Teaching Hospital which is situated about 15km from Abak town. This health care delivery system provides health care services for the immediate community (JNC, 2003). A cross sectional study was conducted involving 710 randomly selected subjects, 367 with elevated blood pressure and 343 with normal blood pressure, attending free medical outreaches carried out at different faith-based centres in Abak Town between March and December 2019. Free health services were organized by the research team, with the prior public notices, to achieve the maximum participation of the inhabitants. Only adults aged 18 years and above were selected from the screening units by the attending medical professional for the study. The study population was stratified into three different age groups; younger adults (18 - 40 years), middle age adults (41 - 60 years) and elderly (> 60 years). Biodata of subjects were recorded after the necessary informed consents were obtained. Blood pressure was measured using BP measurement protocol after the patient had rested for at least 10 minutes (Choudhury, K. N. et al., 2014). Two measurements of blood pressure of subjects were taken on sitting position, with at least a 15-minutes interval between successive measurements and the mean blood pressure was determined, based on the procedure documented by Hambly, P. (2000) and Henry, I. B. (2011). Normotensives were defined as subjects whose mean systolic blood pressures were between 90 and 140 mmHg and diastolic blood pressure between 60 and 90 mmHg. (JNC, 2003). Hypertensives were defined as subjects with mean systolic blood pressure above 140 mmHg and mean diastolic blood pressure above 90 mmHg, using the criteria of the seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-7) (Henry, I. B. 2011). The selected subjects were asked to come back next morning without eating any meal. A volume of 5 ml of blood was collected in the morning by venopuncture and serum was extracted and used for biochemical tests. Total cholesterol (TC), triglycerides (TG), low density lipoproteins (LDL) and high density lipoproteins (HDL) were estimated by enzymatic colorimetric methods. Serum levels of lipids, namely, TC, TG, LDL and HDL were classified based on recommendations by National Cholesterol Education Program (NCEP), 21 and Adult Treatment Panel III (ATP III) guidelines (Third report of the National Cholesterol Education Program. 2000; & Krousel-Wood, M. et al., 2012).
Total cholesterol (mg/dl) <200= desirable, 200–239= borderline high, ≥ 240 = very high; triglyceride (mg/dl) <150= normal (goal), 150–199= borderline high, 200–499= high, ≥ 500 = very high; HDL-cholesterol (mg/dl) < 40 = low, ≥ 60 = high; LDL-cholesterol (mg/dl) < 100 = optimal, 100–129 = near optimal/above optimal, 130–159 = borderline high, 160–189 = high, ≥ 190 = very high (Krousel-Wood, M. et al., 2012).

Data analyses were done using Statistical Package for Social Sciences software, version 16.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation (SD) and were compared using independent group Student’s t-tests. A P-value <0.05 was considered statistically significant.

Table 1: Mean blood pressure and mean total cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol of normotensives in Abak, Akwa Ibom State, Nigeria

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of subjects</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>Triglycerides (mg/dl)</th>
<th>Total Cholesterol (mg/dl)</th>
<th>HDL-Cholesterol (mg/dl)</th>
<th>LDL-Cholesterol (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–40</td>
<td>126</td>
<td>121.18 ± 3.03</td>
<td>76.11 ± 3.91</td>
<td>155.82 ± 7.26</td>
<td>188.81 ± 7.07</td>
<td>71.41 ± 8.15</td>
<td>81.48 ± 5.98</td>
</tr>
<tr>
<td>41–60</td>
<td>120</td>
<td>124.09 ± 4.03</td>
<td>82.47 ± 3.02</td>
<td>140.52 ± 5.41</td>
<td>176.57 ± 7.03</td>
<td>75.44 ± 6.66</td>
<td>74.47 ± 5.98</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>97</td>
<td>128.07 ± 2.13</td>
<td>76.75 ± 5.70</td>
<td>152.84 ± 8.80</td>
<td>202.96 ± 7.99</td>
<td>78.92 ± 4.68</td>
<td>96.51 ± 4.55</td>
</tr>
</tbody>
</table>

n = Mean age of population, t = Total number of subjects, SBP = Systolic blood pressure, DBP = Diastolic blood pressure

There were 155 male and 203 male normotensive participants with SBPs of 125.43 ± 4.43 mmHg and 123.11± 3.40 mmHg respectively, and DBPs of 80.57 ± 4.12 mmHg and 76.31 ± 4.51 mmHg respectively. The mean SBP and DBP of the male subjects were significantly (P<0.05) higher than that of the females. The mean serum TC and LDL of the females was significantly (P<0.05) higher than that of the males, while the males had a significant (P<0.05) increase in mean serum TG level. Mean serum HDL level did not significantly vary with gender (Table 2).

Table 2: Gender distribution of the mean blood pressure; mean total cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol of adult normotensives in Abak, Akwa Ibom State, Nigeria

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of subjects</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>Total Cholesterol (mg/dl)</th>
<th>Triglycerides (mg/dl)</th>
<th>HDL-Cholesterol (mg/dl)</th>
<th>LDL-Cholesterol (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–40</td>
<td>60 males, 86 females</td>
<td>123.23 ± 3.32</td>
<td>77.06 ± 4.12</td>
<td>185.41 ± 8.72</td>
<td>162.81 ± 5.95</td>
<td>70.49 ± 8.15</td>
<td>72.36 ± 3.81</td>
</tr>
<tr>
<td>41–60</td>
<td>50 males, 70 females</td>
<td>125.11 ± 7.07</td>
<td>80.51 ± 3.21</td>
<td>189.35 ± 5.85</td>
<td>175.74 ± 6.57</td>
<td>72.29 ± 8.07</td>
<td>74.59 ± 6.15</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>45 males, 47 females</td>
<td>128.02 ± 3.54</td>
<td>82.67 ± 5.83</td>
<td>192.35 ± 8.21</td>
<td>213.60 ± 5.04</td>
<td>74.03 ± 8.58</td>
<td>75.84 ± 7.59</td>
</tr>
</tbody>
</table>

n = Mean age of population, t = Total number of subjects, SBP = Systolic blood pressure, DBP = Diastolic blood pressure

The mean SBP and DBP for the hypertensive subjects were 161.20 ±5.0 mmHg and 97.49 ±4.94 mmHg respectively. Both the SBP and DBP showed significant (P<0.05) increases with age (Table 3).
The mean serum Triglyceride, Total Cholesterol, HDL-Cholesterol and LDL-Cholesterol were 216.32±29.97, 238.27±29.92, 39.55±2.01 and 155.60±21.91 respectively. All the serum lipid levels, apart from HDL-cholesterol, showed significant (P<0.05) increase when compared with that of the normotensive subjects. The mean serum HDL-Cholesterol of hypertensive subjects was significantly (P<0.05) reduced when compared with the normotensive subjects. The mean serum Triglyceride, Total Cholesterol and LDL-Cholesterol of young adults (18 – 40 years) were significantly (P<0.05) higher than that of the middle aged (41 – 60 years), but significantly lower than that of the elderly (> 60 years). There were no significant changes in HDL-Cholesterol levels within age groups (Table 3).

Table 3: Mean blood pressure and mean total cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol of hypertensives in Abak, Akwa Ibom State, Nigeria

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of subjects</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>Triglycerides (mg/dl)</th>
<th>Total Cholesterol (mg/dl)</th>
<th>HDL-Cholesterol (mg/dl)</th>
<th>LDL-Cholesterol (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-40</td>
<td>112</td>
<td>147.42±4.71</td>
<td>94.77±5.77</td>
<td>225.51±11.39</td>
<td>243.70±18.15</td>
<td>39.62±1.54</td>
<td>159.38±14.33</td>
</tr>
<tr>
<td>41-60</td>
<td>178</td>
<td>162.53±5.41</td>
<td>97.13±4.47</td>
<td>196.30±47.57</td>
<td>218.59±35.24</td>
<td>39.71±2.80</td>
<td>139.76±22.93</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>77</td>
<td>173.66±7.28</td>
<td>100.57±6.29</td>
<td>227.15±30.96</td>
<td>252.42±36.36</td>
<td>39.33±1.70</td>
<td>167.67±28.47</td>
</tr>
<tr>
<td>n≥2±3.2</td>
<td>t367</td>
<td>161.20±5.01</td>
<td>97.49±4.94</td>
<td>216.32±29.97</td>
<td>238.27±29.92</td>
<td>39.55±2.01</td>
<td>155.60±21.91</td>
</tr>
</tbody>
</table>

n = Mean age of population, t = Total number of subjects, SBP = Systolic blood pressure, DBP = Diastolic blood pressure

Out of 367 hypertensive subjects, 165 were males and 202 were females. The male and female hypertensive subjects had mean SBPs of 166.67±11.87 mmHg and 156.67±12.82 mmHg, and mean DBPs of 97.67±7.36 mmHg and 91.67±4.18 mmHg respectively. The mean SBP and DBP of the male hypertensive subjects were significantly (P<0.05) higher than that of the females counterparts (Table 4). The mean serum Total Cholesterol, Triglycerides and LDL-Cholesterol of male hypertensive subjects were significantly (P<0.05) than that of the female hypertensives, the HDL-Cholesterol of hypertensive female subjects was significantly (P<0.05) higher than that of the male hypertensives. The mean serum lipid levels of the middle aged (41 – 60 years) female hypertensive subjects were significantly higher the male counterparts (Table 4).

Table 4: Gender distribution of the mean blood pressure; mean total cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol of adult hypertensives in Abak, Akwa Ibom State, Nigeria

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of Subjects</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>Total Cholesterol (mg/dl)</th>
<th>Triglycerides (mg/dl)</th>
<th>HDL-Cholesterol (mg/dl)</th>
<th>LDL-Cholesterol (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>18 - 40</td>
<td>50</td>
<td>62</td>
<td>146.62</td>
<td>148.21±4.71</td>
<td>97.4±5.9</td>
<td>257.21±7.57</td>
<td>225.51±11.39</td>
</tr>
<tr>
<td>41 - 60</td>
<td>78</td>
<td>100</td>
<td>164.38</td>
<td>160.4±15.41</td>
<td>94.1±5.9</td>
<td>201.4±7.8</td>
<td>196.30±47.57</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>37</td>
<td>40</td>
<td>182.11</td>
<td>165.2±15.49</td>
<td>102.9±7.1</td>
<td>256.2±10.3</td>
<td>227.15±30.96</td>
</tr>
<tr>
<td>n=2±16</td>
<td>t202</td>
<td>166.67±1.87</td>
<td>156.67±7.3</td>
<td>97.6±12.1</td>
<td>97.6±12.1</td>
<td>239.6±12.1</td>
<td>223.6±12.1</td>
</tr>
</tbody>
</table>

n = Mean age of population, t = Total number of subjects, SBP = Systolic blood pressure, DBP = Diastolic blood pressure
Discussions

Our study evaluated the serum lipid profile of normotensive and hypertension individuals among an urban population in Abak in the Niger Delta region of Southern Nigeria. The mean serum TC, TG, HDL and LDL of normotensive subjects were within the values classified by NCEP and ATP III as “desirable”, “normal”, “high” and “optimal” respectively. Our results showed that the mean values of serum Total Cholesterol, Triglycerides, and LDL-Cholesterol were significantly higher and statistically significant among the hypertensive subjects compared to normotensives. The mean HDL-Cholesterol level was, however, lower in the hypertensives compared to normotensives and was statistically significant. The mean serum Total Cholesterol, triglycerides, HDL-Cholesterol and LDL-Cholesterol levels for hypertensive subjects were within the NCEP and ATP III ranges for “borderline”, “high”, “low” and “border-high” respectively. The findings of high Total cholesterol, triglycerides and LDL-cholesterol and low HDL-Cholesterol reported by this study are similar to earlier reports of some other studies (World Medical Association Declaration of Helsinki, 2000; Choudhury, K. N. et al., 2014; Anjum, R. et al., 2013; Bambara, R. et al., 2013). Several studies have shown a direct association of hypertension with increased levels of total cholesterol, triglycerides, low density lipoproteins and very low density lipoproteins while the levels of high density lipoproteins are decreased at the same time. Total cholesterol, triglycerides and LDL-cholesterol are known as “bad cholesterol”, as they play undesirable roles in several diseases pathogenesis (Choudhury, K. N. et al., 2014). Dyslipidaemia is reported to be more common in untreated hypertensives than normotensives and about 80% of hypertensive individuals have other coexisting morbidities such as obesity, abnormalities in lipid metabolism and glucose intolerance (World Medical Association Declaration of Helsinki, 2000; & Ijeh, I. et al., 2010).

Our study has shown that blood pressure increases in highest in older age groups in both male and females, and also higher in male in comparison to the females of same age groups, in both normotensive and hypertensive subjects. This is consistent with earlier study in Nigeria and several studies in both developed and developing countries have consistently shown a positive relationship between age and blood pressure (Osuji, C. U. et al., 2012). From our results the female hypertensive subjects had significantly higher total cholesterol, triglycerides and LDL-Cholesterol than their male counterparts, suggesting that hypercholesterolaemia and hypertriglyceridaemia may be more associated with cardiovascular diseases in female than males in this population. In a study carried out in Benin City on the plasma lipid profile of hypertensive Nigerians, female hypertensives were also reported to have higher serum total Cholesterol than their male counterparts (Osuji, C. U. et al., 2012).

However, a prospective study in Bangladesh in Asia on serum lipid profile and its association with hypertension showed higher serum Cholessterols in male than in females (24). Although the exact mechanisms underlying the cardiovascular disease risk mediated by dyslipidaemia are not fully elucidated, high levels of serum cholesterol are known to increase the risk of developing macrovascular complications such as coronary heart disease and cerebrovascular accident (stroke) (Ijeh, I. et al., 2010; & Idemudia, J., & Ugwuja, E. 2020).

Whereas the normotensive subjects had mean serum HDL-Cholesterol level >60 mg/dl, corresponding to the NCEP and ATP III “high” range, the hypertensive counterparts had a “low” mean serum HDL-Cholesterol level. Low HDL-Cholesterol can result in endothelial damage, trigger an increase in blood pressure and increases risk of other cardiovascular diseases by not fully elucidated pathogenetic mechanism. Experimental studies had suggested that HDL-Cholesterol may play a direct role in promoting cholesterol efflux from foam cells in the atherosclerotic plaque depots in blood vessels to the liver for excretion (Albucher, J. F. et al., 2000).

The overall picture from this study reveal that there were significant hypertension and dyslipidaemias comorbidity in the evaluated population. This coexistence of hypertension and dyslipidaemia in the population has multidimensional clinical implications, including enhancement of cardiovascular diseases, obesity and insulin resistance. Dyslipidaemia had been strongly linked with pathogenesis of hypertension in apparently healthy individuals. Hypertension is known to be strongly associated with alterations in lipid metabolism leading to derangements in serum lipids and lipoprotein levels. The presence of hyperlipidaemia has been demonstrated to substantially worsens prognosis in hypertensive patients and dyslipidaemia in apparently healthy individuals leads to hypertension (Ijeh, I. et al., 2010; & Pavithran, P. et al., 2007).

Conclusions

Our study demonstrate that hypertensive individuals are more likely than normotensives to exhibit dyslipidaemia, namely elevated blood Total Cholesterol, LDL-cholesterol, Triglycerides, and reduced HDL-cholesterol levels. There is, therefore, a high risk of cardiovascular disease among hypertensive individuals in the population. From our results, the female hypertensives are more likely to develop cardiovascular complications of hypertension in comparison to the male counterparts. Hypertensive patients in this population will benefit from lipid lowering therapy, apart from blood pressure control strategies. There is an urgent need for health education on lifestyle modifications, including reduction in the consumption of table salt, alcohol, and fried foods rich in saturated fats, which have been shown to increase blood lipids.
CONFLICT OF INTEREST
Authors have declared that no competing interests exist.

ETHICAL CLEARANCE
Ethical clearance was obtained from the Research and Ethical Committee of the Faculty of Basic Medical Science, College of Health Science, University of Uyo. Informed consent was obtained from participants. Data collection was based on the Helsinki Declaration.

REFERENCES


