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Assessment of Lipid and Atherogenic Profile of Scavengers at Refuse Dumpsites in Port Harcourt, Rivers State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author EASB, HB and HIN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EASB and HIN managed the analyses of the study. Author HIN managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Scavengers are individuals who gather waste and recyclable materials from refuse dumpsites, and thus are exposed to varieties of deleterious substances that have the potential to modulate and affect human health. This study was designed to assess the lipid and atherogenic profile of scavengers utilising refuse dumpsites in Port Harcourt, Nigeria.

Methodology: Fifty (50) exposed (scavengers) aged 31.32±9.49 years and 50 non-exposed (control) aged 32.92 ±10.63 years (age-matched) male subjects were sampled. The blood pressure was measured and body mass index calculated from the height and weight of the subjects. Total cholesterol, high density lipoprotein, low density lipoprotein and triglycerides levels of the subjects were determined from fasting serum samples using standard spectrophotometric methods. Atheogenic ratios were also computed using established formulae. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 21 and expressed as mean and standard deviations. Variations between parameters was considered significant at $p<0.05$.

Results: The result obtained revealed that the mean ± SD of total cholesterol, triglycerides and low density lipoprotein showed no significant difference ($p > 0.05$) while the level of high density

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lipoprotein showed significant difference ($p < 0.05$) between exposed (scavengers) and non-exposed (control) individuals. Body mass index and blood pressure did not also vary significantly ($p>0.05$) between the two group of subjects.

Conclusion: Cardiovascular disease risk exist among the study subjects as revealed by atherogenic profiling of the subjects indicating the need for life style changes and socio economic intervention among the subjects.

Keywords: Scavengers; lipoproteins; atherogenic ratios; cardiovascular disease; blood pressure.

1. INTRODUCTION

Scavengers also known as rag pickers, play pivotal role in waste management and recycling processes particularly amongst the developing nations of the world [1]. Scavenging activity has remained a source of income for many unskilled individuals in the developing nations like Nigeria and it is achieved by gathering recyclable materials that has been discarded and turning them into valuable substances [2]. The gathering of recyclable materials is done at dumpsites often times without any form of personnel protective equipment (PPE) for health and safety of these scavengers. As a result, they are exposed to hazardous chemicals and materials with potentials of altering lipid sequence, causing respiratory disorder and other inimical health challenges [3]. Serum lipid levels have been reported to be influenced by environmental factors such as exposure to chemicals, anthropometric and demographic factors [4]. Factors like exposure to chemicals and pollutants emanating from dumpsites may disturb lipid metabolism, cause dyslipidaemia resulting in atherosclerosis [5]. Dyslipidaemia is a known metabolic derangement of lipid which is a major risk factor of cardiovascular diseases and other heart related diseases that has caused many deaths across the globe [4]. Unfortunately, very limited study on the health effect of scavenging activity especially its impact on lipid and atherogenic profile of scavengers has been reported in Nigeria despite large scale presence of scavenging activities at refuse dumpsites in most parts of the country. This study was thus designed to assess the lipid and atherogenic profile of scavengers at refuse dumpsites in Port Harcourt, Rivers State, Nigeria This study shall provide pertinent information on whether scavenging activities at dumpsites have effect on the lipid and atherogenic profile of scavengers. Such data shall assist health practitioners and policy makers in the management of dumpsites operations in Nigeria since cardiovascular disease has been shown to be a major public health burden in Nigeria [6].

2. MATERIALS AND METHODS

2.1 Study Area

This cross sectional study was carried out at different dumpsites in Port Harcourt, Rivers State.

2.2 Study Design and Population

The study population consist of 50 scavengers (test subjects) aged 31.32 ±9.49 years found at different dumpsites in Port Harcourt and 50 control subjects (unexposed subjects), aged 32.92 ± 10.63 years who lived at locations that were far from the dumpsites. Both the scavengers and non-scavengers (control) were randomly sampled with their consent obtained and questionnaire administered to them in order to ascertain their age, number of years spent in the occupation, health history and number of hours their physical activity requires. Information obtained from them were confidentially treated and maintained.

2.3 Inclusion Criteria

All male subjects actually seen at dumpsites involved in all forms of waste picking during the course of the study who gave their consent to participate were included.

2.4 Exclusion Criteria

Subjects who reported having history of hypertension, diabetes mellitus, respiratory disease, kidney disease, liver disease or symptoms suggestive of metabolic syndrome were excluded from the study. Also subjects involved with smoking cigarettes and consumption of any forms of alcoholic beverages were not included as control subjects.

2.5 Anthropometric Measurements

The measurement of blood pressure was done on the left hand with the aid of mercury sphygmomanometer and Stethoscope as described by Egbi et al. [7]. The body mass index (BMI) was calculated after measuring the height (m) and weight (kg) with the use of metre rule and standardized scale respectively as described by Afolabi et al. [8] using the formular:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m2)}}$$

2.6 Sample Collection and Preparation

Five (5) mls of venous blood was collected from participants after an over-night fast, and put into plain sample bottles with the aid of 5 ml syringes and needles, cotton wool and methylated spirit. The samples collected were transported to the laboratory where they were separated by centrifugation at 2500 rpm for 10 minutes, and the supernatants were collected using Pasture pipettes into new plain bottles, then stored in a refrigerator at 4^0C until the time of analysis.

2.7 Determination of Serum Lipid Profile

Serum lipid profile, including total cholesterol (Tchol), high density lipoprotein cholesterol (HDL-C) and triglycerides (TG) were determined using a Chemwell (R) T-Automated Chemistry Analyzer, produced by Awareness Technology Inc., USA. The ChemWellR-T is a fully automated open system analyzer for biochemistry assays and is supplied with optimized programmed protocols ready for use with an extensive range of Megazyme test kits. All the reagents and serum samples were left out to adjust to room temperature prior to analyses. Low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald et al. [9] equation.

2.8 Calculation of Atherogenic Indexes

The Atherogenic ratios were calculated as follows:

Atherogenic Index of Plasma (AIP) = log TG/HDL-C [10]

Cardiac Risk Ratio-1 (CRR-I) = TC/HD-C [11];

Cardiac Risk Ratio-11 (CRI-II) = LDL-C/HDL-C [11];

Atherogenic Coefficient (AC) = (TC- HDL-C) / HDL-C [12]

2.9 Statistical Analysis

The data were analyzed using Statistical Package for Social Sciences (SPSS) version 21. Data are presented as Means±SD and variation between two groups was done using the Student t-test analysis and variation in means of parameters was considered statistically significant at $p < 0.05$.

3. RESULTS

The result of this study as shown in Table 1 revealed that the mean values of total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-C) and low density lipoprotien cholesterol (LDL-C) were 4.60 ± 0.70 mmol/L, 1.13 ± 0.42 mmol/L, 1.19 ± 0.70 mmol/L and 2.96 ± 0.60 mmol/L respectively for exposed subjects (scavengers), while the mean values for the non-exposed subjects (control) were 4.53 ± 0.60 mmol/L, 1.13 ± 0.32 mmol/L, 1.26 ± 0.16 mmol/L and 2.76 ± 0.42 mmol/L respectively. There was no significant difference ($p > 0.05$) in lipid levels among exposed and non-exposed individuals except for HDL-C level which showed significant difference ($p < 0.05$).

The determination of the atherogenic status of the subjects is shown in Table 2. The table shows that while the control subjects had low risk using atherogenic index of plasma, the AIP of the exposed population was normal and the values were significantly (p=0.021) different between the

Table 1. Comparison of lipid profile of exposed and non-exposed subjects

Subjects	TC (mmol/L)	TG (mmol/L)	HDL-C (mmol/L)	LDL-C (mmol/L)
Exposed (n = 50)	4.60 ± 0.70	1.13 ± 0.42	1.19 ± 0.18	2.96 ± 0.60
Control (n = 50)	4.53 ± 0.60	1.13 ± 0.32	1.26 ± 0.16	2.76 ± 0.42
t-value	0.55	1.195	2.641	1.970
p-value	0.585	0.235	0.010	0.052
Summary	NS	NS	S	NS

Key: TC – Total cholesterol, TG – Triglycerides, HDL-C- high density lipoprotein cholesterol, LDL-C – low density lipoprotein cholesterol, S – significant, NS – not significant, n= number of subjects, S= significant at p<0.05, NS- not significant at p>0.05

Table 2. Comparison of lipid ratios between the exposed subjects and control

Subjects	CR1–I (TC/HDL)	CR1-II (LDL/HDL)	AIP [Log(TG/HDL)]	AC ([TC-HDL] /HDL)
Exposed (n = 50)	3.92±0.50	2.54±0.50	0.05±0.02	2.92±0.50
Control (n = 50)	3.60±0.43	2.21±0.40	0.11±0.02	2.60±0.43
t-value	3.490	3.635	2.341	3.490
p-value	0.01	<0.001	0.021	0.001
Summary	S	S	S	S

Key: CRI-I-Cardiac risk index I, CRI-II- Cardiac risk index- II, AIP- atherogenic index of plasma. Abnormal values for cardiovascular risk: Atherogenic index of plasma (AIP): low risk > 0.1, intermediate risk 0.1-0.24, high risk >0.24 [10] Cardiac risk index 1 (CRI-I)- > 3.0 and Cardiac risk index II (CRI–II) - > 3.3 [11], AC- >3.0 [12], n= number of subjects, S-significant at p<0.05, NS-not significant at p>0.05

control and exposed subjects. Using CRI-1 as the risk index, both the control and exposed subjects exhibited atherogenic risk with significant (p=0.01) values between the exposed and control subjects. The CRI-II did not show abnormal risk ratio in both categories of subjects although the ratio was significantly increased in the exposed subjects (p=0.001). The atherogenic coefficient of both the control and exposed subjects did not also show atherogenicity in the subjects despite significantly (p=0.001) increased value in the exposed subjects.

Table 3 shows that occupational exposure at refuse dumpsites did not significantly (p>0.05) affect the body mass index and blood pressure measurement of the subjects in the study.

4. DISCUSSION

Scavengers are exposed to variety of harmful materials which may contain toxic substances such as heavy metals, e-waste and other chemicals that could modulate levels of lipid in humans [13]. From the result of total cholesterol, it was clearly shown that the mean value of exposed individuals was slightly higher than that of the non-exposed with no significant difference (p > 0.05). The values for both exposed (scavengers) and non-exposed (control) were similar with those reported by Ahmed et al. [14] as total cholesterol level of normal human of 70 kg weight usually fall below ≥5.17 mmol/L, the American Heart Association cut off point as reported by Rinaldi et al. [15]. This is an indication that the exposed individuals (scavengers) were not sufficiently exposed to harmful substances that could have modulated or alter the levels of their body lipid. This observation is also consistent with the report of Olude et al. [3] among rag pickers in Osogbo. Also, the moderate total cholesterol levels recorded in both exposed and non-exposed individuals could be attributed to the lower body mass index, since lower BMI correlates positively with lower total cholesterol [16].

Triglycerides is a vital lipid profile marker used to assess the risk of atherosclerosis in man [17]. The result presented in Table 1 revealed that there was no significant difference (p > 0.05) between exposed individuals (scavengers) and non-exposed individuals (control). The mean values of triglycerides observed in this study fell below the American Heart Association guideline reported by Rinaldi et al. [15]. This obervation evidentially points to the fact that scavengers in Port Harcourt refuse dumpsites may not have been reasonably exposed to inimical chemicals for a long period of time while on their enterprise at the dumpsites. Long term exposure at dumpsites have been reported to modulate or alter triglyceride levels; since occupational exposure to substances like Pb, has been reported to result in hyperglyceridaemia [18]. The low level of triglycerides in both exposed and non-exposed individuals could be attributed to physical exercise such as trekking and pushing of gathered materials, an act that has the potential to “burn out” accumulated lipids if any [19]. Elevated levels of triglycerides in human are risk factor of stroke, coronary heart disease and health challenges [14].

High density lipoprotein cholesterol is a protective factor against atherosclerosis but whenever it is altered, HDL is reduced by the alteration of critical enzymes of lipid transport, lowering lecithin-cholesterol acyltransferase (LCAT) activity and altering cholesterol ester transfer protein and hepatic activity [20]. The result of HDL-C showed that there was

Table 3. Comparison of anthropometric parameter

Subjects	BMI (kg/m^2)	SBP (mmHg)	DBP (mmHg)
Exposed (n = 50)	23.81 ± 3.30	124.70 ± 5.25	76.88 ± 5.91
Control (n = 50)	24.74 ± 2.11	124.06 ± 6.13	77.18 ± 4.42
t-value	1.681	0.542	0.287
p-value	0.096	0.589	0.774
Summary	NS	NS	NS

Key: BMI – Body mass index, SBP – Systolic blood pressure, DBP – Diastolic blood pressure, n = number of subjects, S – significant, NS – not significant

significant difference ($p < 0.05$) between exposed and non-exposed individuals, though the non-exposed was slightly higher than the exposed (scavengers). The lower HDL value of the exposed individuals could be attributed to the lifestyle of the scavengers such as tobacco smoking, which may have caused the reduction in HDL, since cigarette smoking is known to be associated with rise in plasma homocysteine level, thereby causing decreases in high density lipoprotein-cholesterol [21]. The decreased value of HDL level in exposed individuals (scavengers), portray higher risk of cardiovascular.

The mean value of low density lipoprotien cholesterol for exposed and non-exposed individuals, showed no significant difference ($p > 0.05$) from each other. This is similar with the findings of Olude et al. [3], who reported no significant ($p>0.05$) difference between exposed subjects and non-exposed subjects. The values of LDL recorded for exposed individuals (scavengers) and non-exposed individuals (control) fell below ≥ 3.36 mmol/L, American Heart Association cut off point reported by Rinaldi et al. [15]. Generally, the values obtained seem to leave no unfavorable risk profile for cardiovascular disease for both exposed (scavengers) and non-exposed individuals.

Cardiac risk index 1 (CRI-1): cardiac risk index II (CRI-II), atherogenic index of plasma (AIP) and atherogenic coefficient (AC) are useful indicators with greater predictive value for coronary artery disease (CAD) [22]. Table 2 shows that total cholesterol/ high density lipoprotein cholesterol ratio (CRI-1) of both exposed individuals and unexposed individuals (control) were slightly elevated than the reference value stipulated by Genest et al. [11]. The values showed significant difference ($p<0.05$) from each other, with the exposed individuals having higher value than the control, which is an indication of most probable higher risk of cardiovascular disease than the control [23] although the lipid risk ratio for the unexposed (control) was slightly higher than 3.0 reference value as well. Also, the ratio of low density lipoprotein to high density lipoprotein, (CRI-II) did not indicate risk of cardiovascular disease for both exposed and control individuals indicating that CRI-1 could be a better predictor of CVD in this study. Atherogenic index of plasma (AIP) a strong independent indicator of extensive coronary artery disease and it shows the inverse relationship that exists between TG and HDL-C, which easily predicts infarction and predicting arteriosclerosis strongly. In this study. AIP value of exposed individuals (< 0.1) did not indicate CVD risk in the exposed population, however, in the control subjects, a low CVD risk was indicated (AIP value >0.11). The atherogenic coefficients of the exposed individuals although higher than the values of the unexposed individuals (control) was lower than the stipulated cut off which could indicate CVD risk [12]. These observation thus strengthened the proposition that risk ratios and atherogenic indices serve as indicators with greater predictive value than isolated parameters used independently such as total cholesterol, high density lipoprotein cholesterol, triglycerides and low density lipoprotein cholesterol. This is consistent with the observation of Devadawson et al. [22].

In terms of the body mass index, the results of the study shows that there was no significant difference ($p > 0.05$) in the means of BMI for the exposed (scavengers) and non-exposed. Although, the values of BMI recorded for the exposed population is slightly higher than that of the control, the slight variation could be attributed to the physical activities such as pushing of truck, thereby expending quality energy which is impacting positively on the BMI [24] to which the scavengers are involved daily in the course of the picking activities.

The present study reported systolic blood pressure of 124.70 mmHg the for exposed individuals (scavengers) were while that of non-exposed individual (control) was 124.06 mmHg.

The value of the diastolic blood pressure for the exposed subjects was 76.88 mmHg while that for non-exposed recorded 77.18 mmHg with no significant ($p>0.05$) variation between the blood pressures among the two groups. The systolic blood pressure fell below 140 mmHg reportedly stipulated as cut-off for high blood pressure [25] while the diastolic blood pressure value was below 80-89 mmHg classified as pre-hypertensive [26]. Body mass index and blood pressure are established risk factors of cardiovascular diseases in sub Saharan African [27].

5. CONCLUSION

Although there was no observed elevated abnormality in terms of isolated lipid parameters of scavengers in Port Harcourt dumpsites, elucidation of the atherogenic profile of the subjects reveal some level of cardiovascular risk which could accelerate into high profile cardiovascular disease if confounding factors such as life style changes and socio economic factors are not reasonably taken care of among the subjects.

CONSENT

All the subjects who participated in the study gave oral consent and confidentiality of their information was ensured.

ETHICAL APPROVAL

Ethical approval was obtained from Rivers State Health Research Ethics Committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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