

PREVALENCE AND ATHEROGENIC INDEX OF PLASMA AS A PREDICTOR OF CARDIOMETABOLIC SYNDROME AMONGST ROAD TRANSPORT WORKERS

ABSTRACT

Cardiometabolic Syndrome is a constellation of cardiovascular risk factors which include diabetes, hypertension, obesity, dyslipidaemia amongst others. This study was designed to determine the prevalence and predictors of cardiometabolic syndrome. The Study was a work – site based cross sectional study carried out on one hundred and twenty (120) workers at Imo Transport Corporation, Owerri. The Questionnaires were designed to address the background information of the respondents with respect to gender, age, job title, departments and address. The respondents were anthropometrically examined. The prevalence was calculated as a ratio and reported in percentage. Glucose was estimated using the oxidase- peroxidase enzymatic colourimetric method of Trinder. The lipid parameters of Total Cholesterol (TC) and Triglycerides (TG) were analyzed using the enzymatic colourimetric method of Friedewal. The High Density Lipoprotein Cholesterol (HDLc) was assayed after precipitation with phosphotungstate and magnesium ions. The results generated were analyzed using both Microsoft Excel 2016 and XLSTAT 2016, Statistical Software. Principal Component Analysis (PCA) and Multinomial Probit Regression Model were employed to determine the degree of relationship between the Atherogenic Index of Plasma (AIP) and Cardiometabolic parameters and their order of importance. The prevalence of cardiometabolic syndrome was found to be 17.5%. AIP was shown to be statistically significant and positively correlated with waist circumference (WC) and body mass index (BMI). Atherogenic Index of Plasma (AIP) was shown to be a principal dominant predictor of cardiometabolic syndrome. AIP as a calculated factor can be used in the clinical setting for assessing cardiometabolic syndrome beyond the routinely done lipid profile.

Keywords: Prevalence, Atherogenic Index of Plasma, Cardiometabolic Syndrome, Predictors, Principal Component Analysis

1. INTRODUCTION

There is a global increase in the prevalence of non-communicable diseases. This growth is felt more in the developing countries of the world [1]. These days in sub-Saharan Africa, non-communicable diseases are projected to surpass communicable diseases, whereas it used to be the other way. The trend is that there is a rise in both non-communicable and communicable diseases. This presents a double burden in the developing countries, a condition termed epidemiological transition [2;3].

Cardiometabolic Syndrome is a constellation of cardiovascular risk factors like hypertension, central adiposity, dyslipidaemia, type 2 diabetes. Other risk factors include insulin resistance,

sedentary lifestyle, consumption of calorie-dense foods and smoking [4]. Information concerning the prevalence and risk factors of cardiometabolic syndrome among sub-Saharan Africa is sparse, as most studies have been conducted in North America, Europe and Asia [5; 6]. To the best of our knowledge, no study has systematically evaluated the prevalence of cardiometabolic syndrome in Owerri, Nigeria. The prevalence of cardiometabolic syndrome was determined according to the International Diabetes Federation definition.

Atherogenic Index of Plasma (AIP) is the logarithmically transformed ratio of molar concentration of Triglycerides (TG) to the High Density Lipoprotein cholesterol (HDLc) [7]. This calculated fraction can be used in the clinical setting for assessing the risk of cardiovascular morbidity beyond the routinely done lipid profile. This is even more important in a poor resource setting with economic recession like in Nigeria and other developing nations.

2 METHODOLOGY

2.1 Study Area

Owerri is the capital of Imo State of Nigeria. It is situated at latitude 5.4891° N, longitude 7.0176° E. Owerri is mainly inhabited by Igbos, one of the major tribes in Nigeria. There are pockets of other ethnic groups in Owerri. The Otamiri and Nworie Rivers surround Owerri by the east and south respectively [8]. A Hausa community exists in Owerri Metropolis. They have an area predominantly habited by the Hausa community known as “Ama Hausa”. There are so many academic institutions both secondary and tertiary found in Owerri capital. The biggest hospital is the Federal Medical Centre, Owerri located at the Orlu road. There is an upsurge of hostels, junk restaurants and eatries in Owerri with an increased consumption of high-calorie diets. Night life and adoption of western lifestyle is fast becoming the trend especially among the youths in Owerri.

2.2 Study Site

The Study site was Imo Transport Corporation (ITC), Owerri. It is located at Plot 16 - 28, MCC-Uratta Road, Owerri. ITC is among the largest and oldest transportation Corporation and maintains a web of network in the country. They maintain excellent services, time conscious and have regards for safety. They operate Shuttle Services within and outside the State and offer Sports events, Corporate transportation, Local tours, Staff and school bus shuttle services.

ITC is a government owned Transport Corporation. Recently it was concessioned to a Private Partner known as Global Ginika Services Limited. It is believed that this Public – Private Partnership will create more jobs for the people of Imo State.

2.3 Study Design

This Study was a work – site based cross sectional study carried out on one hundred and twenty (120) workers at Imo Transport Corporation, Owerri.

2.4 Population for the Study

The Study population was made up of workers in the Imo Transport Corporation (ITC) Owerri, which included drivers, bus conductors, receptionists, security men, cashiers, accountants and traffic orderlies. The Corporation’s registers were used to determine the population/sampling frame.

2.4.1 Inclusion Criteria

The Criteria included workers of Imo Transport Corporation, Owerri who were 18 years and above. They had given informed written consent for the study.

2.4.2 Exclusion Criteria

Excluded from this study were Imo Transport Corporation, Owerri workers who had physical deformities affecting the spine and/or deformities that could not stand for height and weight the anthropometric measurements. Pregnant women were also excluded from the study.

2.5 Sample size Estimation

The sample size determined using the prevalence formula:

$$N = \frac{Z^2 P(1-P)}{T^2} \dots\dots\dots \text{Equation (1)}$$

Where N represents the sample size, T = tolerance error (0.05); P = prevalence from a previous study [9]; and; Z= 1.96, is the level of significance (standard normal deviate) which corresponds to 95% confidence level.

Substituting the applicable parameters to Equation (1) yields:

$$N = \frac{1.96^2 \times 0.075 (1-0.075)}{0.05^2}$$

$$= 106.6 \approx 107.$$

The sample size was calculated as 107 with attrition rate of 10% which gave a total of 120 respondents.

2.6 Sample Techniques

Stratified method was used to obtain a representative sample based on the inclusion criteria. Each department in the Corporation was regarded as a stratum.

2.7 Methods of Data Collection

2.7.1 Training of Research Assistants

Ten Healthcare professionals were engaged, trained and certified competent for the purpose of this study.

2.7.2 Questionnaire

The Questionnaires were designed to address the background information of the respondents with respect to gender, age, job title, departments and address.

2.7.3 Physical (Anthropometric) Measurements

The physical measurements undertaken were height (H), weight (W) and waist circumference (WC). The Body Mass Index (BMI) was calculated as the ratio of height and weight squared.

The weight was measured in kilograms with workers standing bare feet in their minimal clothing using weighing scale by MettlerToleds Switzerland and measured to the nearest kilogrammes. The weighing scale was calibrated every morning before use with a 10kg Standard weight and the zero mark was checked after each measurement. The Height was measured with the respondent being bare-footed and without head-gear or cap stood against the wall with the heels, gluteus and occiput touching the wall where the measuring tape was fixed. A pointer was placed firmly against the scale and the measurement read off on the scale in metres to the nearest centimetres.

The waist circumference was measured using a flexible tape and placing it at midway between the upper border of the iliac crest and the lower border of the coastal margin. The reading was taken when the tape was snug but did not compress the skin at the workers' exhalation [10].

2.7.4 Clinical Measurements

The blood pressure was measured using the auscultatory method with Standard mercury in glass Accuson[®] Sphygmomanometer and Stethoscope. This was in accordance with the JNC VII guidelines [11].

2.7.5 Laboratory Estimations

The Laboratory estimations carried out were the fasting lipid profile which represents the lipid parameters of Total Cholesterol (TC) and Triglycerides (TG) which were assayed using the enzymatic colourimetric method of Friedewald and others [12]. The High Density Lipoprotein (HDL) was assayed after precipitation with phosphotungstate and magnesium ions [13]. Glucose was estimated using the Glucose oxidase/Peroxidase method [14, 15, 3].

2.8 Method of Data Analysis

The data generated were entered into the Microsoft Excel 2016 and transported into XLSTAT 2016, which is an instinctive statistical software that interprets seamlessly into Microsoft Excel. The prevalence was calculated as a ratio and reported in percentage. The Principal Component Analysis was applied in determining the degree of relationship between the AIP and cardiometabolic parameters. The Principal Component Analysis reduced the outcome (dependent variables) on a set of variables (the independent variables) without losing information on the process. The XLSTAT was adopted by subjecting 8 independent variables $x_1 - x_8$ (WC, BMI, AGE, PP, MABP, FBS, DBP, SBP) to PCA to identify, the most weighted parameters otherwise known as principal components or factors which gave the information that described the majority of the data set after data reduction. Varimax rotation was performed on these extracted factors to improve the interpretation of the plot as it increased the absolute values. Furthermore, Logistic Probit Regression Analysis was then employed to develop models with regard to the outcome from the application of PCA (see Equations 3-5).

Operational Definition

The authors defined Cardiometabolic Syndrome according to the International Diabetes Federation Criteria: Any person was considered to have cardiometabolic syndrome in the presence of $WC \geq 102\text{ cm}$ for men and 88 cm for women plus any two or more of the following: Systolic and/or diastolic blood pressure $\geq 130/85\text{ mmHg}$ and/or hypertension on treatment. Fasting blood glucose $\geq 100\text{ mg/dl}$ and/or diabetes mellitus on treatment, Triglyceride level $\geq 150\text{ mg/dl}$ and/or hypertriglyceridaemia on treatment and high density lipoprotein cholesterol (HDLc) $< 40\text{ mg/dl}$ for men or $> 50\text{ mg/dl}$ for women and/or dyslipidaemia on treatment [16, 17].

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Demography Distribution

One hundred and twenty (120) participants who scaled through the inclusion criteria and who gave their informed written consent were physically examined and subsequently, questionnaires were administered to them primarily to generate background information on gender, age, sex, job description and department (see Table 1 and Figure 2). Also, Table 2 presents the descriptive statistic of the participants' data with respect to Cardiovascular Parameters. The prevalence of cardiometabolic syndrome among ITC workers was determined to be 17.5% (see Equation 2)

$$\begin{aligned} \text{Prevalence Rate} &= \frac{\text{No. of Respondents with Cardiometabolic Risk}}{\text{Total No. of Respondents at Risk}} \times 100 \\ &= \frac{21}{120} \times 100 = 17.5 \end{aligned} \quad (2)$$

Table 1: Demographic Information of ITC Workers

Age Group (years)	Male		Female		Total No. of respondents in Age group	Proportion of respondents in Age group (%)
	No. of Respondents	Proportion of respondents (%)	No. of Respondents	Proportion of respondents (%)		
25 – 34	8	6.7	8	6.7	16	13.4
35 – 44	32	26.7	21	17.5	53	44.2
45 – 54	28	23.3	13	10.8	41	34.1
55 – 64	10	8.3	0	0.0	10	8.3
65 and above	0	0.0	0	0.0	0	0.0
Total	78	65	42	35	120	100.0

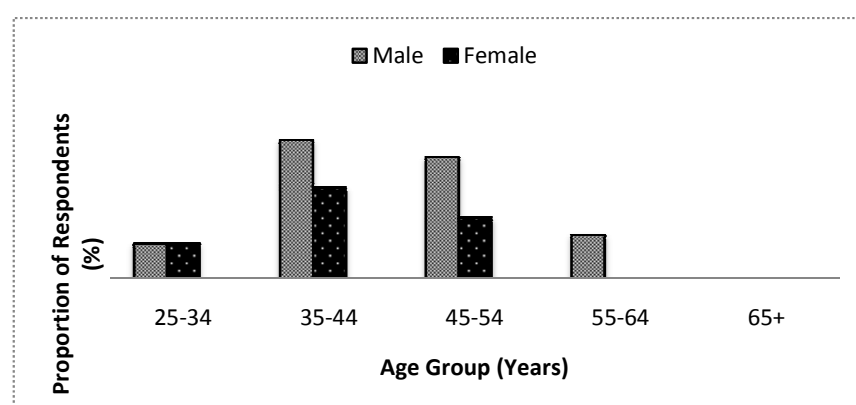


Fig 1: Age Distribution of Respondents of ITC Workers

Table 2: Descriptive Statistics of Cardiovascular Parameters of ITC Workers

Variable	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
AIP	120	0.01	0.06	0.0403	0.00073	0.00798
WC	120	65	125	91.6529	1.1032	12.13515
BMI	120	13.13	53.33	27.5874	0.5207	5.72766
FBS	120	10	401	95.7355	4.22414	46.46554
SBP	120	90	193	124.314	1.81921	20.01126
DBP	120	10	110	80.5537	1.17386	12.91249

3.1.2 Principal Component Analysis

On application of Principal Component Analysis (PCA) on the collected data, Table 3 was obtained as the output, with Figure 2 as the extracted factors (scree plot). Also, The biplot of the correlation of respondents on the variables ($x_1 - x_8$) is as shown in Figure 3 and Tables 4 – 5 present the percentage contribution of the variables after undergoing varimax rotation.

Table 3: Principal Component Analysis:

	F1	F2	F3	F4	F5	F6
Eigenvalue	3.0262	1.6278	1.4047	0.9570	0.8039	0.1804
Variability (%)	37.8277	20.3474	17.5593	11.9621	10.0490	2.2544
Cumulative %	37.8277	58.1751	75.7344	87.6966	97.7456	100.0000

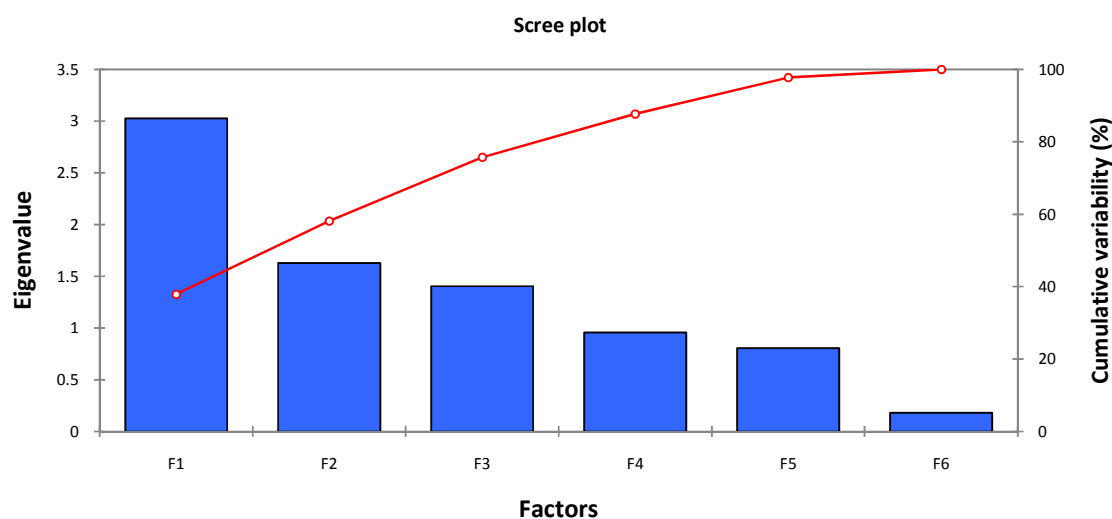


Figure 2: Scree plot for factor extraction with respect to the variables

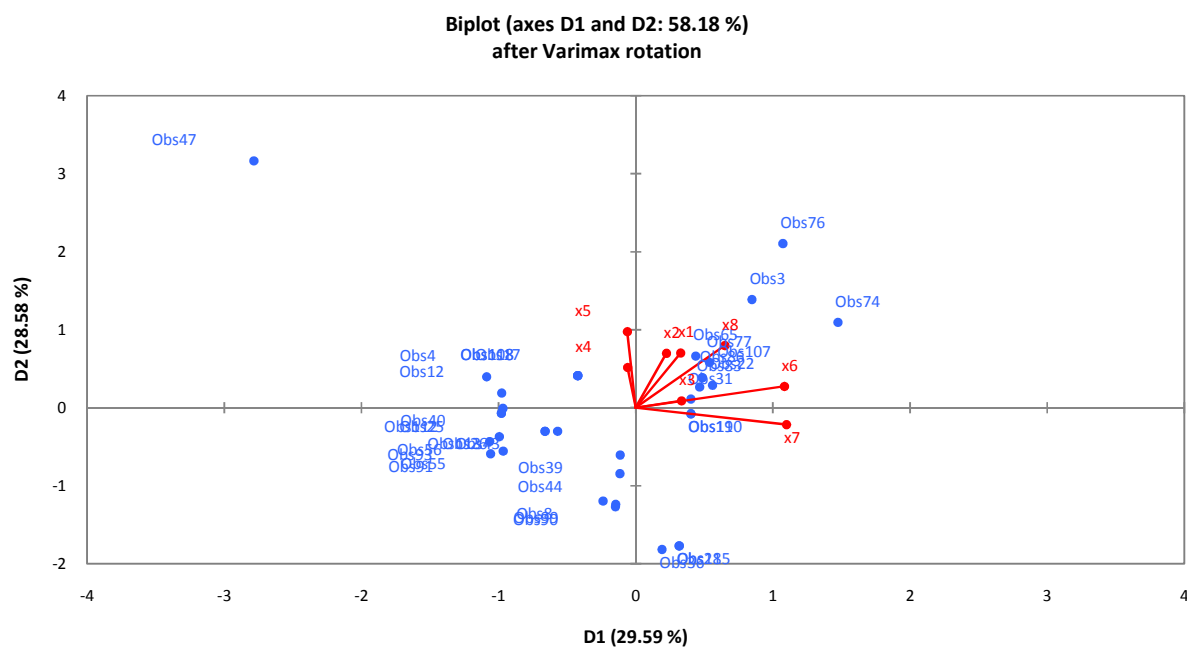


Figure 3: Biplot of the correlation of respondents on the variables

Table 4: Contribution of the variables (%) after Varimax rotation:

Variable	D1	D2
x ₈	13.7202	21.4962
x ₇	39.2669	1.5340
x ₆	38.0717	2.5306
x ₅	0.1232	31.9971
x ₄	0.1138	8.9866
x ₁	3.4605	16.7093
x ₂	1.6161	16.4662
x ₃	3.6275	0.2799

Table 5: Squared cosines of the variables after Varimax rotation:

Variables	D1	D2
x ₈	0.3248	0.4915
x ₇	0.9297	0.0351
x ₆	0.9014	0.0579

x ₅	0.0029	0.7316
x ₄	0.0027	0.2055
x ₁	0.0819	0.3821
x ₂	0.0383	0.3765
x ₃	0.0859	0.0064

3.1.3 Model Development for Atherogenic Index of Plasma (AIP)

From the output of PCA, three logistic probit models were developed assuming the collected data type as ordinal at 95% confidence interval. AIP was assumed as the dependent variable (y) while WC, BMI, FBS, Age, PP, MAPB, DBP, and SBP were assumed as independent variables representing x₁, x₂, x₃, x₄, x₅, x₆, x₇, and x₈, respectively (see Appendix A). The first model employed all the variables in its development while the second model development involved the use of variables corresponding to the extracted factor 1 (F1) after varimax rotation (see Table 5). Finally, the third model was developed using variables corresponding to extracted factor 2 (F2). Table 6 presents the summary of the regression analyses with the respective resultant goodness of fits for each developed model (see Appendix B). Variable x₇ and x₈ were omitted in the model development for Model 1 due to multicollinearity between them (see Equation 3). The frequency distribution of Atherogenic Index of Plasma and the risk stratification among workers in ITC, is shown in Table 7.

Table 6: Summary of Regression Analyses

Model	Goodness of Fit (R ²)	Modelled Independent Variable	Model Parameter Interpretation
Model 1	65.87%	x ₁ , x ₂ , x ₃ , x ₄ , x ₅ , x ₆ , x ₇ , x ₈	WC, BMI, FBS, Age, PP, MAPB, DBP, SBP.
Model 2	64.45%	x ₃ , x ₆ , x ₇	FBS, MAPB, DBP .
Model 3	65.62%	x ₁ , x ₂ , x ₄ , x ₅ , x ₈	WC, BMI, Age, PP, SBP.

Equations (3 – 5) are the developed models:

Model 1:

$$y = -0.093x_1 - 0.127x_2 + 0.091x_3 - 0.068x_4 + 0.03x_5 - 0.104x_6 + 2.9618 \quad (3)$$

Model 2:

$$y = 0.101x_3 - 0.204x_6 + 0.049x_7 + 1.849 \quad (4)$$

Model 3:

$$y = -0.127x_1 - 0.098x_2 - 0.066x_4 + 0.119x_5 - 0.128x_8 + 3.084 \quad (5)$$

Table 7: Frequency Distribution of Atherogenic Index of Plasma (AIP).

AIP Range	Frequency	Percentage (%)
AIP < 0.011	0	0.0
AIP = 0.011 – 0.021	2	2.0
AIP >0.021	118	98.0
Total	120	100

3.2 Discussion

3.2.1 Demography Distribution

The age distribution of the workers ranged from 25.0 to 64.0 years. Seventy eight (78) respondents were males while forty two (42) were females. The modal age group for this study was the age category of 35.0 – 44.0 years. This represents 32 and 21 males and females participants, respectively (see Table 1 & Figure 1). The distribution of the measured variables ranged from 65-125cm, 13.13-53.33, 10-401mg/dl, 193-90mmHg, 10-110mmHg and 0.01-0.06 with respect to WC, BMI, FBS, SBP, DBP, and AIP, respectively (see Table 2). While the mean plus/minus the standard deviation of AIP with respect to this study was 0.0403 ± 0.008 (see Table 2).

3.2.2 Principal Component Analysis

The output from the analysis of the collected data using PCA, generated six factors (F1 – F6). This is with respect to the eigenvalues and eigenvectors of the cardiovascular parameter data collected from the various participants (see Table 3). Factors 1 and 2 cumulatively reflects 58% of the collected parameters (cardiovascular parameters) (see Figure 2). This is just above average which can be used as the minimum factor that could be employed for reasonable judgement or prediction based on the collected cardiovascular parameters. On the application of varimax rotation on the extracted factors, D1 and D2 accounting for the percentage contribution of the variables generated (see Tables 4 and 5). From Table 4, variable x_6 (MAPB), and x_7 (DBP) have relatively high contribution with respect to D1, while variable x_5 (PP) has the highest contribution with respect to D2, followed by x_8 (SBP) and finally

x_1 (WC) and x_2 (BMI) which have the same contribution to D2. The biplot (see Figure 3) is a plot of the correlation of respondents on the cardiovascular variables. It can be seen from the biplot that most of the variables correlate positively with each other when reflected on the respondents (participants).

3.2.3 Regression of Principal Components

Kishore and others [18] used multivariate logistic regression analysis to demonstrate a strong association between age and hypertension. The models developed using logistic probit regression analysis yielded goodness fit of 64 – 65%. From the three models developed it showed that FBS, MAPB, and DBP have very high contribution or influence on AIP (see Table 7). Thus, one could confidently make predictions of AIP using FBS, MAPB, and DBP (see Equation 4). This is not at variance with the study reported by Niroumand and others [19]. In which they found a significant association between AIP and FBS. In another study, it was shown that hyperglycaemia and hypertension are contributory to the development of atherosclerosis [20]. From Table 7 the AIP risk stratification has been presented as AIP less than 0.11 to be of low risk, AIP greater than 0.11 to 0.0210 to be of moderate risk and AIP greater than 0.0210 to be of a high risk. Among the ITC workers more than 98% of them have a high risk of developing cardiometabolic syndrome. They carried a high value of AIP. Only two percent of the workers have a moderate risk of developing cardiometabolic syndrome.

This Study has demonstrated that Atherogenic Index of Plasma (AIP) correlates statistically and significantly with WC and BMI (Equation 4). According to Grundy and others [21], Bhardwaj and others [7] both WC and BMI are important components and determinants of cardiometabolic syndrome. Thus, this study has shown that AIP is a strong predictor of cardiometabolic syndrome. This is in agreement with the study of Rexrode and others [22] and Arden and others [23] who reported the usefulness of WC as an indicator of truncal obesity which is associated with abnormal adiposity. This also, is a strong risk factor for cardiovascular morbidity and diabetes. Furthermore, in a study carried out in a Qatar population, it was found that WC happened to be the best predictor of cardiometabolic syndrome. In another cross-sectional study which took place among Whites and African-Americans in the United States of America, WC was reported to be the most powerful anthropometric tool in predicting cardiometabolic syndrome [24]. This Study has also demonstrated that the prevalence of cardiometabolic syndrome in Owerri was 17.5%.

Adediran and others [25] reported that the cardiometabolic syndrome was 12.1% in Lagos. In Ethiopia in a study carried out among working adults the prevalence of cardiometabolic syndrome was 17.9% [26].

Study Implications

Cardiometabolic Syndrome is a constellation of cardiovascular risk factors and it is no longer rare in sub-Saharan Africa. The prevalence is increasing and the trend is that it increases with age. Nigeria is not an exception, the prevalence as reported in Jos was as high as 63.6% [27]. This could be attributed to the adoption of western life style and departure from traditional African lifestyles.

In situations where other lipid parameters like TG and HDLc appear normal, the use of AIP may be of diagnostic value [28]. Many clinicians are now using AIP as significant predictor of atherosclerosis [29]. There is also the advantage of using AIP when other sub-fractions appear normal or elevated. The risk stratification of AIP into low, moderate and high risk helps in determining the appropriate intervention to be applied which could be physical activity, nutritional, pharmacological or surgical.

CONCLUSION

This study has established that the:

- i) Prevalence of cardiometabolic syndrome in Owerri is 17.5% and the age group of 35.0 – 54.0 years were mostly affected;
- ii) AIP has shown to be statistically significant and positively correlated with WC and BMI; and
- iii) AIP has shown to be a statistically significant predictor of cardiometabolic syndrome.

Recommendations

The following recommendations were made as a result of this study:

- i) The increasing trend of epidemiological and nutritional transition should be revised. There is need to introduce preventive strategies and interventional programmes in the workplace.
- ii) This can be accomplished through the establishment of occupational health programmes that increase physical activities.

- iii) Aerobic exercises should be encouraged and may take the form of cycling, swimming or jogging. Thirty minutes brisk walking four times a week could be helpful. The benefits of exercise cannot be overemphasized, it reduces both SBP, DBP, Blood lipids, FBS, BMI and WC. It is the most singular important tool in preventing cardiovascular risks.
- iv) Efforts should be made to reduce intake of calorie-dense foods. Whole grain cereals, fruits, vegetables and white meat should be taken. One must avoid the intake of sugar containing beverages and other simple sugars.

Ethical clearance

Ethical approval was obtained from the Chairman of Research & Ethics Committee, Department of Health Services, Federal University of Technology, Owerri. All respondents gave their informed written consent for the study. All information shared during the research

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APPENDIX A – CARDIOVASCULAR PARAMETERS

Table A1: Cardiovascular Parameter of ITC Workers

No	AIP	WC	BMI (kg/m)	FBS	Age (yrs)	pp	MAPB	DBP (mm/Hg)	SBP (mm/Hg)
	y	x ₁	x ₂	x ₃	x ₄	x ₅	x ₆	x ₇	x ₈
1	0.049	89	48.23	107	53	50	96.667	80	130
2	0.0386	84	42.78	79	52	40	93.333	80	120
3	0.056	115	58.24	203	44	70	113.333	90	160
4	0.0433	90	44.12	10	50	50	76.667	60	110
5	0.0317	84	41.67	146	40	40	83.333	70	110
6	0.0382	103	53.53	108	39	50	86.667	70	120
7	0.033	96	50.31	76	29	30	80	70	100
8	0.0269	88	40.74	83	35	10	83.333	80	90
9	0.0452	80	34.36	104	40	50	86.667	70	120
10	0.042	80	39.08	94	50	50	96.667	80	130
11	0.0406	74	35.32	70	62	20	96.667	90	110
12	0.0235	92	46.01	108	50	40	73.333	60	100
13	0.0372	87	44.91	108	58	40	93.333	80	120
14	0.0459	72	28.75	102	32	40	83.333	70	110
15	0.0419	99	44.67	134	51	50	106.667	90	140
16	0.0356	97	51.51	80	48	40	103.333	90	130
17	0.0513	94	48.57	107	45	50	86.667	70	120
18	0.0468	118	63.16	91	37	50	106.667	90	140
19	0.0496	94	47.6	78	40	40	103.333	90	130
20	0.0457	89	43.29	80	53	50	106.667	90	140
21	0.0323	86	40.85	401	43	70	113.333	90	160
22	0.0433	97	52.87	113	36	50	106.667	90	140
23	0.0431	104	52.25	100	48	30	100	90	120
24	0.033	96	50.31	76	29	30	80	70	100
25	0.0451	91	43.07	79	40	40	73.333	60	100
26	0.0384	77	38.82	88	47	40	81.333	68	108
27	0.0417	94	47.85	100	47	10	93.333	90	100
28	0.044	65	31.65	89	22	20	96.667	90	110
29	0.0475	93	50	89	43	10	93.333	90	100
30	0.0322	104	50.7	106	37	40	103.333	90	130
31	0.0281	96	48.05	99	48	40	103.333	90	130
32	0.0447	99	52.26	85	26	40	93.333	80	120
33	0.0404	67	46.88	82	34	39	92	79	118
34	0.0366	100	50	102	54	40	93.333	80	120
35	0.0331	102	53.31	87	45	20	96.667	90	110

36	0.0356	71	31.17	73	30	10	93.333	90	100
37	0.0468	118	63.16	91	37	50	106.667	90	140
38	0.0227	89	40.12	62	62	40	93.333	80	120
39	0.0356	85	38.69	102	42	30	90	80	110
40	0.0364	92	46.86	77	38	40	73.333	60	100
41	0.0339	85	39.49	85	60	30	90	80	110
42	0.0235	82	37.11	78	49	50	106.667	90	140
43	0.0466	75	42.33	85	45	40	83.333	70	110
44	0.0373	79	35.54	96	38	30	90	80	110
45	0.0408	84	44.94	84	27	20	86.667	80	100
46	0.0432	96	48.07	75	43	70	113.333	90	160
47	0.0426	89	47.02	85	64	130	53.333	10	140
48	0.0432	102	55.28	105	40	20	96.667	90	110
49	0.0345	81	41.21	89	40	50	86.667	70	120
50	0.0398	88	42.6	227	56	30	100	90	120
51	0.0408	69	31.25	98	35	40	93.333	80	120
52	0.025	83	37.5	84	38	60	100	80	140
53	0.044	85	43.67	91	36	40	93.333	80	120
54	0.0419	115	57.69	89	50	40	103.333	90	130
55	0.0376	75	36.84	91	35	40	73.333	60	100
56	0.0422	85	36.18	69	37	40	73.333	60	100
57	0.0504	91	49.4	90	33	40	83.333	70	110
58	0.0514	67	57.42	212	40	30	100	90	120
59	0.0406	97	48.13	105	29	40	83.333	70	110
60	0.0521	104	52.87	84	36	20	96.667	90	110
61	0.0456	102	50.56	81	51	30	100	90	120
62	0.047	88	35.29	97	56	50	86.667	70	120
63	0.039	97	41.04	75	52	108	121	85	193
64	0.0504	91	49.4	90	33	40	83.333	70	110
65	0.0365	99	56.73	83	50	50	106.667	90	140
66	0.0371	96	43.45	143	30	50	106.667	90	140
67	0.0472	94	46.28	83	42	40	93.333	80	120
68	0.0406	83	40.63	81	45	50	106.667	90	140
69	0.0478	92	43.9	83	39	50	96.667	80	130
70	0.0433	104	49.69	87	40	40	93.333	80	120
71	0.0477	91	46.86	93	52	40	93.333	80	120
72	0.0355	96	46.88	94	61	60	100	80	140
73	2.19	90	5.27	36	54	-26	101.333	110	84

74	0.0373	102	52.78	74	51	70	133.333	110	180
75	0.033	96	50.31	76	29	30	80	70	100
76	0.0547	119	67.28	62	56	80	126.667	100	180
77	0.0468	107	55.56	101	40	50	106.667	90	140
78	0.0469	125	61.25	90	52	50	106.667	90	140
79	0.0444	83	41.57	90	35	40	93.333	80	120
80	0.0432	91	40.12	61	47	30	90	80	110
81	0.0368	98	44.64	81	62	50	86.667	70	120
82	0.0333	108	59.52	81	34	50	86.667	70	120
83	0.0438	95	48.24	81	42	50	106.667	90	140
84	0.0446	91	41.32	104	48	70	113.333	90	160
85	0.0443	98	46.43	74	61	40	83.333	70	110
86	0.0413	99	51.52	84	41	50	106.667	90	140
87	0.0532	86	36.42	88	60	80	106.667	80	160
88	0.0513	98	48.78	81	38	50	106.667	90	140
89	0.0487	124	72.28	65	33	20	86.667	80	100
90	0.0493	69	30	66	30	30	90	80	110
91	0.0396	71	29.76	74	45	40	73.333	60	100
92	0.0426	118	64.53	111	39	60	100	80	140
93	0.0345	85	32.5	33	38	40	73.333	60	100
94	0.0384	80	40	71	26	30	100	90	120
95	0.038	95	48.24	76	36	20	96.667	90	110
96	0.0508	100	67.76	81	53	40	83.333	70	110
97	0.0434	95	46.79	95	48	40	93.333	80	120
98	0.039	82	37.13	79	56	40	113.333	100	140
99	0.0163	70	36.67	127	38	20	86.667	80	100
100	0.0208	88	31.71	90	24	30	100	90	120
101	0.0398	88	42.6	227	56	30	100	90	120
102	0.0408	69	31.25	98	35	40	93.333	80	120
103	0.025	83	37.5	84	38	60	100	80	140
104	0.044	85	43.67	91	36	40	93.333	80	120
105	0.0446	91	41.32	104	48	70	113.333	90	160
106	0.0443	98	46.43	74	61	40	83.333	70	110
107	0.0413	99	51.52	84	41	50	106.667	90	140
108	0.0513	94	48.57	107	45	50	86.667	70	120
109	0.0468	118	63.16	91	37	50	106.667	90	140
110	0.0496	94	47.6	78	40	40	103.333	90	130
111	0.0457	89	43.29	80	53	50	106.667	90	140

112	0.0451	91	43.07	79	40	40	73.333	60	100
113	0.0384	77	38.82	88	47	40	81.333	68	108
114	0.0417	94	47.85	100	47	10	93.333	90	100
115	0.044	65	31.65	89	22	20	96.667	90	110
116	0.0475	93	50	89	43	10	93.333	90	100
117	0.0322	104	50.7	106	37	40	103.333	90	130
118	0.0513	94	48.57	107	45	50	86.667	70	120
119	0.0468	118	63.16	91	37	50	106.667	90	140
120	0.0443	98	46.43	74	61	40	83.333	70	110

WC = Waist Circumference; FBS = Fasting Blood Sugar; DBP = Diastolic Blood Pressure; SBP = Systolic Blood Pressure; BMI= Body Mass Index; AIP = Anthrogenic Index of Plasma.

APPENDIX B – MODEL DEVELOPMENT

Goodness of fit statistics (Variable y) – MODEL 1:

DF	38
-2	
Log(Likelihood)	1002.4617
R ² (Cox and Snell)	0.6587
R ² (Nagelkerke)	0.6588
AIC	1166.4617
SBC	1395.0360
Iterations	6

Goodness of fit statistics (Variable y) – MODEL 2:

DF	41
-2	
Log(Likelihood)	1007.3892
R ² (Cox and Snell)	0.6444
R ² (Nagelkerke)	0.6445
AIC	1165.3892
SBC	1385.6010
Iterations	6

Goodness of fit statistics (Variable y) – MODEL 3:

DF	39
-2 Log(Likelihood)	1003.3479
R ² (Cox and Snell)	0.6562
R ² (Nagelkerke)	0.6563
AIC	1165.3479
SBC	1391.1348
Iterations	6