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Prevalence and Atherogenic Index of Plasma as a Predictor of Cardiometabolic Syndrome amongst Ken Saro-Wiwa Polytechnicstudent.

Miikue – Yobe, T. Francis*and Udeagha,Kingsley C.
Department of science laboratory technology Ken Saro-Wiwa Polytechnic, Bori
Corresponding Author:T. Francis

Abstract:*Cardiometabolic syndrome (CMS) sometimes regarded as insulin resistance syndrome is a combination of metabolic risk factors, including a combination of diabetes mellitus, systemic arterial hypertension, obesity and hyperlipidemia. This study was carried out on 50 students of Ken Saro-Wiwa Polytechnic (Kenpoly) Bori, using atherogenic index of plasma (AIP) to determine the prevalence and as a predictor of cardiometabolic syndrome among students of school age. Biochemical (lipid profile analysis) as well as anthropometrical (waist circumference, height, weight, systolic and diastolic blood pressure) tests were performed using standard method of measurements. In addition to questionnaires designed to assess the biodata, background information and health history of participants in respect to smoking, diabetics and hypertension. AIP was derived as log of (triglyceride/high density lipoprotein cholesterol). Results were analyzed using regression analysis at p≤0.05. The prevalence was calculated as ratio of (number of participant at risk/the total number of the participant) and reported in percentage, and was found to be 20%. The mean age in years of the respondent males (56%) was 26.80±3.30 while that of the females (44%) was 24.10±2.30. AIP ranged from -0.0013 to 0.451 with overall mean of -0.033±0.351. There was a significant negative correlation between (AIP) and waist circumference (r=-0.144,p=0.319), age (r=-0.115,p=0.427) and pulse pressure (r=-0.143,p=0.321) and a positive correlation between AIP, diastolic blood pressure (DBP) and fasting blood sugar (FBS) levels. The result indicated that AIP may be an independent factor predicting the risk of cardiometabolic syndromes amongst students of Kenpoly. It is therefore recommended that further studies be conducted on a large population of students to clearly elucidate the inter-relationship between AIP and the risk of cardiometabolic syndrome.*

Keywords*: cardiometabolic syndrome; atherogenic index of plasma; lipid profile; predictor; prevalence; regression analysis.*

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I. Introduction

Atherogenic index of plasma defined as the logarithm to base ten of triglyceride divided by high density lipoprotein cholesterol HDL-C, is been used as a predictor of cardio metabolic syndrome a constellation of some cardiovascular diseases or risk factors.

Pathological accumulation of cholesterol (plaques) as a result of excess supplies through diet can obstruct blood vessels resulting to the condition of atherosclerosis. This condition is associated with high level of cholesterol in the blood and particularly that of the low density lipoprotein cholesterol (LDL-C) and triglyceride (*Nelson and Cox, 2013).*

Prevalence of non–communicable disease has being on the increase globally. Such non-communicable disease as cardio vascular disease (CVD) is rapidly growing or gaining prevalence in developing countries such as sub-Saharan Africa (SSA) (*Wekesa et al.,* 2016).

Recently in sub-Saharan Africa it has been found that non- communicable disease prevalence seems to surpass communicate disease of which the reverse has being the case before now (*Onoh et al.,* 2017).

Cardio metabolic syndrome (CMS) sometimes regarded as insulin resistance syndrome is a constellation of some metabolic disorders which essentially include hypertension, central obesity or adiposity, Hyperlipidemia and diabetes mellitus. Relative to these metabolic disease is the development of atherosclerotic cardiovascular disease (ASCVD). Cardiovascular disease has become of interest as its associated disease such as diabetes and hypertension has being a major risk factor surrounding the death of over 18 million people around the world (*Kelli et al., 2015*).

International Diabetes Federation (IDF) defines metabolic syndrome based on central obesity and weight circumference (WC) for men 94cm, women 80cm, raised triglyceride≥ 1.7mmol/l (150mg/dl) reduced

HDL–cholesterol <1.03mmol/l (40mg/dl) in male or <1.29mmol/l (50mg/dl) in females raised blood pressure of systolic ≥ 130mmHg or diastolic ≥ 85mmHg or treatment of previously diagnosed hypertension and raised fasting glucose ≥5.6mmol/l (100mg/dl) or previously diagnosed type 2 diabetes (www.idf.org).

The increase in obesity has also been used globally to relate to increase in CMS. Such that out of 1.1 billion reported cases of overweight, 313 million are obsessed. In some region of the world such as the Middle East, the rate of obesity has tripled with the past 20 years, thus leaving the region at the highest risk of disease effect (*Kelli et al.,* 2015).

Furthermore, atherogenic index of Plasma (AIP), is defined as the logarithmically transformed ratio of triglyceride (TG) to high Density lipoprotein cholesterol (HDLC). AIP present a superior predictor of cardio vascular disease (CVD) than previous lipid parameters. AIP by definition is dependent on HDL-C and TG and correlates to influence the risk of cardiovascular disease and other related ailment of CMS (Noumegni *et al.,* 2017).

Since the most efficient method of tackling this rapid spreading epidemic cardio vascular disease is thought to be by preventing the risk factors essentially lipid make–up (profile) of an individual and understanding their mechanism of action, considering inadequate data to ascertain this population risk and vulnerability to cardio metabolic disease, the present study is conducted to assess the relationship between AIP and CVD among of Students in Ken Saro-Wiwa Polytechnic Bori, Nigeria, as a means proffering recommendation for early detection of the disease.

II. Methods

Study Area

The research work was conducted in Bori, Khana Local Government Area of Rivers State in a Government owned institution; Ken Saro-Wiwa Polytechnic located along Zaakpon Road. The institution is among the best rated learning Polytechnic in Rivers State and Nigeria at large.

Study Design

The study was a work carried out on 50 students of the institution, which were selected randomly from various school.

Inclusion Criteria

The criteria include males and female students of the above mentioned institution who has been given a written consent regarding their involvement in the study and were between the ages 18 years and above.

Exclusion Criteria

Excluded from this study are student who were physically challenged and could not stand for height and weight measurements as well as other anthropometric measurement and also pregnant and nursing mothers.

III. Method of Data Collection

Training of Research Personnel

A health care professional was consulted an to train the researchers on the handling of clinical and sensitive parts of the research data collection such as registration, questionnaire administration,anthropometric measurement, clinical measurement and biochemical laboratory estimation.

Questionnaire Design

A questionnaire was designed to address the respondents background information such as gender, age, sex, smoking history, use of alcohol, family history of diabetes mellitus and hypertension and some socio-demographic characteristics and address.

Blood Sampling

Blood samples of all the participants were taken after 10-12 hours fasting to determine the lipid profile and FBS. All samples were taken to the Biochemistry Research laboratory.

Biochemical Laboratory Estimation

The biochemical estimations carried out were those of fasting blood sugar as well as fasting lipid profile which included the following parameters total cholesterol, triglyceride (TG) and high density lipoprotein which was assayed using enzymatic colorimetric method.

Procedure for Triglyceride (TG)

A volume (3.0ml) of the colour reagent was pippetted into test corresponding to test, standard and blank to which 0.03ml of plasma obtained from the blood sample were added to the test tubes while same volume of standard and distilled water were added to the standard and blank test tubes respectively. The Solution was properly mixed and incubated at 37^0C for 15 minutes. Absorbance reading of the tests and standard solution were read at 420nm wavelength and concentration obtained by calculation.

Procedure for Total Cholesterol TC

Three test tubes were set-up labeled T_1, (standard) and T_2 (test sample). T_1 contained 0.01ml distilled water, T_2 contained 0.01ml plasma. To each tube was added 1.0ml of Randox cholesterol reagent.
The contents were thoroughly mixed. Placed in water bath at 25^0c for 10min after which their absorbance (A) were read at 546nm, against the blank in a spectrophotometer and concentration obtained by calculation.

Procedure for High Density Lipoprotein Cholesterol (HDLC)

This involve precipitation reaction three test tubes were set-up labeled T_1 (blank) T_2, standard and T_3 (test sample) T_3 contained 0.50ml plasma. To each tube was added 1.00ml randox precipitant. The content were thoroughly mixed and allowed to stand for 10min at room temperature before they where centrifuged at 400rpm for 10min. The supernatants were than obtained and their cholesterol content was determined as showed below.
Three test tubes were set-up labeled T_1 (blank) T_2 (Randox standard cholesterol) and T_3 (test sample). T_1 contained 0.10ml of supernatant from the tube above, T_2 contained 0.10ml of the supernatant randox from the standard cholesterol solution tube and water T_3 contained 0.10ml supernatant from sample tube. To each tube was added 1.0ml of Randox reagent. The contents were thoroughly mixed, placed in water bath at 25^0c for 10min after which there absorbance (A) were read at 546nm, against the blank in a spectrophotometer and concentration obtained by calculation.

Body Mass Index (BMI)

Body mass index (BMI) was calculated based on the following formular, weight (kg) divided by height in square meter (m^2). BMI is used to predict under weight, normal weight, over weight and obesity.
Body weight was measured using a standard analogue scale in (kg) with participants standing bare foot in their minimal clothing. The weighting scale was checked and adjusted to zero calibration mark before measurement. Height of the participants were measured with the participant being bare footed without cap or head gear and stood against the wall with the head touching the wall where a pointer was placed firmly against the wall and measurement read on the scale to the nearest centimeter.
Based on the result obtained, participants were placed under four different categories under weight (BMI <18.5), Normal (18.5≤BMI<25) over weight (25≤BMI<30) and obesity BMI>,30 *(Niroumand et al.,* 2015).

Waist Circumference (WC)

Waist circumference was measured using a flexible measuring tape and measurement was taken to the nearest centimeter in the standing position during exhalation by participants with tape not compressing their skin.

Blood Pressure

The blood pressure (BP) of participants were measured using an electronic sphygmomanometer to determine the systolic blood pressure (SBP) as well as the diastolic blood pressure DBP respectively.

Statistical Analysis

The data were obtained in duplicate and expressed as mean ± SD and where then compared using regression analysis. Values were considered significant at P≤0.05 level of statistic.

IV. Result

Table 1: Distribution of Clinical and Biochemical parameter

Parameter	Total	Male	Female
	n = 50	n=28	n=22
Mean AIP	-0.033±0.331	-0.054±0.33	-0.007±0.88
Mean WC (cm)	78.44±6.58	77.64±4.67	79.45±8.57
Mean BMI (kg/m^2)	21.74±2.74	21.59±2.34	21.93±3.21
Mean FBS (mmol/l)	4.13±0.39	4.07±0.44	4.21±0.31
Mean AGE (Year)	25.10±2.94	26.78±3.33	24.14±2.26
Mean PP (mmHg)	40.32±11.94	44.82±13.89	34.59±9.98
Mean NAPB	78.64±10.81	78.36±11.39	78.99±10.98.
Mean DBP (mmHg)	65.56±10.65	64.11±9.81	67.41±11.48
Mean SBP (mmHg)	105.48±13.78	108.93±12.96	102±10.60.

Result are presented as mean ± standard deviation for duplicate analysis. BMI: Body mass index, AIP: Atherogenic index of plasma, WC: waist circumference, FBS: Fasting Blood sugar PP: pulse pressure, MAPB: Mean arterial pulse Blood, DBP: diastolic Blood pressure, SBP systolic Blood pressure.
Prediction model of cardiometabolic syndrome using AIP as dependent variable:
$Y=b_o–b_1x_1+b_2x_2+b_3x_3-b_4x_4+b_5x_5+b_6x_6+b_7x_7-b_8x_8$---model 1.
$Y=0.496-0.013x_1+0.016x_2+0.013x_4+0.27x_5+0.380x_6+0.028x_7-0.0406X_8$

Where X_1=WC,X_2 BMI,X_3=FBS,X_4=AGE,X_5=PP,X_6=MAPB,X_7=DBP,
X_8 = SBP and Y = AIP.

The study population consisted of 50 students of 56% (n=28) male of mean age 26.78±3.33 year and 44%(n=22) female of mean age 24.14±2.60. Mean overall atherogenic index of plasma (AIP)-0.054±, 0.33 and -0.007±0.38 in male and female respectively.

The overall mean of their body mass index (BMI) in kg/m^2 was 21.74± 2.74 with 21.39±2.34 for male and 21.93±3.21 i and female respondents respectively. The overall waist circumference (WC) of the population has 78.44±2.74 with 77.64±4.69 and 79.45±8.57 for male and female respondents respectively as shown in table 1.0 above.

The mean FBS in (mmol/l) was 4.07±0.44 in males and 4.21±0.31 in females with an overall of 4.13±0.39.

The overall age distribution of the population was 25.10±2.94 with 26.78±3.33 and 24.14±2.26 in males and females respondents.

The measure of total hypertension diastolic blood pressure (DBP) (mmHg) of the population was 64.11±9.81 in males and 67.41±11.48 in females, total systolic blood pressure (SBP) (mmHg) was 108.93±.96 and 102±10.60 in males and females respectively. The overall DBP and SBP were 65.56±10.65 and 105.48± 13.78 respectively.

Pulse pressure (PP) and mean arterial pulse blood (MAPB) has an overall mean of 40.32±11.94 and 78.64± 10.81 respectively with mean PP in males and females as 44.82±13.89 and 34.59±9.98. MAPB 78.36±11.39 and 78.99±10.98 in males and females respectively.

Table 2: Correlation between the Atherogenic Index of Plasma (AIP) and other variables

Variable	Coefficient (r)	P. Value
WC	-0.144	0.319
FBS	0.053	0.715
BMI	-0.023	0.875
AGE	-0.115	0.427
PP	-0.143	0.321
MAPB	-0.009	0.953
DBP	0.090	0.536
SBP	-0.092	0.527

BMI: Body mass index, AIP: Atherogenic index of plasma, WC: waist circumference, FBS: Fasting Blood sugar PP: pulse pressure, MAPB: Mean arterial pulse Blood, DBP: diastolic Blood pressure, SBP systolic Blood pressure.

The correlation between atherogenic index of plasma (AIP) and other variables such as WC, FBS, BMI, AGE, PP, MAPB, DBP, and SBP as shown in table 2, implying that there was a positive correlation with DBP (r=0.090, P=0.536), and fasting blood sugar FBS (r=0.053, P = 0.715), and a negative correlation with SBP (r=-0.092, P= 0.527), MAPB (r=-0.009, P=0.953), PP (r=-0.143,P=0.321), AGE (r=-0.115,0.427), BMI (r=-0.023, P=0.875) and WC(r=-0.144, P=0.319).

V. Discussion

Atherogenic index of plasma (AIP) is categorized in the following other AIP <0.1 as (low risk), 0.1-0.24 as (intermediate risk) and >0.24 as (high risk) (Wekesa et al., 2016). Following this, 70% (n=35) of the study population were at low risk, 10% (n=5) at intermediate risk and 20% (n=10) were at high risk of cardiometabolic syndrome as shown on appendix I.

BMI as well is categorized into underweight (<18.5kg/m^2), Normal weight (18.5-24.9), overweight (25.0-29.9) and obese ≥30(Niroumand *et al.*, 2015). From the categorization 20% (n=10) of the respondents were underweight, 70% (n=35) were normal weight, 8%(n=4) were overweight and 2% (n=1) was obese.

Following International Diabetes Federation (IDF) definition of cardiometabolic syndrome 96% (n=48) of the study population had normal waist circumference (WC) range and 4% (n=2) of the respondent population were below the normal WC range and they fell in the female category.

Although none of the participants had been diagnosed or treated of hypertension prior to this investigation,the result obtained showed that 4% (n=2) of the respondent indicated high systolic blood pressure (SBP) and 4% (n=2) indicated high diastolic blood pressure (DBP), whereas 92% (n=46) were at normal diastolic and systolic blood pressure.

Similarly, none of the respondents were diagnosed previously of diabetes mellitus nor showed impaired fasting blood sugar level as the result obtained indicated overall mean 4.13± 0.39 of which males were 4.07±0.44 and females 4.21±0.31 compared to the ≥5.6 mmol/l of IDF definition of cardiometabolic syndrome.

The study also considered the cross sectional association between AIP and other risk factor, and the result showed that most participants were in the normal and underweight categorizes. Following this

categorization, this differs from that of previous investigation carried out on AIP of 10 years cardiovascularrisk on populations in the presence of some health risk complication such as HIV, obesity and diabetes mellitus. AIP risk of our population of study was 20% (high AIP risk) compared to that of Noumegni *et al.*, 2017, 32.5% (high AIP risk) obtained from study of (Noumegni *et al.*, 2017).Moreover,the prevalence of AIP in the study population was slightly higher than that obtained by (Onoh *et al.*, 2017) inspite of a higher study population without an earlier diagnosis of cardiometmabolic risk.

Atherogenic index of plasma (AIP) was positively correlated with FBS and DBP, determining factors associated with diabetic mellitus and hypertension in this study but negatively correlated with WC, BMI, SBP, PP and MAPB. This is at variance with the result obtained from previous report (Niroumand *et al*., 2015) who reported that waist circumference (WC) and body mass index (BMI) were significantly correlated with AIP. Also the study was also at variance with the report of (Onoh *et al.*, 2017) where atherogenic index of plasma (AIP) correlated positively with BMI and WC. This variation could be explained as due to difference in age of the respondent in our research and those of others as the mean age of the overall population as 25.10 ± 2.94 and majority of the participants not possessing impaired cardiometabolic risk factors compared to that of previous reports.Atherogenic index of plasma (AIP) from the study showed a negative correlation with SBP, AGE, BMI, WC, PP and MAPB.

Further studies are warranted in middle age young adult without much cardiometabolic risk such as diabetic mellitus, hypertension and obesity to clearly elucidate the relation between these parameters, as the study did not find and clear reason justifying the observation.

Cardiometabolic risk can be predicted with the model developed from regression analysis, Where AIP a dependent variable can be of predictive value in relation with other cardiometabolic risk factor.

VI. Conclusion

In recent time,non-communicable diseases such as those related with cardiometabolic risk has been in the increase. In thestudy ,the result shows that

- The prevalence of cardiometabolic syndrome amongst Ken Saro-Wiwa Polytechnic students was established to be 20%.
- Atherogenic index of plasma is positively related with diastolic blood pressure (DBP) and fasting blood sugar (FBS),thus FBS and DBP can be used relatively with AIP for the prediction of cardiometabolic syndrome.
- Impaired cardiometabolic risk factor increases the chances of developing cardiometabolic syndrome.

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APPENDIX I

CARDIOVASCULAR PARAMETER OF KENPOLY STUDENTS

NO	AIP	WC (CM)	BMI (kg/m2)	FBS (mmol/l)	AGE (yrs)	PP (mmHg)	MAPB (mmHg)	DBP (mmHg)	SBP (mmHg)
1	- 0.001	80	20.98	4.17	22/M	47	89.67	74	121
2	-0.855	82	23.12	4.28	24/F	35	74.67	63	98
3	0.247	77	22.94	4.44	23/M	44	79.67	65	109
4	0.867	74	19.84	4.11	24/F	37	83.33	70	107
5	0.360	82	27.54	4.27	23/M	48	65.00	49	97
6	0.158	104	30.85	4.80	22/F	33	98.00	87	120

7	0.079	81	21.72	4.10	28/M	39	86.00	73	112
8	-0.610	74	19.27	3.67	35/M	62	89.33	68	130
9	0.451	70	17.19	4.00	25/F	44	56.67	42	86
10	0.216	87	26.06	4.17	26/F	30	88.00	78	108
11	0.045	83	22.86	4.44	27/M	59	82.67	63	122
12	-0.141	72	20.86	4.44	22/F	30	64.33	54	84
13	0.004	77	21.01	5.00	25/F	34	76.33	65	99
14	0.073	87	24.56	4.06	24/F	31	69.33	59	90
15	-0.657	80	21.61	4.22	22/F	60	70.00	50	110
16	-0.063	77	16.61	3.50	26/M	43	49.33	35	78
17	-0.117	72	20.42	3.77	26/M	31	67.33	57	88
18	-0.181	69	22.23	3.89	28/M	32	80.67	70	102
19	-0.162	73	22.76	3.72	23/M	28	79.33	70	98
20	0.218	79	21.97	4.27	25/F	29	86.67	77	106
21	-0.198	73	18.52	3.77	23/M	46	91.33	76	122
22	-0.055	74	20.55	3.83	25/F	13	82.33	78	91
23	0.275	75	20.81	3.83	21/F	34	74.33	63	97
24	-0.089	79	20.57	3.94	25/M	33	72.00	61	94
25	-0.189	87	24.17	4.06	22/F	44	90.67	76	120
26	0.208	75	19.66	4.27	28/F	16	79.33	74	90
27	0.084	70	19.89	4.50	27/F	30	100.00	90	120
28	-0.494	80	21.97	4.27	28/M	22	68.33	61	83
29	-0.202	74	21.87	4.27	24/M	40	83.33	70	110
30	-0.379	81	21.63	4.33	22/M	37	73.33	61	98
31	0.014	77	21.55	4.44	28/M	45	75.00	60	105
32	-0.412	74	21.51	3.06	26/M	56	71.67	53	109
33	-0.059	73	17.09	3.39	24/M	39	83.00	70	109
34	0.250	79	20.18	3.72	24/M	37	95.33	83	120
35	-0.009	83	23.11	4.00	20/F	45	78.00	68	108
36	0.035	88	26.75	4.33	23/M	43	75.33	61	104
37	0.360	77	22.32	4.78	22/M	45	79.00	64	109
38	0.018	75	17.58	3.89	25/M	38	77.67	65	103
39	0.216	82	22.31	4.72	30/M	48	75.00	59	107
40	-0.184	88	24.24	3.78	27/F	44	75.67	61	105
41	0.033	75	20.55	4.40	26/M	67	84.33	62	129
42	0.529	81	20.61	4.22	26/M	35	74.67	63	98
43	0.478	63	17.44	4.33	25/F	28	71.33	62	90
44	-0.374	87	25.86	4.44	23/F	40	85.33	72	112
45	-0.385	82	23.78	4.33	23/M	50	88.67	72	122
46	0.100	80	24.54	4.11	34/M	67	104.33	82	149
47	-0.358	78	20.96	4.11	27/F	29	82.67	73	102
48	-0.976	82	20.20	4.78	26/M	54	76.00	58	112
49	-0.233	79	20.81	4.28	28/M	35	69.67	58	93
50	0.401	71	22.05	3 56	23/M	60	58	38	98

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