

**ATHEROGENIC INDEX OF PLASMA AND VISCERAL ADIPOSITY INDEX
AMONG HEALTHCARE WORKERS IN UNIVERSITY OF BENIN TEACHING
HOSPITAL, BENIN CITY, NIGERIA.**

ABSTRACT

OBJECTIVE: This study aims to determine the level of atherogenic index of plasma and visceral adiposity index among the healthcare workers in the University of Benin Teaching Hospital, Benin City.

BACKGROUND: The healthcare workers are prone to various diseases; most especially cardiovascular diseases by virtue of the nature of their work. The use of traditional lipid profile in evaluation of cardiovascular risk among health care workers; most especially atherogenic index of plasma [$\log (\text{triglyceride} / \text{HDL-Cholesterol})$] and visceral adiposity index, has been advocated among the clinicians. In this cross-sectional study, atherogenic index of plasma and visceral adiposity index are assessed among healthcare workers.

SUBJECT AND METHOD: A total of 325 healthcare workers between the age range of 21-69 years, comprising of the medical doctors, nurses and the other health professional were recruited using a structured questionnaire. One hundred and sixty (160) of the subjects were males while 165 were females. Subjects were categorised as medical doctors, nurses and other health professionals. They were all evenly distributed. Their anthropometrics and blood pressure were measured using standard techniques. Biochemical assays done include fasting serum lipid profile (total cholesterol, triglyceride, HDL-cholesterol and LDL-cholesterol) using standard enzymatic methods. Atherogenic index of plasma and visceral adiposity index were calculated.

RESULTS: Approximately 32% of the subjects were overweight while 26% were obese. Average serum lipids were: Total cholesterol (5.06 ± 1.33 mmol/L), triglycerides (0.91 ± 0.54 mmol/L), HDL-cholesterol (4.08 ± 1.37 mmol/L). Atherogenic index of plasma and visceral adiposity index were 0.27 ± 0.23 and 1.52 ± 0.91 respectively. A strongly positive correlation was found between triglycerides and visceral adiposity index ($r = 0.784$; $p = 0.000$) and atherogenic index of plasma ($r = -0.223$; $p = 0.000$). Approximately 56% of the subjects were at high risk of cardiovascular diseases using atherogenic index of plasma while 23% of the subjects had elevated visceral adiposity index. Triglyceride and HDL-cholesterol were good predictors of levels of atherogenic index of plasma while triglyceride, HDL-cholesterol and waist circumference were good predictors of visceral adiposity index.

CONCLUSION: In this study, we demonstrated that a high percentage of health care workers have elevated atherogenic index of plasma and visceral adiposity index. There is an urgent need for a more aggressive screening programme to detect and reduce the scourge of dyslipidaemia among healthcare workers.

Keywords: Atherogenic index of plasma, visceral adiposity index, lipids profile, healthcare workers, dyslipidaemia.

INTRODUCTION

Healthcare workers occupy important position in the economy of a nation just as the saying goes that “health is wealth”.⁽¹⁾ However, healthcare workers face numerous health challenges ranging from overweight and obesity, hypertension, diabetes mellitus, chronic stress, cardiovascular diseases, exposure to healthcare associated infection, osteoarthritis to mention a few.^(2,3,4) Nigeria as a nation is currently faced with paucity of healthcare workers as currently a nurse would have to attend to about 600 patients as against six patients at a time while the dire need of doctors has also been reported as a doctor now covers 4,857 citizens

48 against the World Health Organisation (WHO) stipulated ratio of a doctor to 600 citizens.⁽⁵⁾
 49 At present, there is little or no provision for healthcare workers in Nigeria as individuals tend
 50 to rely on their own clinical judgement and indulge in self-medication.

51 This necessitated this study which seeks to evaluate the atherogenic index of plasma (AIP)
 52 and visceral adiposity index (VAI) in this group of individuals.

53 Cardiovascular disease has been reported among healthcare workers worldwide.⁽²⁾ Established
 54 risk factors identified include overweight, obesity, dyslipidaemia, physical inactivity,
 55 smoking, family history of heart diseases and excessive alcohol intake have also been
 56 documented among healthcare workers.⁽⁷⁾

57 Metabolic derangements commonly seen among the general population are also seen among
 58 the healthcare workers, hence nurses, physicians and other healthcare workers suffer the same
 59 diseases seen in the patients they seek to manage.⁽⁴⁾ This has been reported as a common
 60 hinderance in health education of the affected patients.⁽⁸⁾

61 Atherogenic index of plasma (AIP) is a new marker of atherogenicity as it has been
 62 documented to be related directly to the risk of atherosclerosis in an individual. AIP is a
 63 triglyceride based index of atherogenicity which is used as a predictor of cardiovascular risk
 64 among various group of patients.^(9,10,11)

65 AIP is given mathematically as $\log \left(\frac{TG}{HDL-C} \right)$.⁽¹¹⁾

66 AIP has been documented to be elevated in diabetes mellitus, hypertension, menopause,
 67 coronary artery disease, dyslipidaemias, polycystic ovarian syndrome, obesity, and metabolic
 68 syndrome⁽¹²⁻¹⁴⁾, hence a hallmark of non-communicable disease (NCD) which have been
 69 reported as the leading cause of morbidity and mortality worldwide without sparing the low-
 70 and middle- income nations like Nigeria.⁽⁶⁾ Central obesity has been documented to be a risk

71 factor of cardiovascular diseases, diabetes mellitus and even malignancies (breast, prostate,
72 colon, lung, cervix and pancreas). The use of visceral adiposity index (VAI) has been
73 reported in assessing the risk of CVD and other diseases in different groups of patients.⁽¹⁵⁾

74 Visceral adiposity index (VAI) is a sex-specific index for visceral fat measurement. It takes
75 gender into consideration by combining anthropometry and biochemical parameters in
76 evaluating visceral adiposity.⁽¹⁵⁾ Mathematically; it is given by $VAI (female) = \frac{WC}{36.58} +$
77 $(1.89BMI) \times \frac{TG}{0.81} \times \frac{1.52}{HDL-C}$ while in male, VAI is given by $\frac{WC}{39.68} + (1.89BMI) \times \frac{TG}{1.03}$
78 $\times \frac{1.31}{HDL-C}$. Where WC=waist circumference, BMI= body mass index, TG=serum triglyceride,
79 HDL-C= high density lipoprotein-cholesterol.

80 VAI is derived from BMI, WC, TG and HDL-C. Visceral adipose tissue has been reported to
81 have autocrine, paracrine, and endocrine functions; hence adipose tissue being a
82 metabolically active organ ⁽²¹⁾ with different distribution in the body has been found to be
83 associated with abnormal lipid metabolism, pro-inflammatory activity and insulin resistance
84 in overweight and obese individuals.⁽¹⁶⁾ Visceral adiposity index is a cheaper method for the
85 measurement of adipose tissue distribution when compared with the computerised
86 tomography (CT) scan and magnetic resonance imaging techniques which are the gold
87 standard for the measurement of fat distribution in the body.⁽¹⁶⁾ VAI has been documented as
88 an easy to use method in most clinical settings.⁽¹⁷⁾ Elevated levels of visceral adiposity index
89 leads to diabetes mellitus, atherosclerosis and protein wasting in dialysis patient.⁽¹⁷⁾ The
90 levels of VAI and AIP have not been documented among the health workers. This study will
91 take a look at the levels of VAI and AIP among the healthcare workers and use them for
92 cardiovascular risk prediction.

93 SUBJECTS AND METHODS

Study location and population: This cross-sectional study was carried out in University of Benin Teaching Hospital, Department of Chemical Pathology from March 2017 to June, 2017. Three hundred and twenty –five apparently healthy subjects were recruited from the workforce of the hospital. Approximately 49% (160) of the study population were males while 51% (165) were females. Staff were categorized into medical doctors, nurses and other health professionals. Chronically ill, pregnant and individuals on lipid-lowering medications were excluded from the study. Ethical clearance was obtained from the Ethical committee of the University of Benin Teaching Hospital and utmost confidentiality maintained throughout the study. Data were protected via password in personal computers and subjects reports were given to them.

Blood Pressure and anthropometric measurements:

Consented and eligible subjects who have fasted were made to rest for five minutes before blood pressure was measured. Blood pressure (systolic and diastolic) was measured using sphygmomanometer and Litmann® stethoscope by the same person. The cuff was wrapped round the left mid-upper arm, systolic blood pressure was detected initially by palpation and later by the korotkof sound along with the diastolic blood pressure. Subjects were weighed with light clothing, without shoes to the nearest 0.5 kg and height measured (to the nearest 0.1cm) using a stadiometer (RGZ-120) in the Advanced Clinical Investigation Laboratory. Body Mass Index (BMI) was calculated as weight divided by height square metre in kg/m^2 . BMI of 18-24.9, 25-29.9 and $>30 \text{ kg/m}^2$ were considered as normal weight, overweight and obesity respectively. Waist circumference was measured midway between the inferior margin of the last rib and the iliac crest in a horizontal plane with the measuring tape not compressing the soft tissue and subject standing erect with the feet 25-30 cm apart to ensure weight as evenly distributed. Hip circumference was measured around the pelvis at the point of maximum protrusion of the buttocks.⁽¹⁸⁾

119 **SUBJECT PREPARATION AND SAMPLE COLLECTION**

120 The subjects were told to fast overnight for about 8-12 hours. Venepuncture site was cleaned
 121 with 70% methylated spirit; and allowed to dry. Three millilitre of whole blood was
 122 collected, dispensed into a labelled plain bottle; allowed to clot, centrifuged for 15minutes at
 123 3000 revolution per minute and separated into a plain bottle and stored at -80°C freezer
 124 located in Advanced Clinical Investigation Laboratory in the Department of Chemical
 125 Pathology until they were analysed.

126 **Biochemical assay of the fasting serum lipid profile**

127 Serum total cholesterol and triglyceride levels were determined using the enzymatic
 128 spectrophotometric methods. Serum high density lipoprotein-cholesterol were determined
 129 enzymatically after precipitating other lipoproteins as described by Burstein *et al.*,⁽¹⁹⁾ while
 130 low density lipoprotein-cholesterol (LDL-C) was calculated using Friedewald equation
 131 [LDL-C (mmol/L) = Total cholesterol - (HDL-cholesterol) – (triglyceride/2.2)].⁽²⁰⁾
 132 Atherogenic index of plasma (AIP) was calculated using the formula: AIP=log
 133 (triglyceride/HDL-cholesterol) while sex specific visceral adiposity index (VAI) was
 134 calculated as follows: VAI(male)=[WC/39.68]+[1.89BMI]x[triglyceride/1.03]x[1.31/HDL-C]
 135 VAI(female)=[WC/36.58]+[1.89BMI]x[triglyceride/0.81]x[1.52/HDL-C].

136 WC=waist circumference in (cm), triglyceride and HDL-C measure in mmol/L. Result of AIP
 137 and VAI were interpreted as described by Dobiasova and Amato respectively.^(21,22)

138 AIP of -0.3 to 0.1, 0.1 to 0.24 and >0.24 were considered as low, medium and high
 139 cardiovascular risk respectively while VAI >2.69 was reported as elevated.

140 **DATA ANALYSIS**

141 Data collected were analyzed using SPSS version 20. Data were presented using tables, bar
142 and pie- charts. Quantitative variables were expressed as mean $\pm$ standard deviation while
143 qualitative data were presented using frequencies and proportion. Pearson correlation analysis
144 was used to determine the relationship between lipids or anthropometric parameters and
145 atherogenic index of plasma or visceral adiposity index. Multiple regression analysis was
146 done to determine lipid or anthropometric parameters that best predict the levels of
147 atherogenic index of plasma and visceral adiposity index. Statistical significance was taken as
148 p-values less than 0.05

149 **RESULTS**

150 Three hundred and twenty five subjects with average age of 40.9 ± 8.8 years, consisting of
151 160(49 %) males and 165(51%) female healthcare workers were recruited for this study.
152 The mean body mass index among the study population was 26.7 ± 5.9 kg/m². Other
153 anthropometric parameters include: waist circumference (89.5 ± 15.3 cm), hip circumference
154 (103.2 ± 15.7 cm), waist hip ratio (0.867 ± 0.06) and waist height ratio (0.54 ± 0.09).

155 Serum total cholesterol, LDL-cholesterol and non HDL-cholesterol were elevated. There is a
156 reduction in HDL-cholesterol in the study population.

157 The means of atherogenic index of plasma and visceral adiposity index were 0.27 ± 0.23 and
158 1.52 ± 0.91 respectively among the study subjects. Using the AIP, approximately 56% of the
159 subjects were at high risk of cardiovascular disease while 23% had elevated visceral adiposity
160 index. A strongly positive correlation was found between serum triglyceride and atherogenic
161 index of plasma ($r=0.784$; $p=0.000$).

162 Weak negative correlation was found between HDL-cholesterol and atherogenic index of
163 plasma ($r=-0.234$; $p=0.000$) and visceral adiposity index ($r=0.223$; $p=0.000$). Triglyceride

164 ($\beta=0.744$; $p=0.0002$) and HDL-cholesterol($\beta =-0.204$; $p=0.0001$) were found to be good
 165 prediction of atherogenic index of plasma while triglyceride ($\beta=0.847$; $p=0.000$), HDL
 166 cholesterol ($\beta =0.245$; $p=0.000$) and waist circumference ($\beta =0.215$; $p=0.0001$) were
 167 predictors of visceral adiposity index.

168 **Discussion**

169 Health care workers are prone to non-communicable diseases most especially cardiovascular
 170 diseases. ⁽⁴⁾This study has revealed that more than half of the healthcare workers are at high
 171 risk of atherosclerotic cardiovascular diseases as shown by increased abnormality in
 172 atherogenic index of plasma using the cut-offs as stated by Dobiasora *et al.*⁽²¹⁾ Several
 173 factors can be adduced to the elevation of atherogenic index of plasma (AIP) among the
 174 healthcare workers: such as physical inactivity, diet high in saturated fat, overweight and
 175 obesity which have been found to account for high level of triglycerides in this group of
 176 persons.⁽¹⁴⁾ A considerable number of healthcare workers have abnormal visceral adiposity
 177 index (VAI) in the study. This still points to the role triglycerides play in atherogenicity.
 178 Levels of triglycerides and HDL-Cholesterol were found to be strong predictors of both
 179 atherogenic index of plasma and visceral adiposity index.

180 Evaluation of atherosclerotic cardiovascular disease risk in healthcare workers should be
 181 emphasised; most especially the levels of serum triglycerides and HDL-Cholesterol as both
 182 analytes are determinants of atherogenicity among healthcare workers.

183 Moreso, this study revealed that waist circumference is a predictor of visceral adiposity
 184 index. Therefore, the use of simple anthropometric measurement, most especially waist
 185 circumference measurement can be helpful in the evaluation of healthworkers at risk of
 186 atherosclerotic cardiovascular diseases. Waist circumference measurement is a simple, cheap
 187 and readily available parameter that can be used in poor-resource settings.

Dyslipidaemia seem among healthcare workers in this study as shown by elevated total cholesterol, reduced HDL-cholesterol, and LDL-cholesterol. This is in agreement with Nobahar et al., who reported high prevalence of hyperlipidaemia among Iranian healthcare workers in a tertiary hospital.⁽¹⁰⁾ This calls for a public health response in the form of periodic general routine screening of the health care workers. This helps to prevent non-communicable diseases among the health workers and preserve the health of this group of persons and eventually making them available to take care of the patients.

CONCLUSION

Atherogenic index of plasma, a measure of atherosclerotic cardiovascular disease risk, is elevated among healthcare workers in UBTH, Benin City. Visceral adiposity index abnormality is fairly common among the same group of workers. Regular medical checkup can be helpful in preventing healthcare workers from cardiovascular diseases.

RECOMMENDATION

1. Periodic evaluation of serum lipids among healthcare workers for early detection of dyslipidaemia.
2. Reporting lipid profile tests with emphasis on the level of atherogenic index of plasma and visceral adiposity index.
3. Institutionalising therapeutic lifestyle (regular exercise and balance diet) among healthcare workers will help preventing cardiovascular disease.

RESULTS

Table 1: Anthropometric characteristics of the study subjects.

Parameters	Mean $\pm$ standard deviation $\bar{X} \pm SD$
Age (years)	40.9 $\pm$ 8.8
Weight (kg)	73.9 $\pm$ 14.5
Height (m)	1.67 $\pm$ 0.08
BMI (kg/m ²)	26.7 $\pm$ 5.9
Waist circumference (cm)	89.5 $\pm$ 15.3
Hip circumference (cm)	103.2 $\pm$ 15.7
Waist-Hip Ratio	0.867 $\pm$ 0.06
Waist-Height Ratio	0.54 $\pm$ 0.09

BMI: Body mass index, WC: waist circumference, HC: Hip circumference, WHR: Waist- hip ratio.

Table 2: Clinical and biochemical characteristics of the study subjects.

Lipid parameters	Mean $\pm$ standard deviation $\bar{X} \pm SD$
Total cholesterol (mmol/L)	5.06 $\pm$ 1.33
Triglyceride (mmol/L)	0.91 $\pm$ 0.54
HDL- Cholesterol (mmol/L)	0.98 $\pm$ 0.14
LDL- Cholesterol (mmol/L)	3.66 $\pm$ 1.38
Non HDL- Cholesterol (mmol/L)	4.08 $\pm$ 1.37
AIP	0.27 $\pm$ 0.23
VAI (male)	1.20 $\pm$ 0.69
VAI (female)	1.83 $\pm$ 1.07

AIP: Atherogenic index of plasma , VAI: Visceral adiposity index

216 **Table 3:** Relationship between atherogenic index of plasma, visceral adiposity index,
217 lipid parameters and body mass index.

Variables	AIP		VAI	
	r	P	r	P
VAI	0.852	0.000	1.000	-
AIP	1.000	-	0.852	0.000
Triglyceride	0.875	0.000	0.784	0.000
HDL- Cholesterol	-0.234	0.000	-0.223	0.000
BMI	-0.059	0.288	-0.129	0.020
NonHDL- Cholesterol	0.191	0.001	0.116	0.036
Total Cholesterol	0.174	0.002	0.097	0.081

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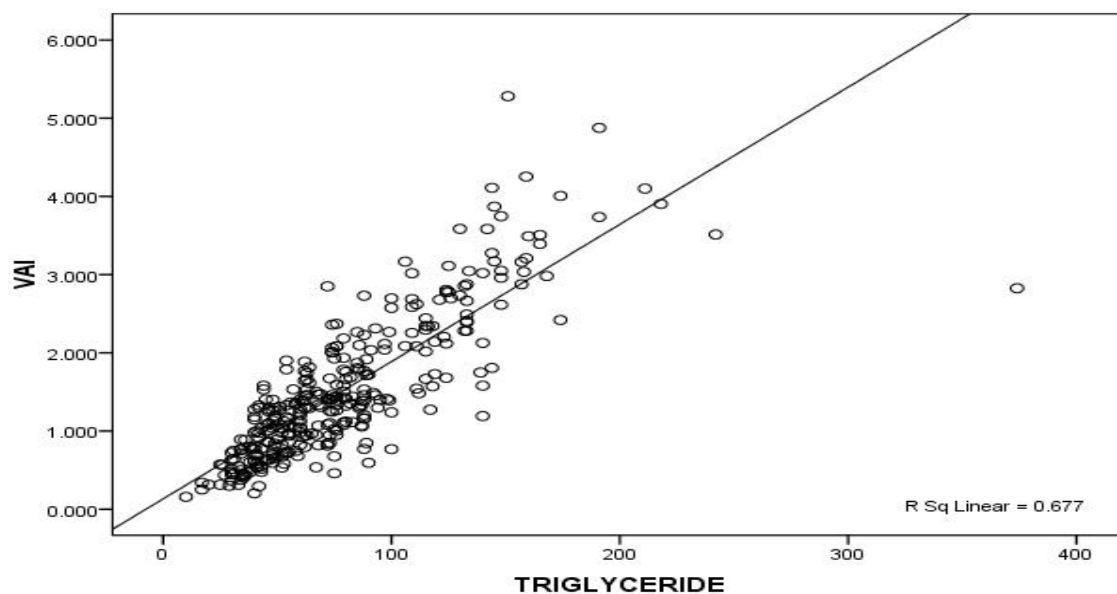
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Correlation plot of visceral adiposity index and triglyceride

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229 Figure 1: Correlation plot of visceral adiposity index and triglyceride

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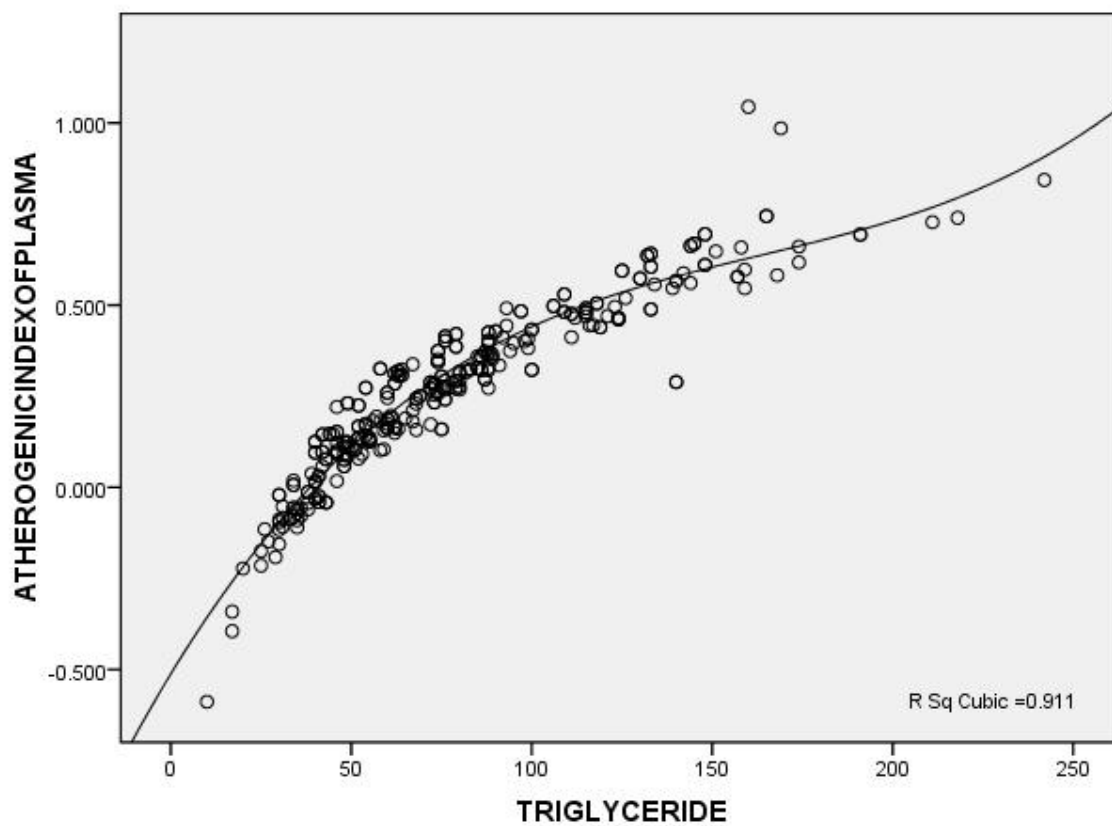


Figure 2: Correlation plot of atherogenic index of plasma and triglyceride

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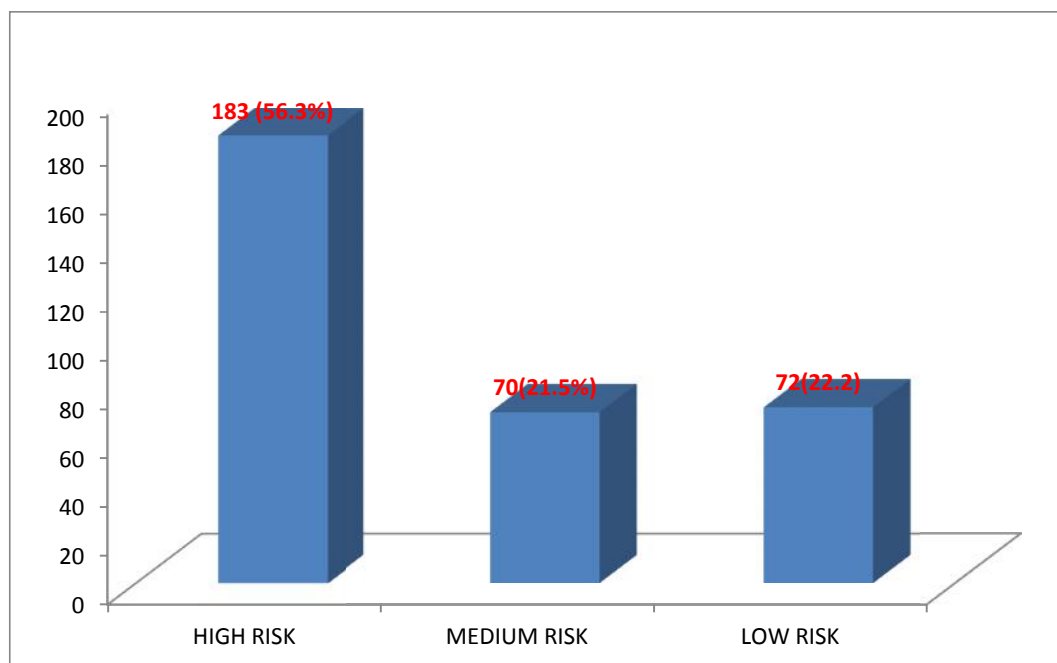


Figure 3 :Cardiovascular risk categories using Atherogenic index of plasma

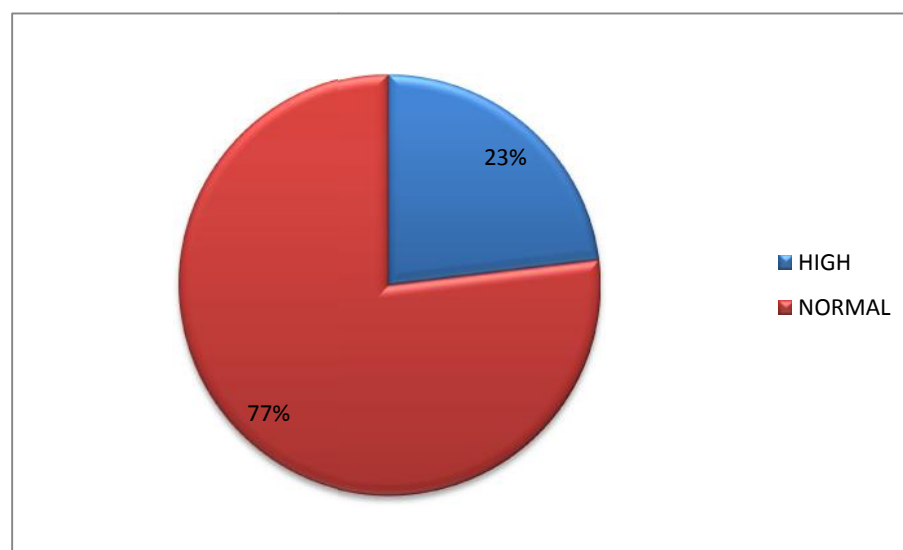


Figure 4 : Cardiovascular risk categories using Visceral Adiposity Index (VAI)

Table 4 : Result of multiple regression analyses

Predictors	Dependent variable AIP		Dependent variable VAI	
	β	p	β	p
Triglyceride	0.744	0.000	0.847	0.000
HDL-C	-0.207	0.000	-0.245	0.000
VAI	0.193	0.000	-	-
WC	-	-	0.215	0.000

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