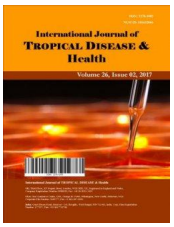

International Journal of TROPICAL DISEASE & Health

29(3): 1-11, 2018; Article no.IJTDH.39493
ISSN: 2278–1005, NLM ID: 101632866

Atherogenic Index of Plasma and Visceral Adiposity Index among Healthcare Workers in University of Benin Teaching Hospital, Benin City, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author TMA designed the study, performed the statistical analysis, managed the literature searches and wrote the first draft of the manuscript. Author OEOS wrote the protocol and managed the analyses of the study. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2018/39493
Editor(s):
(1) Jorge Paredes Vieyra, Universidad Autonoma De Baja California, Campus Tijuana, Mexico.
Reviewers:
(1) Kolade O. Sharaye, Ahmadu Bello University Teaching Hospital, Nigeria.
(2) D. Atere Adedeji, Achievers University, Nigeria.
(3) Ehimen Phyllis Odum, University of Port Harcourt, Nigeria.
(4) Ngo Nonga Bernadette, Universlity of Yaounde, Cameroon.
Complete Peer review History: http://www.sciencedomain.org/review-history/23512

Original Research Article

Received 18th December 2017
Accepted 26th February 2018
Published 7th March 2018

ABSTRACT

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 the evaluation of cardiovascular risk among health care workers; most especially atherogenic index of plasma [log (triglyceride /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.
Aim of the Study: This study aims to determine the level of the atherogenic index of plasma and visceral adiposity index among the healthcare workers in the University of Benin Teaching Hospital, Benin City. The relationship between these parameters was also determined.
Materials and Methods: A total of 325 healthcare workers in the age range of 21-69 years,

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comprising 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 based on their gender and body mass index. 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 (AIP) and visceral adiposity index (VAI) were 0.27±0.23 and 1.52±0.91 respectively. Low atherogenic index of plasma and visceral adiposity index were found in the obese healthcare workers. The higher biochemical profile was seen among the female healthcare workers while AIP and VAI were more elevated in the males. 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. Moreso, there is a strong relationship between AIP and VAI.

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

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

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

Cardiovascular disease has been reported among healthcare workers worldwide [2]. Established risk factors identified include overweight, obesity, dyslipidaemia, physical inactivity, smoking, family history of heart diseases and excessive alcohol intake have also been documented among healthcare workers [6].

Metabolic derangements commonly seen among the general population are also seen among the healthcare workers, hence nurses, physicians and other healthcare workers suffer the same diseases seen in the patients they seek to manage [4]. This has been reported as a common hinderance in health education of the affected patients [7].

Atherogenic index of plasma (AIP) is a new marker of atherogenicity as it has been documented to be related directly to the risk of atherosclerosis in an individual. AIP is a triglyceride-based index of atherogenicity which is used as a predictor of cardiovascular risk among various group of patients [8-10].

AIP is given mathematically as log $\mathbf{(TG/_{HDL\text{-}C})}$ [10].

AIP has been documented to be elevated in diabetes mellitus, hypertension, menopause, coronary artery disease, dyslipidaemias, polycystic ovarian syndrome, obesity, and

metabolic syndrome. [11-13]; hence a hallmark of non-communicable disease (NCD) which have been reported as the leading cause of morbidity and mortality worldwide without sparing the low- and middle- income nations like Nigeria [14]. Central obesity has been documented to be a risk factor for cardiovascular diseases, diabetes mellitus and even malignancies (breast, prostate, colon, lung, cervix and pancreas). The use of visceral adiposity index (VAI) has been reported in assessing the risk of CVD and other diseases in different groups of patients [15].

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

VAI is derived from BMI, WC, TG and HDL-C. The visceral adipose tissue has been reported to have autocrine, paracrine, and endocrine functions; hence adipose tissue being a metabolically active organ [15] with a different distribution in the body has been found to be associated with abnormal lipid metabolism, pro-inflammatory activity and insulin resistance in overweight and obese individuals [16]. Visceral adiposity index is a cheaper method for the measurement of adipose tissue distribution when compared with the computerised tomography (CT) scan and magnetic resonance imaging techniques which are the gold standard for the measurement of fat distribution in the body [16]. VAI has been documented as an easy to use the method in most clinical settings [17]. Elevated levels of visceral adiposity index lead to diabetes mellitus, atherosclerosis and protein wasting in dialysis patient [17]. The levels of VAI and AIP have not been documented among the health workers.

Currently, fasting serum lipid profile results are sent to the clinicians without accompanying calculated lipid ratios and indices. This study seeks to reinforce the importance of evaluation of fasting serum lipid profile using atherogenic index of plasma and visceral adiposity index most especially patients and apparently healthy healthcare workers having their lipid parameters within the reference intervals. With an atherogenic index of plasma and visceral adiposity index, individuals with normal lipid parameters but deranged lipid indices and ratios are identified earlier and preventive measures instituted to avert impending cardiovascular events.

This study will take a look at the levels of VAI and AIP among the healthcare workers in University of Benin Teaching Hospital, Benin City and also determine the relationship between these lipid indices.

2. MATERIALS AND METHODS

2.1 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 based on their gender and body mass index. 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.

2.2 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. Subjects were weighed with light clothing, without shoes to the nearest 0.5 kg and height measured (to the nearest 0.1 cm) using a stadiometer (RGZ-120). 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 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. Hip circumference was measured around the pelvis

at the point of maximum protrusion of the buttocks [18].

2.3 Subject Preparation and Sample Collection

The subjects were told to fast overnight for about 8-12 hours. Three millilitres of whole blood was collected, dispensed into a labelled plain bottle; allowed to clot, centrifuged for 15 minutes at 3000 revolutions per minute and separated into a plain bottle and stored at -80°C freezer until they were analysed.

2.4 Biochemical Assay of the Fasting Serum Lipid Profile

Serum total cholesterol and triglyceride levels were determined using the enzymatic spectrophotometric methods. Serum high density lipoprotein-cholesterol were determined enzymatically after precipitating other lipoproteins as described by Burstein et al. [19] while low density lipoprotein-cholesterol (LDL-C) was calculated using Friedewald equation [LDL-C (mmol/L) = Total cholesterol - (HDL-cholesterol) – (triglyceride/2.2)] [20]. Atherogenic index of plasma (AIP) was calculated using the formula: AIP=log (triglyceride/HDL-cholesterol) while sex specific visceral adiposity index (VAI) was calculated as follows:

VAI(male)=[WC/39.68]+[1.89BMI]x[triglyceride/1.03]x[1.31/HDL-C]

VAI(female)=[WC/36.58]+[1.89BMI]x[triglyceride/0.81]x[1.52/HDL-C].

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

AIP of -0.3 to 0.1, 0.1 to 0.24 and >0.24 were considered as low, medium and high cardiovascular risk respectively while VAI >2.69 was reported as elevated [21,22].

2.5 Data Analysis

Data collected were analyzed using SPSS version 20. Data were presented using tables, bar and pie- charts. Quantitative variables were expressed as mean ± standard deviation while qualitative data were presented using frequencies and proportion. Pearson correlation analysis was used to determine the relationship between lipids or anthropometric parameters and atherogenic index of plasma or visceral adiposity index. Student's t-test and analysis of variance (ANOVA) were used to compare means of two and more than two groups respectively. Multiple regression analysis was done to determine lipid or anthropometric parameters that best predict the levels of an atherogenic index of plasma and visceral adiposity index. Statistical significance was taken as p-values less than 0.05.

3. RESULTS

A total of 325 healthcare workers were recruited for this study. They consist of 160 males and 165 females with their mean ages being: 40.08±8.41 and 41.81±9.10 years respectively. Female healthcare workers have a relatively higher body mass index (27.77±6.02 kg/m^2) than the males (25.66±5.61 kg/m^2). The differences in the average waist and hip circumferences, waist-hip- and waist-height ratios were not statistically significant in both genders (p<0.000).

Table 1. General and anthropometric characteristics of the subjects

Characteristics	Mean±Standard deviation	Mean±Standard deviation
	Male (n=160)	Female (n=165)
Age (years)	40.08±8.41	41.81±9.10
Weight (Kg)	72.39±14.44	75.52±14.53
Height (m)	1.68±0.08	1.65±0.07
BMI (Kg/m^2)	25.66±5.61	27.77±6.02
WC (cm)	90.33±15.50	88.72±15.10
HC (cm)	102.84±15.71	103.56±15.84
WHR	0.878±0.06	0.857±0.058
WHtR	0.538±0.097	0.538±0.099
SBP (mmHg)	117.45±15.40	115.04±15.81
DBP (mmHg)	78.11±15.06	83.41±13.40

BMI: Body mass index, WC: waist circumference, HC: Hip circumference, WHR: Waist-hip ratio. WHtR: waist height ratio, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Using student's t-test for mean comparison, there are significant differences in the means of each parameter in both male and female healthcare workers (p<0.000)

Serum total cholesterol (5.06±1.33 mmol/L), LDL-cholesterol (3.66±1.38 mmol/L) and non-HDL-cholesterol (4.08±1.32 mmol/L) were elevated. There is a reduction in HDL-cholesterol (0.98±0.14 mmol/L) in the study population. Total cholesterol level was found to be higher among the underweight (5.78±1.47 mmol/L), overweight (5.78±1.47 mmol/L) and the obese (5.04±1.26 mmol/L) categories; even though there is no significant difference in their means (p=0.183). Moreso, low levels of HDL-cholesterol was found across all the BMI categories, which was not statistically significant (p=0.414). The means of atherogenic index of plasma and visceral adiposity index were 0.27±0.23 and 1.52±0.91 respectively among the study subjects. However, the obese category has the least atherogenic index of plasma (0.251±0.21) and visceral adiposity index (1.37±0.700); while the higher atherogenic index of plasma (0.289±0.21 vs 0.246±0.249) and visceral adiposity index (1.81±0.93 vs 1.211±0.77) were seen among male healthcare workers (Figs. 3 and 4).

The female healthcare workers have higher average biochemical profile compared with their male counterparts except for very low-density lipoprotein and triglyceride (Fig. 4)

Atherogenic index of plasma and visceral adiposity index were more elevated in male than the female subjects (p<0.05).

Table 2. Biochemical characteristics of the subjects based on their body mass index

Parameters	BMI category				p-value
	Underweight	Normoweight	Overweight	Obese	
BMI (kg/m^2)	16.4±1.46	22.4±1.60	27.02±1.28	34.68±4.51	0.000
FPG (mmol/L)	4.85±0.76	4.88±1.28	4.84±1.32	4.87±1.30	0.974
T.Chol (mmol/L)	5.78±1.47	5.00±1.43	5.04±1.24	5.04±1.26	0.183
VLDL (mg/dl)	16.22±10.53	16.2±9.10	16.34±11.4	15.01±6.80	0.977
TRIG (mmol/L)	0.92±0.60	0.92±0.52	0.896±0.50	0.85±0.39	0.977
HDL-C (mmol/L)	0.95±0.12	0.99±0.14	0.96±0.13	0.99±0.16	0.414
LDL-C (mmol/L)	4.41±1.41	3.59±1.46	3.66±1.29	3.67±1.33	0.163
NonHDL-C (mmol/L)	4.83±1.49	4.00±1.48	4.08±1.28	4.05±1.30	0.111
AIP	0.277±0.264	0.275±0.225	0.272±0.26	0.251±0.21	0.733
VAI	2.12±1.39	1.51±0.85	1.568±1.00	1.37±0.700	0.472

BMI: Body mass index, TChol: Total cholesterol, FPG: Fasting plasma glucose, TRIG: Triglyceride, HDL-C: High-density lipoprotein-cholesterol, LDL-C: low-density lipoprotein-cholesterol, AIP: atherogenic index of plasma, VAI: Visceral adiposity index.

Using analysis of variance (ANOVA), there was no significant difference in the means of the biochemical parameters across the BMI categories (p>0.05)

Table 3. Gender-based biochemical characteristics of the study population

Parameters	Mean±Standard deviation	Mean±Standard deviation	p-value
	Male (n=160)	Female (n=165)	
FPG(mmol/L)	4.83±0.99	4.90±1.52	0.000
TChol(mmol/L)	4.94±1.29	5.18±1.38	0.000
VLDL(mg/dl)	16.44±9.65	15.45±9.19	0.000
TRIG(mmol/L)	0.91±0.44	0.88±0.52	0.000
HDL-C(mmol/L)	0.97±0.14	0.99±0.14	0.000
LDL-C(mmol/L)	3.54±1.35	3.79±1.40	0.000
NonHDL-C(mmol/L)	3.97±1.33	4.19±1.42	0.000
AIP	0.289±0.21	0.246±0.249	0.000
VAI	1.81±0.93	1.211±0.77	0.000

Table 4. Frequencies of dyslipidaemia in the study population

Lipid abnormality	Frequency (n)	Percentage (%)
Elevated Triglyceride	18	5.5
Elevated Total cholesterol	141	43.4
Elevated LDL-cholesterol	182	56.0
Reduced HDL-cholesterol	267	82.2

In total, reduced HDL-cholesterol was found in 267(82.2%) of the study population while 18(5.5%) of the subjects have hypertriglyceridaemia.

A higher percentage of the study population has reduced levels of HDL-cholesterol. More than 80% of the overweight and obese subjects have reduced HDL-cholesterol while more than 50% of the same BMI categories have elevated LDL-cholesterol. Also noted are various patterns of dyslipidaemia among the normal weight subjects with 98 (78.4%) having low HDL-cholesterol and 66 (52.8%) with elevated LDL-cholesterol.

The reference intervals of various lipids in our centre are as follow: total cholesterol (2.38-4.65 mmol/l), triglycerides (0.22-0.87 mmol/l),HDL-cholesterol (0.75-1.55 mmol/L), LDL-cholesterol (1.99-3.36 mmol/l), nonHDL-cholesterol (1.63-3.10 mmol/l).

Table 5. Frequency distribution of abnormal lipids based on body mass index

BMI Category	Elevated Total cholesterol n(%)	Elevated LDL-cholesterol n(%)	Elevated Triglyceride n(%)	Reduced HDL-cholesterol n(%)
Normoweight(n=125)	54 (43.2)	66 (52.8)	8 (6.4)	98 (78.4)
Underweight(n=14)	10 (71.4)	11 (78.6)	2 (14.3)	13 (92.9)
Overweight (n=103)	46 (44.7)	59 (57.3)	7 (6.8)	85 (82.5)
Obese (n=83)	31 (37.3)	46 (55.4)	1 (1.2)	71 (85.5)

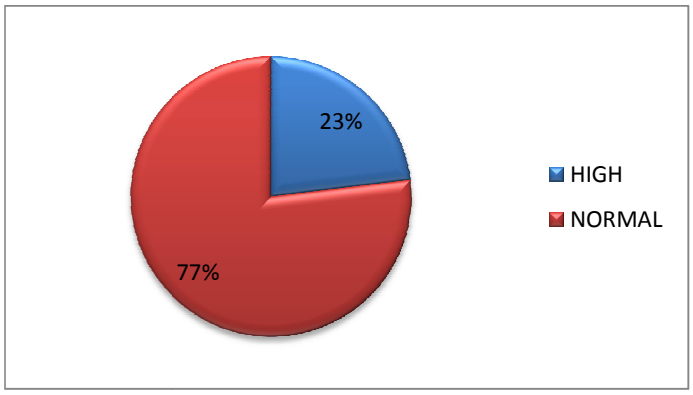

Fig. 1. Cardiovascular risk categories using Visceral Adiposity Index (VAI)

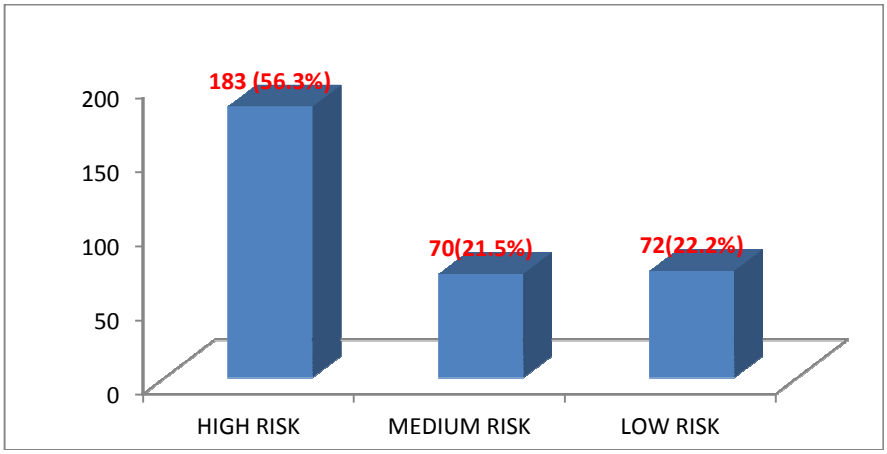

Fig. 2. Cardiovascular risk categories using Atherogenic index of plasma

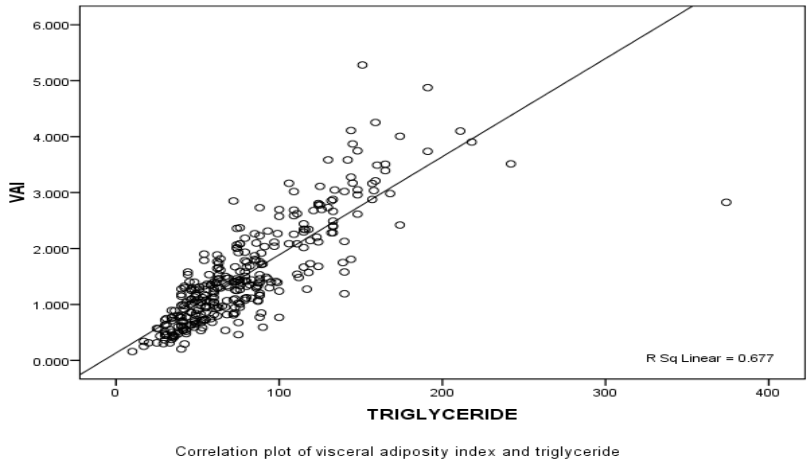

Fig. 3. Correlation plot of visceral adiposity index and triglyceride

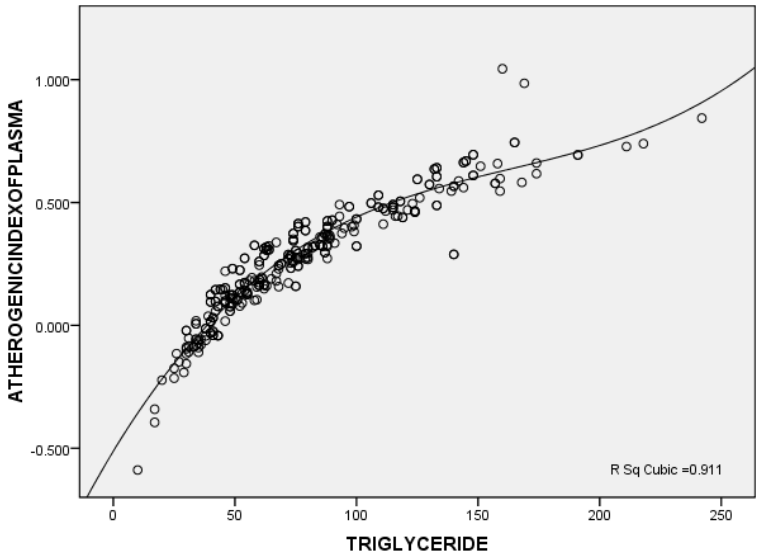

Fig. 4. Correlation plot of atherogenic index of plasma and triglyceride

Using the AIP, approximately 56% of the subjects were at high risk of cardiovascular disease while 23% had elevated visceral adiposity index.

A strongly positive correlation was found between serum triglyceride and atherogenic index of plasma ($r_=0.784$;$p_=0.000$). The weak negative correlation was found between HDL-cholesterol and atherogenic index of plasma ($r_=-0.234$; $p_=0.000$) and visceral adiposity index ($r_=0.223$; $p_=0.000$).

Triglyceride ($\beta_=0.744$; $p_=0.0002$) and HDL-cholesterol ($\beta_=-0.204$; $p_=0.0001$) were found to be a good prediction of the atherogenic index of plasma while triglyceride ($\beta_=0.847$:$p_=0.000$), HDL cholesterol ($\beta_=0.245$; $p_=0.000$) and waist circumference (β =0.215; p=0.0001) were predictors of visceral adiposity index.

4. DISCUSSION

Health care workers are prone to non-communicable diseases most especially cardiovascular diseases [4]. This study has revealed that more than half of the healthcare workers are at high risk of atherosclerotic cardiovascular diseases as shown by increased

abnormality in atherogenic index of plasma using the cut-offs as stated by Dobiasora et al. [21] Several factors can be adduced to the elevation of atherogenic index of plasma (AIP) among the healthcare workers: such as physical inactivity, diet high in saturated fat, overweight and obesity which have been found to account for high level of triglycerides in this group of persons [14]. A considerable number of healthcare workers have abnormal visceral adiposity index (VAI) in the study. This still points to the role triglycerides play in atherogenicity. Levels of triglycerides and HDL-Cholesterol were found to be strong predictors of both atherogenic indexes of plasma and visceral adiposity index.

Visceral adiposity index, a mathematical model based on simple anthropometric (body mass index and waist circumference) and biochemical (triglyceride and HDL-cholesterol) parameters, is considered as a simple surrogate marker of visceral adipose tissue dysfunction. Elevation of VAI in the study population connotes predisposition of the healthcare workers to metabolic syndrome, diabetes mellitus, insulin resistance, hypertension and other non-communicable diseases. Several studies have implicated elevated serum triglyceride and HDL-cholesterol as the key components of metabolic syndrome and strong predictors of coronary artery disease. These analytes the major components of the atherogenic index of plasma and visceral adiposity index; therefore, non-communicable diseases should be investigated among the healthcare workers. This could form the basis for further research on non-communicable diseases among the healthcare workers. With the use of AIP and VAI, cardiovascular and cerebrovascular risk assessment becomes easier among the healthcare workers. This creates awareness among them and eventually the patient population. According to Amato et al., the use of visceral adiposity index is cheaper than the commonly used magnetic resonance imaging technique used in visceral adiposity assessment. This could be helpful in low resource settings like ours.

Using the local reference intervals, 267 (82.2%) of the subjects have reduced HDL-cholesterol while 18(5.5%) have elevated serum triglyceride. This implies that reduction in HDL-cholesterol is common among the healthcare workers. This is in agreement with the studies done in different geopolitical zones in Nigeria where reduced HDL-cholesterol was the commonest pattern of dyslipidaemia seen among adult Nigerians [23]. Similar finding was reported by Moor et al. [24] from a tertiary hospital in Yaounde, Cameroon, where reduced HDL-C was the commonest dyslipidaemia seen among adult population.

The healthcare workers who are at the forefront in the healthcare delivery and health education of the at-risk individuals, patients and even healthy individuals are at risk of most non-communicable diseases by virtue of the elevated atherogenic index of plasma and visceral adiposity index seen in them.

Table 6. Relationship between the atherogenic index of plasma, visceral adiposity index, 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

Table 7. Result of multiple regression analyses

Predictors	Dependent variable		Dependent variable	
	AIP		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

Evaluation of atherosclerotic cardiovascular disease risk in healthcare workers should be emphasised; most especially the levels of serum triglycerides and HDL-Cholesterol as both analytes are determinants of atherogenicity among healthcare workers. There an urgent need to institute routine screening programme for non-communicable diseases among the healthcare workers to avert impending morbidity and mortality. Physical exercise and diets known to increase plasma HDL-cholesterol could alleviate this pattern of dyslipidaemia seen among the healthcare workers.

Moreso, this study revealed that waist circumference is a predictor of visceral adiposity index. Therefore, the use of simple anthropometric measurement, most especially waist circumference measurement can be helpful in the evaluation of healthcare workers at risk of atherosclerotic cardiovascular diseases. Waist circumference measurement is a simple, cheap and readily available parameter that can be used in poor-resource settings. However, the obese category has the lowest AIP and VAI. This invariably brings into the picture the current phenomenon of obesity paradox where obese individuals are found to be protected by virtue of their increased adipose tissue. Obesity paradox is a medical hypothesis which holds that obesity and even high cholesterol levels may counter-intuitively be protective and associated with greater survival in a certain group of persons [25]. Pathophysiologically, adipose tissues has been found to secrete a tumour necrotic factor-α receptor that binds TNF- α thereby preventing its pro-inflammatory action and the binding of endotoxins by high lipid levels in the obese and the synthesis of my hormone, irisin by the muscles in the obese individuals have been hypothesized as protective mechanisms in obesity [26].

The higher biochemical profile was found among the female healthcare workers. This finding might be from food preference, physical inactivity and possibly contraceptives. Fast food intake has been reported to be commoner in female than males [27]. This finding is in agreement with a study conducted among the civil servants in Abakaliki, South-East, Nigeria, where male workers were reported to have favourable lipid levels than their female counterparts [27].

High levels of AIP were found in the underweight, normoweight and overweight categories.

Dyslipidaemia saw 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. [10] who reported a high prevalence of hyperlipidaemia among Iranian healthcare workers in a tertiary hospital. 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.

5. 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. A strongly positive relationship exists between the atherogenic index of plasma and visceral adiposity index. A regular medical checkup can be helpful in preventing healthcare workers from cardiovascular diseases.

6. 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 the atherogenic index of plasma and visceral adiposity index.
3. Institutionalising therapeutic lifestyle (regular exercise and balance diet) among healthcare workers will help to prevent cardiovascular disease.

7. LIMITATION

Atherogenic index of plasma and visceral adiposity index are not currently used in our centre. Lipid results are not usually reported by the pathologists; therefore, lipid indices and ratios are not calculated or interpreted before results are used by the clinicians.

CONSENT

It is not applicable.

ETHICAL ISSUES

This research was approved the Ethical and Research Committee of the University of Benin

Teaching Hospital, Benin City, Edo State, Nigeria. Clearance certificate number is ADM/E22/A/VOL. VII/1500.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kabene SM, Orchard C, Howard JM, Soriano MA, Leduc R. Human resources for health the importance of human resources management in health care: A global context. 2006;17:1–17.
2. Hazmi H, Wan Rosli WI, Jalil RA, GanSiew H, Hamid NF, Haron R, et al. Traditional cardiovascular risk-factors among healthcare workers in Kelantan, Malaysia. Southeast Asian J Trop Med Public Health [Internet]. 2015;46(3):504–11.
3. Al Alwan I, Badri M, Al-Ghamdi M, Aljarbou A, Alotaibi H, Tamim H. Prevalence of self-reported cardiovascular risk factors among Saudi physicians: A comparative study. Int J Health Sci (Qassim) [Internet]. 2013;7(1):3–13.
4. Lin C, Li C. Prevalence of cardiovascular risk factors in Taiwanese Healthcare Workers. 2009;411–8.
5. Nwaopara UA. Doctor to patient ratio and infrastructure gap in a psychiatric hospital in oil rich Eket, Nigeria. African J Psychiatry (South Africa) [Internet]. 2016;19(2):72–85.
6. Anderson TJ, Gregoire J, Hegele RA, Couture P, Mancini GB, McPherson R, et al. 2012 Update of the Canadian Cardiovascular Society Guidelines for the diagnosis and treatment of dyslipidemia for the prevention of cardiovascular disease in the adult. Can J Cardiol [Internet]. 2013;29(2):151–67.
7. Nobahar M, Razavi MR. Lifestyle and the most important risk factors of cardiovascular disease in physicians, nurses, and faculty members. Middle East J Rehabil Heal [Internet]. 2015;2(2). Available:http://www.jrehabilhealth.com/?page=article&article_id=28882
8. Bhardwaj S, Bhattacharjee J, Bhatnagar MK, Tyagi S, Delhi N. Atherogenic index of plasma, castelli risk index and atherogenic coefficient - new parameters in assessing cardiovascular risk. Int J Pharm Biol Sci. 2013;3(3):359–64.
9. Nwagha U, Ikekpeazu EJ, Ejezie FE, Neboh EE, Maduka IC. Atherogenic index of plasma as useful predictor of cardiovascular risk among post-menopausal women in Enugu, Nigeria. Afr Health Sci. 2010;10(3):248–52.
10. Niroumand S, Khajedaluee M, Khadem-Rezaiyan M, Abrishami M, Juya M, Khodaee G, et al. Atherogenic Index of Plasma (AIP): A marker of cardiovascular disease. Med J Islam Repub Iran. 2015;29(1):627–35.
11. Rajab T. Study for Atherogenic Index of Plasma (Aip) in patients with type1 diabetes mellitus, type2 diabetes mellitus, betathalassemia. Ijcsr [Internet]. 2012;02i2:1–9. Available:http://www.doaj.org/doaj?func=fulltext&aId=1082638
12. Koleva DI, Andreeva-Gateva PA, Orbetzova MM, Atanassova IB, Nikolova JG. Atherogenic index of plasma, castelli risk indexes and leptin/adiponectin ratio in women with metabolic syndrome. Int J Pharm. 2015;6:2348–262.
13. Adediran OS, Akintunde AA, Opadijo OG, Araoye MA. Dyslipidaemia, atherogenic index and urbanization in Central Nigeria: Associations, impact, and a call for concerted action. Int J Cardiovasc Res. 2013;2:4.
14. World Health Organization. Global Atlas on cardiovascular disease prevention and control. Organization. 2011;156.
15. Chen GP, Qi JC, Wang BY, Lin X, Zhang XB, Zhao JM, et al. Applicability of visceral adiposity index in predicting metabolic syndrome in adults with obstructive sleep apnea: A cross-sectional study. BMC Pulm Med [Internet]. 2016;16(1). Available:http://www.biomedcentral.com/1471-2466/16/37
16. Oh JY, Sung YA, Lee HJ. The visceral adiposity index as a predictor of insulin resistance in young women with polycystic ovary syndrome. Obesity. 2013;21(8): 1690–4.
17. Amato MC, Magistro A, Gambino G, Vesco R, Giordano C. Visceral adiposity index and DHEAS are useful markers of diabetes risk in women with polycystic ovary syndrome. Eur J Endocrinol. 2015;172(1): 79–88.
18. Carneiro Roriz AK, Santana Passos LC, Cunha De Oliveira C, Eickemberg M, De Almeida Moreira P, Barbosa Ramos L. Anthropometric clinical indicators in the

assessment of visceral obesity: An update. Nutr Clin y Diet Hosp. 2016;36(2):168–79.
19. Burstein M, Scholnick HR, Morfin R. Rapid method for the isolation of lipoproteins from human serum by precipitation with polyanions. Scand J Clin Lab Invest. 1980;40:583-595.
20. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low density lipoprotein-cholesterol in plasma. Chin-Chem. 1972;18:499-502.
21. Dobiasova M. AIP: Atherogenic index of plasma as a significant predictor of cardiovascular risk: From research to practice. Vnitr. Lek. 2006;52(1):64-71.
22. Amato MC, Pizzolanti G, Torregrossa V, Misiano G, Milano S, Giordano C. Visceral adiposity index (VAI) is predictive of an altered adipokine profile in patients with type 2 diabetes. PloS One. 2014;9:e91969.
23. Oguejiofor OC, Onwukwe CH, Odenigbo CU. Dyslipidaemia in Nigeria: Prevalence and pattern. Ann Afr Med. 2012;11(4):197-202.
24. Moor VJA, Amougou SN, Ombotto S, Ntone F, Wouamba DE, Nonga BN. Dyslipidemia in patients with cardiovascular risk and disease at the University Teaching Hospital of Yaoundé, Cameroon. International Journal of Vascular Medicine. 2017;1:1-5. Available:https://doi.org/10.1155/2017/6061306
25. Oesch L, Tatlisumak T, Arnold M, Sarikaya H. Obesity paradox in stroke-Myth or reality? PLoS ONE. 2017;12(3):e0171334. DOI: 10.1371/journal.pone.0171334.
26. Oreopoulos AI, Padwal R, Kalantar-Zadeh K, Fonarow GC, Norris CM, McAlister FA. Body mass index and mortality in heart failure: A meta-analysis. Am Heart J. 2008;156(1):13-22.
27. Ugwuja EI, Ogbonna NC, Nwibo AN, Onimawo IA. Overweight and obesity, lipid profile and atherogenic indices among civil servants in Abakaliki, South- Eastern Nigeria. Ann Med Health Sci Res. 2013;3(1):13-18.

Peer-review history:
The peer review history for this paper can be accessed here:
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