Original Article

Overweight and Obesity, Lipid Profile and Atherogenic Indices among Civil Servants in Abakaliki, South Eastern Nigeria

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Abstract

Background: The association between dyslipidaemia, obesity and hypertension is well established, and all have been found to be risk factors for cardiovascular disease (CVD). **Aim:** To determine the prevalence of overweight and obesity, plasma lipid profile and atherogenic indices as markers for CVD among civil servants. **Subjects and Methods:** Two hundred and five (205) apparently healthy civil servants (106, 51.7% males) aged 21-60 years, mean and standard deviation (SD) 40.9 (11.3) years, enrolled between February and April 2008 were assessed for their plasma lipid profile and anthropometrics (body weight and height) using standard methods and techniques. **Results:** Prevalent rates of overweight and obesity were 34.2% (70/205) and 6.8% (14/205), respectively, with more men affected than women. Abnormal lipids observed were: Elevated total cholesterol 37.1% (76/205), low-density lipoprotein-cholesterol (LDL-C) 37.1% (76/205), triglyceride 6.8% (14/205), reduced high-density lipoprotein-cholesterol (HDL-C) 8.8% (18/205) and elevated Atherogenic Index 10.7% (22/205) and Coronary Risk Index 9.8% (20/205), with the older age groups and higher Body Mass Index (BMI) groups being the most affected. Male subjects were found to have more favorable plasma lipid profile (lower LDL-C and higher HDL-C) than the females. Plasma lipids were positively correlated with BMI and artherogenic indices, except for HDL-C, which was negatively correlated with artherogenic indices and LDL-C but positively correlated with BMI. **Conclusion:** The findings show that civil servants in Abakaliki, particularly the females, those with higher BMI and advanced in age, exhibited unfavorable plasma lipids and social habits with a low level of physical activity, which may predispose them to CVD. In addition to epidemiological study of the general population, there is a need for education on healthier lifestyles such as good nutrition, weight reduction, smoking and alcohol cessation, greater physical activity and regular medical check-up.

Keywords: Cardiovascular disease, Dyslipidaemia, Obesity, Overweight

Introduction

Cardiovascular diseases (CVDs), the leading cause of morbidity and mortality in the western World, are now emerging public health challenges in developing countries,[1] accounting for 80% of deaths and 87% of related disability currently recorded in the low-and middle-income countries. In developing countries, mortality due to CVD is expected to rise to 19 million by 2020,[2] with deaths among persons 15-59 years of age three to eight times as high in Tanzania and Nigeria as in England and Wales.[3] In fact, it has been reported that CVD in developing countries causes twice as many deaths as HIV, malaria and tuberculosis combined.[4] According to earlier speculation,[5] almost all unexpected deaths of medical origin in Nigeria are due to cardiovascular cause.

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The association between dyslipidemia, obesity and hypertension is well established,[6,7] and all have been found to be major risk factors for the development of CVD, a leading cause of visits to physicians[8] and cause of death.[9] Dyslipidaemia is

becoming increasingly common in Africa. For instance, a study in Tanzania[10] observed 25% prevalence of elevated serum total cholesterol (TC > 5.2 mmol/L) and 15% prevalence of elevated triglyceride (Tg > 1.7 mmol/L) among adults over 35 years of age, with women being affected more than men. This abnormal lipid metabolism has been associated with urbanisation and westernisation.[10] Although there have been reports of plasma and/or serum lipids among different Nigerian populations,[11-14] little is known about the lipid profile of Nigerian civil servants, a population viewed as much vulnerable to dyslipidemia and other cardiovascular risk factors due to western lifestyle, such as alcohol consumption, cigarette smoking, sedentary life and consumption of diet with high fat contents (especially the unsaturated fats), all of which are associated with abnormal lipid metabolism. Therefore, the present study was designed to investigate the prevalence of obesity (high Body Mass Index [BMI]), plasma lipid profile and artherogenic indices as markers for CVD among civil servants in Ebonyi State.

Subjects and Methods

A total of 205 apparently healthy civil servants (106 males and 99 females) from 10 ministries (Health, Public Utility, Works and Transport, Commerce and Industry, Education, Agriculture, Women Affairs, Justice, Urban and Rural Development and Youths and Sports) in Abakaliki, the capital city of Ebonyi State, were enrolled between February and April 2008. The age of the participants ranged between 21 and 60 years. Convenient sampling method was used. The protocol for the study was approved by the Research and Ethics Committee of the Federal Medical Centre, Abakaliki. Written consent of the participants was obtained before the commencement of the study. Set of questionnaires were used to collect subjects' sociodemographic data, such as age, sex, marital status, educational level, living accommodation, alcohol and tobacco intakes. The anthropometrics (weight [kg] and height [m]) of the participants were measured using weighing scale and measuring tape, respectively, and the BMI (kg/m^2) was calculated. All the measurements were taken by one of the researchers (ANN). Based on the values of BMI, the subjects were classified as underweight (BMI < 18.5 kg/m^2), normal (BMI 18.5-24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2) and obese (BMI ≥ 30 kg/m^2). Blood samples (5.0 mL) were obtained once from the subjects between the hours of 08.00-10.00 after overnight fast and dispensed into EDTA bottles. The blood samples were placed on ice until separation within 2 h. The samples were centrifuged at 2000 *g* for 5 min, after which plasma was isolated into dry plain plastic screw-capped containers and stored frozen-20°C prior to analyses. Plasma TC and Tg concentrations were determined by enzymatic colorimetric assay as described previously[15] and modified by Richmond,[16] and high-density lipoprotein-cholesterol (HDL-C) and low-density lipoprotein-cholesterol (LDL-C) were determined enzymatically after precipitation of other lipoproteins as described by Burstein *et al.*,[17] and Assmann *et al.*,[18] respectively, using kits from Biosystem Laboratories (Spain). All samples were analyzed in duplicates, after which the mean was determined. Atherogenic Index (AI = LDL-C/HDL-C) and Coronary Risk Index (CRI = TC/HDL-C) were thereafter calculated for individual subjects. Plasma lipid abnormality was based on the expert panel of the National Cholesterol Education Programme (NCEP)[19] cut-off values.

Data collected were analyzed using SPSS® software for Window® version 16 (SPSS Inc., Chicago, IL, USA). The differences between groups were compared using one-way analysis of variance (ANOVA). Data were expressed either as mean and standard deviation or percentage. The statistical significance was set at the *P* value of ≤ 0.05.

Results

The means and standard deviation (SD) of the parameters determined were age 40.9 (11.3) years, BMI 24.6 (3.6) kg/m^2, TC 4.92 (1.00) mmol/L, LDL-C 2.83 (0.92) mmol/L, HDL-C 1.50 (0.59) mmol/L, Tg 1.29 (0.57) mmol/L, AI 2.28 (1.33) and CRI 3.75 (1.59). Taken together, all the participants had normal BMI, artherogenic indices and lipid parameters within the NCEP reference ranges. However, prevalence rates of abnormal lipid parameters observed were: Elevated TC 37.1% (76/205), elevated LDL-C 37.1% (76/205), elevated Tg 6.8% (14/205), reduced HDL-C 8.8% (18/205), elevated AI 10.7% (22/205) and elevated CRI 9.8% (20/205) (data not shown).

Table 1 shows the general characteristics of the study population. Majority of the subjects were in the age group of 31-40 years (32.2%, 66/205) and >50 years (30.2%, 62/205), had tertiary education (77.1%, 158/205) and lived in single rooms (50.2%, 103/205) and flats (42.4%, 87/205). As regards social habits and physical activity, 5.9% (12/205) of the subjects take tobacco, 23.9% (49/205) take alcohol and 2.4% (5/205) take both alcohol and tobacco, while 9.3% (19/205) were involved in physical activity. Five (5) subjects were found to be underweight, representing 2.4% of the study population (2.7% (3/106) males and 2.2% (2/99) females), while 34.1% (70/205) were overweight (41.5% (44/106) males and 26.3% (26/99) females) and 6.8% (14/205) (7.8% (8/106) males and 6.1% (6/99) females) were obese.

Table 2 compares BMI, plasma lipids (TC, LDL-C, HDL-C and Tg) and the artherogenic indices (CRI and AI) among the age groups. Subjects in the age group of 41-50 years had significantly (*P* = 0.023) higher BMI than the other age groups. For the plasma lipids, significantly (*P* = 0.019) higher values were observed for TC and LDL-C in the age groups 41-50 and >50 years, respectively, while significantly (*P* = 0.036) higher Tg was observed in the age group of >50 years only. However, there was no age difference in the value of plasma HDL-C. Although subjects in the higher age groups tend to have higher artherogenic indices, only values in subjects in the

Table 1: General characteristics of the study population

Parameters	Frequency	%
Sex		
Male	106	51.7
Female	99	48.3
Total	205	100
Age groups (years)		
<30	37	18.1
31-40	66	32.2
41-50	40	19.5
>50	62	30.2
Total	205	100
BMI groups (kg/m^2)		
<18.5	5	2.4
18.5-24.9	116	56.6
25-29.9	70	34.2
>30.0	14	6.8
Total	205	100
Level of education		
Secondary	32	15.6
Tertiary	158	77.1
Postgraduate	15	7.3
Total	205	100
Living accommodation		
Single room	103	50.2
Flat	87	42.4
Bungalow	11	5.4
Duplex	4	2.0
Total	205	
Tobacco intake		
Yes	12	5.9
No	193	94.1
Alcohol intake		
Yes	49	23.9
No	156	76.1
Physical activity		
Active	19	9.3
Inactive	186	90.7

BMI: Body Mass Index

age groups of 31-40 and >50 years were found to be statistically significant ($P = 0.011$).

Both overweight and obese subjects had significantly ($P < 0.05$) higher plasma lipids when compared with individuals that were either underweight or normal weight, while the obese subjects had significantly ($P = 0.037$) higher Tg in comparison with overweight subjects [Table 3]. Nevertheless, there was no difference in the artherogenic indices among the BMI groups.

BMI was found to be comparable ($P = 0.107$) between male and female subjects [Table 4]. While plasma TC, HDL-C and Tg were higher in males in comparison with their female counterparts, only TC was statistically significant ($P = 0.040$). However, LDL-C was lower ($P = 0.473$) in males in comparison with females [Table 4]. Although female subjects seem to have higher artherogenic indices in comparison with the males, the differences were not statistically significant.

Table 2: Comparison of BMI, lipid profile and artherogenic indices among the age groups

Parameters	Age groups (years)			
	<30	31-40	41-50	>50
Body mass index	23.52 (5.16)^a	24.72 (3.87)^a	25.28 (3.08)^b	24.44 (3.54)^a
Total cholesterol	4.55 (1.00)^a	4.78 (0.98)^a	5.13 (0.98)^b	5.17 (0.85)^{bc}
LDL-C	2.47 (1.03)^a	2.77 (0.93)^a	2.91 (1.05)^b	3.05 (0.66)^b
HDL-C	1.59 (0.54)	1.41 (0.62)	1.61 (0.56)	1.48 (0.59)
Triglyceride	1.12 (0.57)^a	1.28 (0.55)^a	1.34 (0.62)^a	1.39 (0.55)^b
Coronary risk index	3.21 (1.52)^a	4.02 (1.92)^b	3.50 (1.17)^a	3.95 (1.40)^{bc}
Artherogenic index	1.88 (1.31)^a	2.45 (1.50)^b	2.08 (1.05)^a	2.46 (1.25)^b

a,b c are significantly different, LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol

From Table 5, although the effect of alcohol and tobacco intakes was not significant on BMI, plasma lipids and artherogenic indices (CRI and AI), physical activity was found to significantly lower (plasma TC, LDL-C and Tg and CRI and AI). However, physical activity tends to increase HDL-C, although this was not statistically significant ($P = 0.405$).

Table 6 shows the interrelationships between plasma lipids, age, BMI and artherogenic indices (CRI and AI). While the TC, LDL-C and Tg were significantly (P=0.013) positively correlated with BMI and artherogenic indices, there were negative (P=0.021) correlations between HDL-C and the artherogenic indices. There was also a significantly ($r = 0.232$; $P = 0.001$) positive correlation between age and TC. However, LDL-C was significantly ($r = -0.350$; $P = 0.002$) negatively correlated with HDL-C.

Discussion

This study has documented prevalent rates of underweight, overweight and obesity of 2.4%, 34.2% and 6.8%, respectively, among the population. Again, unfavorable plasma lipid profile and artherogenic indices were documented among older subjects and subjects in the higher BMI groups. Male subjects were found to have more favorable plasma lipid profile (lower LDL-C and higher HDL-C) than the females. Although a significant percentage of the population were involved in social habits that may predispose them to CVD, such as cigarette smoking (5.9%) and alcohol consumption (23.9%), few were involved in physical activities (9.3%). Plasma lipids were positively correlated with BMI and artherogenic indices, except for HDL-C, which was negatively correlated with artherogenic indices and LDL-C but positively correlated with BMI.

The prevalence of overweight (34.2%) and obesity (6.8%) recorded in the present study are comparable to 36.0% and

6.5% for overweight and obesity, respectively, reported among senior civil servants in Kuala Lumpur[20] and 33.4% for overweight/obesity reported among civil servants in Nepal.[21] However, the values for obesity in males and females (7.8% and 6.1%, respectively) in the present study are lower than 41.5% and 25.6% in females and males, respectively, reported among civil servants in Tamale metropolis in the northern region of Ghana[22] and 36% and 10% for women and men, respectively, in urban civil servants in Ghana.[23] Previously, Okeke *et al*., reported that 40.58% of the top civil servants in Anambra State were 20% above desirable weight-for-age.[24] Although the higher prevalent rate of overweight and obesity among male subjects observed in the present study was in corroboration with the findings of Oghagbon *et al.,*[25] and Bakari *et al.,*[26] (for obesity), it contrasted the findings of some studies that reported a higher prevalence of overweight[27,28] and obesity[26] in females than in males. The disparities in these findings may best be explained by differences in the subjects studied. However, it has been shown that men gain more weight than women until the perimenopausal period, when the trend is reversed.[29] The finding from this study has an important health implication. It may be speculated that a reasonable proportion of civil servants in Ebonyi State may be at risk of CVD. It is even more worrisome considering the lipid profile pattern and low level of physical activity of the subjects. Previously, higher lipid profile has been reported among hypertensive Nigerians.[30]

Table 3: Comparison of lipid profile and artherogenic indices in relation to the body mass index groups

Parameters	BMI groups (kg/m²)			
	<18.5 (*n*=5)	18.5-24.9 (*n*=116)	25-29.9 (*n*=70)	≥30 (*n*=14)
Total cholesterol	4.16 (1.15)[a]	4. 55 (0.86)[a]	5.41 (0.87)[b]	5.82 (1.12)[bc]
LDL-C	2.10 (0.94)[a]	2.57 (0.88)[a]	3.21 (0.83)[b]	3.29 (0.86)[bc]
HDL-C	1.44 (0.47)[a]	1.42 (0.54)[a]	1.60 (0.64)[b]	1.70 (0.62)[b]
Triglyceride	1.34 (1.05)[a]	1.22 (0.52)[a]	1.31 (0.50)[b]	1.83 (0.83)[c]
Coronary risk index	3.32 (2.03)	3.69 (1.70)	3.87 (1.44)	3.79 (1.46)
Artherogenic index	1.75 (1.41)	2.22 (1.38)	2.42 (1.23)	2.27 (1.32)

Values with different superscripts are significantly different (P<0.05); LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol, BMI: Body mass index

Table 4: Comparison of BMI, lipid profile and artherogenic indices in relation to sex

Parameters	Male (*n*=106)	Female (*n*=99)	*P*-values
Body mass index	24.96 (4.17)	24.07 (3.59)	0.107
Total cholesterol	4.96 (0.98)	4.89 (1.03)	0.040*
LDL-C	2.78 (0.95)	2.87 (0.89)	0.473
HDL-C	1.58 (0.63)	1.42 (0.53)	0.061
Triglyceride	1.30 (0.54)	1.29 (0.61)	0.908
Coronary risk index	3.66 (1.63)	3.84 (1.54)	0.318
Artherogenic index	2.19 (1.36)	2.38 (1.29)	0.419

*P<0.05. LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol, BMI: Body mass index

A more favorable lipid profile of the male subjects (lower LDL-C and higher HDL-C) in comparison with their female counterparts observed in the present study raises some gender-related questions in the metabolism of lipids, and suggests that males in this population may be more protected from CVD than the females. Although the reason for unfavorable lipid profile in women in the present study is obscure, it may not be unconnected with unhealthy lifestyle, such as eating of "fast foods" and low level of physical activity,[31] as only 9.3% of the study population were involved in physical activity. Low physical activity and consumption of diet with high contents of carbohydrate and saturated fatty acids, such as "fast foods," have been associated with dyslipidemia.[32-35] According to Dancy *et al.*,[32] habitually active men and women are less likely to have hypertriglyceridemia and low HDL-C concentrations. Although dyslipidemia was a significant feature in the present study, the plasma lipid profile was better (except for TC) than that reported by Odenigbo *et al.,*[34] among the health professionals in Asaba, south-south Nigerian, in which 5% of the study population had hypercholesterolemia, 23% elevated total serum cholesterol, 51% elevated LDL-C and 60% low HDL-C, with females recording better overall lipid profile. It may be argued that our study population in general may be a bit protected from CVD, as reduced HDL-C was observed only in 8.8% of the study population, with the general population having lipid profile within the NCEP reference values. However, with significant percentage of the population involved in social

Table 5: Comparison of BMI, lipid profile and artherogenic indices in relation to alcohol and tobacco intake and physical activity

Habits	BMI	TC	LDL-C	HDL-C	TG	CRI	AI
Alcohol intake							
No	24.66 (3.79	4.89 (0.95)	2.84 (0.91)	1.46 (0.56)	1.30 (0.60)	3.86 (1.68)	2.37 (1.40)
Yes	24.48 (3.14	5.02 (1.17)	2.79 (0.95)	1.63 (0.65)	1.27 (0.46)	3.41 (1.21)	1.98 (0.99)
Tobacco intake							
No	24.62 (3.57	4.92 (1.01)	2.84 (0.93)	1.49 (0.56)	1.29 (0.58)	3.76 (1.54)	2.29 (1.30)
Yes	24.68 (3.35	4.92 (0.91)	2.59 (0.78)	1.70 (0.90)	1.28 (0.45)	3.66 (2.99)	2.12 (1.75)
Physical activity							
No	24.60 (3.44	4.98 (1.01)	2.88 (0.91)	1.48 (0.59)	1.34 (0.57)	3.85 (1.61)	2.35 (1.34)
Yes	24.77 (4.61	4.42 (0.77)†	2.33 (0.85)†	1.71 (0.49)	0.88 (0.40)†	2.80 (0.94)†	1.56 (0.86)†

†Values significantly different (P<0.05); BMI: Body mass index, LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol

Table 6: Relationship between lipid profile and artherogenic indices

Parameters	Correlation coefficient	*P*-values
TC vs. CRI	0.246	0.001*
TC vs. AI	0.2360	0.001*
LDL-C vs. CRI	0.641	0.004*
LDL-C vs. AI	0.691	0.004*
HDL-C vs. CRI	−0.774	0.003*
HDL-C vs. AI	−0.775	0.003*
Tg vs. CRI	0.241	0.001*
Tg vs. AI	0.133	0.057
TC vs. BMI	0.500	0.004*
TC vs. age	0.232	0.001*
TC vs. LDL-C	0.777	0.004*
TC vs. Tg	0.399	0.002*
LDL-C vs. HDL-C	−0.350	0.002
LDL-C vs. BMI	0.391	0.002*
Tg vs. BMI	0.225	0.001*

*P<0.01; TC: Total cholesterol, CRI: Coronary Risk Index, LDL-C: Low-density lipoprotein-cholesterol, HDL-C: High-density lipoprotein-cholesterol, BMI: Body mass index

habits that may predispose them to CVD, such as cigarette smoking (5.9%) and alcohol consumption (23.9%), with few involved in physical activities (9.3%), such protection may not be sustained. The positive correlations observed between the lipids and BMI on one hand and age on the other hand were in corroboration with previous studies,[12,31,36] and reaffirmed the role of lipids in the pathophysiology of overweight and obesity as well as increasing accumulation of lipids with aging. The present data show that civil servants in Abakaliki exhibited abnormal lipid profile and artherogenic indices, particularly the females, those with high BMI and those advanced in age, which may predispose them to CVD based on the high prevalence of overweight and obesity and low level of physical activity. We therefore recommend that in addition to the epidemiological study of the general population, there is need for education on healthier lifestyles, such as good nutrition, weight reduction, smoking and alcohol cessation, greater physical activity and regular medical check-up.

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