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Gender Related Differences in the Prevalence and Correlates of Modifiable Cardiovascular Disease Risk Factors among Seemingly Healthy Adult Nigerians–A Cross Sectional Study

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Authors' contributions

Author OAG designed the study, authors SJS and OOA collected the data, author SJS analyzed the data and wrote the first draft of the manuscript. All authors contributed to literature search and read and approved the final manuscript.

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ABSTRACT

Background: Mortality from cardiovascular diseases (CVD) is on the increase globally and the presence of multiple CVD risk factors is related to poor CVD outcomes. Most studies in Nigeria described the prevalence of CVD risk factors in populations with hypertension, diabetes, metabolic syndrome and the aged.
Aim: We studied gender disparities in the prevalence and correlates of these factors in a seemingly healthy adult population.
Study Design: A cross-sectional study involving 540 participants aged from 18 to 74 years.
Place and Duration of Study: The study was conducted in five centers in Lagos state; Mafoluku/Airport, Ikeja, Lekki, Ikota and Yaba from February to June 2010.
Methods: Blood pressure, body mass index, total serum cholesterol and random blood glucose were measured with standard methods. Smoking status was also ascertained. Gender differences in the presence of multiple risk factors and prevalence of CVD risk factors were determined by Fisher's Exact Test and Chi-Square test respectively.

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Pearson and partial correlation were used to determine the correlation between risk factors. Statistical significance were set at *P*<.01 and *P*<.05.
Results: The prevalence of hypertension, hypercholesterolemia, obesity, diabetes and smoking was 163(30.2%), 140(25.9%), 106(19.6%), 80(14.8%), and 43(8%) respectively. Females had a higher prevalence of hypercholesterolemia and lower prevalence of smoking than males (*P*=.001). Only 212 (39.3%) participants had no existing CVD risk factors while 148(27.5%) had multiple risk factors with females been more affected (*P*=.03). There was no gender difference in the moderately positive correlations between risk factors before and after adjusting for age (*P*>.05).
Conclusion: The increase prevalence of CVD risk factors and the presence of multiple CVD risk factors call for urgent formulation of policies to address the looming epidemic of cardiovascular diseases through programs targeting prevention, systematic screening, interventions and control.

Keywords: Cardiovascular diseases; risk factors; hypertension; hypercholesterolemia; diabetes; body mass index; smoking; Nigeria.

ABBREVIATIONS

CVD: Cardiovascular Diseases; SSA: Sub-Saharan Africa; SBP: Systolic Blood Pressure DBP: Diastolic Blood Pressure; RBG: Random Blood Glucose; TSC: Total Serum Cholesterol; BMI: Body Mass Index.

1. INTRODUCTION

Cardiovascular diseases (CVD) remain the leading cause of death globally in both men and women. In 1998, it was responsible for 62% of all death with 34% from women and 28% from men [1]. Until recently CVD was thought to be the disease of the developed nations since communicable diseases were still rampant in developing countries. Communicable diseases account for 60% death in Sub-Saharan Africa (SSA) [2]. However, mortality and morbidity of non-communicable diseases is on the increase while those of communicable diseases such as infectious diseases and nutritional deficiencies are on the decline [3]. Low and medium income countries contribute about 77.8% to global non-communicable disease mortality and 78.5% to CVD death in 1998 [1]. The increase in non-communicable diseases like CVD in developing countries is influenced by increase in life expectancy, western diet, poverty, urban migration and globalization [4].

Even though CVD is common to all countries and has no geographical, socio-economical and sex delineation between developed and developing countries; death resulting from CVD is about five times higher in developing countries than in developed countries [5]. The impact of CVD burden is on the increase in resource limited countries. The primary factor responsible for the increasing burden of CVD in developing countries is increasing occurrence of atherosclerotic disease resulting from increased rural-urban migration, higher CVD risk factors level, size of the population, early onset of the disease and the relatively young population [6,7].

Decades of economic development, rural-urban migration as a result of industrialization and changes in social organization has led to epidemiological and nutritional transition in developing countries like Nigeria [3]. Epidemiological transition may be at different stage in

different parts of the world, at different stages within different regions in a country and may occur between different disease categories [6,8,9]. Knowledge about the relationship between CVD and CVD risk factors are garnered from developed countries but have been proven to be true even for developing countries [10]. Though similar CVD risk factors are important all over the world but specific prevalence varies. In Africa the prevalence of the singular most important CVD risk factor, hypertension, varies between 1% and 30% [11,12]. Hypertension, diabetes and abnormal lipid profile are responsible for poor CVD outcomes [13].

In sub-Saharan Africa, there is a relative lack of prevention and control measure to reduce exposure to CVD risk factors [14]. This is occasioned by the non-availability of national data on the prevalence of CVD because of resource limitation; but a pool of sectional studies in subsets of the population may give a picture of the overall prevalence of CVD [15]. Though, there are few studies on CVD risk factors in Nigeria from different parts of the country, none have specifically reported how these CVD risk factors correlate before and after the removal of confounders. And, since the presence of multiple CVD risk factors is associated with increased risk of cardiovascular diseases, our study seeks to identify gender differences in the prevalence of CVD risk factors, examine the interplay between these factors, and identify people who have high multifactorial risk of developing CVD in a population of seemingly healthy adults Nigerians.

2. METHODS

2.1 Study Site and Study Population

Lagos state is the smallest state in Nigeria yet it has the highest population. In 2006, the population was estimated to be 17.5 million with a growth rate of 3%. The ratio of male to female was 1:0.9. This state has about 36.8% of Nigeria's urban population. It is the commercial nerve center of the nation. The state is located on the south-western part of Nigeria. Lagos is a highly heterogeneous state with ethnic groups from all over the country represented in it [16].

2.2 Sample Size

Convenient sampling method was used where an average of one hundred and eight people participated in the study in each of the five shopping centers used. A chain pharmacy store with outlets in all these centers was used for the collection of data from the participants. The centers wereMafoluku/Airport, Ikeja, Lekki, Ikota and Yaba.

2.3 Study Design and Period

This was an observational cross-sectional study involving 540 participants aged from 18 to 74 years. The study was conducted from February to June 2010.

2.4 Inclusion and Exclusion Criteria

People were invited for the study through fliers freely distributed through the chain pharmacy outlet and banners were conspicuously displayed at the entrance to each of the shopping centers. The fliers and banners advertised that people can come for a free cardiovascular

screening on specified dates after breakfast. The screening exercise lasted from 10 a.m. till 4 p.m. on the specified days.

Participants who were 18 years and above were admitted into the study provided they were not a known hypertensive or diabetic patient and were not on medication for any known cardiovascular diseases. We considered these participants to be seemingly healthy. Participants who have established or history of cardiovascular disease were excluded from the study.

For each participant who met the inclusion criteria, the traditional modifiable cardiovascular disease risk factors were measured with standard procedures in all the centers. They included age, height, weight, blood pressure {systolic blood pressure (SBP) and diastolic blood pressure (DBP)}, random blood glucose (RBG) and non-fasting total serum cholesterol (TSC).

2.5 Measurements

Age of participants was recorded as self-reported age in years. Height was measured in meters to the nearest 0.1m barefooted with the aid of Leicester height scale. Weight was measured with light clothing on, to the nearest 100g with a bathroom scale standardized with 20 kg weight. Body mass index (BMI) in kg/m^2 was calculated as the body weight in kilogram divided by the square of the height in meters. It was then categorized into underweight (BMI: <18 kg/m^2), normal (BMI: 18–24.99 kg/m^2), pre-obese (BMI: 25–29.99 kg/m^2) and obese (BMI ≥30 kg/m^2) according to World Health Organization (WHO) [17]. Blood pressure was measured after a 10 minutes rest with Accusson's mercury sphygmomanometer twice, with 10 minutes interval between measurements on the left arm with the upper arm at the chest level in a sitting position. The average of the two readings was recorded. The systolic and the diastolic blood pressure were recorded at phase I and V Korotkoff sound respectively. Blood pressure was categorized as follow according to The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, JNC VII [18]–systolic BP: normal (<120 mmHg), prehypertension (120–139 mmHg), stage I hypertension (140–159 mmHg) and stage II hypertension (>160 mmHg); diastolic BP: normal (< 80 mmHg), prehypertension (80–89 mmHg), stage I hypertension (90 – 99 mmHg) and stage II hypertension (>100 mmHg). Non fasting total serumcholesterol was measured through finger prick with MediCare® and categorized according to the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), (NCEP ATP III) [19] as desirable (<5.18 mmol/L), borderline high (5.18–6.19 mmol/L) and high (≥6.20 mmol/L). Random blood glucose (RBG) was measure with Accuchek active® glucometer and categorized according to American Diabetes Association [20] as normal (<7.8 mmol/L), prediabetic (7.8-<11.1 mmol/L) and diabetic (≥11.1 mmol/L). Smoking status was categorized as smokers-those who are currently smoking or quit smoking about a year ago, and non-smokers were those who never smoked or quit smoking more than a year ago [21].

For the purpose of assessing the level of prevalence of multiple modifiable CVD risk factors; hypertension was defined as SBP of ≥140 mmHg and/or DBP ≥90 mmHg, diabetes as RBG of ≥11.1 mmol/L, obesity as BMI ≥30 kg/m^2, and hypercholesterolemia as TSC ≥6.2 mmol/L. All measurements were conducted by trained personnel some of which include pharmacists and health care assistants.

2.6 Statistical Analysis

The statistical package for social sciences (SPSS) version 20 statistical software was used to analyze the data. Independent sample T-test and Chi-Square test were used to determine gender related differences when the modifiable CVD risk factors measured were presented as continuous and categorical variables respectively. The variables were expressed as mean±SD and proportions for continuous and categorical variable respectively. Pearson correlation coefficients were computed for covariates of CVD risk factors and gender differences in correlation coefficients were determined by computing the Z-score for significance using the formula [22]:

$$Z_{obs} = \frac{Z_1 - Z_2}{\sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}}$$

Where, Z_1 and Z_2 represent Z-values corresponding to the correlation coefficient for male and female participants respectively. N_1 and N_2 are the total number of male and female participants respectively. When $1.96 \leq Z_{obs} \leq -1.96$, differences in correlation coefficients were considered statistically significant. Partial correlation was used to explore changes in the correlation coefficients (r) of the covariates of modifiable CVD risk factors after controlling for age to remove the effect of the obvious confounder. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. Gender related differences in the existence of multiple CVD risks factors were determined using Fisher's Exact Test for dichotomized CVD risk factors. Crude and age-adjusted odds ratios were determined by Mantel-Haenszeltest for each of the risk factors. All tests were two tailed with $P<.05$ and $P<.01$ taken as statistically significant.

3. RESULTS

3.1 Description of the Study Sample

A total number of 540 (334 male and 206 female) participants who had complete data out of the 565 that took part in the study were included in the analysis. These participants were from five centres in Lagos state, 114 from Mafoluku/Airport, 144 from Ikeja, 111 from Lekki, 91 from Ikota and 80 from Yaba. The mean age of the participants was 35.67±11.08 years (male-35.62±10.40 years; female 35.25±12.12 years, $P=.895$). The age range was from 18–74 years with more male participants at all the age groups without any statistically significant difference except at the middle age group of 38–47 years where a statistically significant difference was noticed, $P=.035$ (Table 1).

The mean values of the CVD risk factors are listed in (Table 2). Statistically significant gender difference was observed in the mean of BMI (male–25.25±4.30 kg/m^2; female 26.62±5.45 kg/m^2; $P=.009$) and TSC (male 4.79±1.84 mmol/L, female 5.51±2.18 mmol/L; ($P=.001$).

Table 1. Gender differences in the prevalence of cardiovascular disease risk factors among seemingly healthy Nigerians

CVD risk factors	Total (n=540)	Male (n=334)	Female (n=206)	*P*-value
Age, years				
18–27	127(23.5)	72(21.6)	55(26.7)	
28-37	218(40.4)	136(40.7)	82(39.8)	
38–47	112(20.7)	82(24.6)	30(14.6)	0.035*
48–57	56(10.4)	30(9.0)	26(12.6)	
≥58	27(5.0)	14(4.2)	13(6.3)	
Smoking status				
Smokers	43(8.0)	39(11.7)	4(1.9)	0.001**
Non-smokers	497(92.0)	295(88.3)	202(98.1)	
BMI, kg/m^2				
Underweight (<18.5)	14(2.6)	9(2.7)	5(2.4)	
Normal weight (≥18.5–24.99)	261(48.3)	172(51.5)	39(43.2)	0.066
Preobese (25–29.99)	159(29.4)	99(29.6)	60(29.1)	
Obese class I–III (≥30)	106(19.6)	54(16.2)	52(25.2)	
SBP, mmHg				
Normal (<120)	243(45.0)	140(41.9)	103(50.0)	
Pre-hypertention (120-139)	203(37.6)	130(38.9)	73(35.4)	0.170
Stage I hypertension (140-159)	64(11.9)	46(13.8)	18(8.7)	
Stage II hypertension (≥160)	30(5.6)	18(5.4)	12(5.8)	
DBP, mmHg				
Normal (<80)	231(42.8)	130(38.9)	101(49.0)	
Pre-hypertension (80-89)	167(30.9)	111(33.2)	56(27.2)	0.145
Stage I hypertension (90-99)	94(17.4)	61(18.3)	33(16.0)	
Stage II hypertension (≥100)	48(8.9)	32(9.6)	16(7.8)	
TSC, mmol/L				
Normal (<5.18)	320(59.3)	215(64.4)	105(51.0)	
Borderline high (≥5.18–6.19)	80(14.8)	51(15.3)	29(14.1)	0.001**
High (≥6.20)	140(25.9)	68(20.4)	72(35.0)	
RBG, mmol/L				
Normal (<7.8)	268(49.6)	170(50.9)	98(47.6)	
Pre-diabetes (≥7.8 - <11.1)	192(35.6)	114(34.11)	78(37.9)	0.671
Diabetes (≥11.1)	80(14.8)	50(15.0)	30(14.6)	

*CVD–cardiovascular disease, BMI–body mass index, SBP–systolic blood pressure, DBP–diastolic blood pressure, TSC–total serum cholesterol and RBG–random blood glucose. Figures represent n(%), *P<.05 and **P<.01 were considered significant*

3.2 Gender-specific Prevalence of CVD Risk Factors

As shown in (Table 1), only 43(8%) of the population studied were smokers and out of this, 4 (9.3%) were female, a significantly different figure from the male participants 39(90.7%) *P*=.001. Majority of the smokers were in the 28–37 years age bracket representing about (62.8%) of the smokers. The prevalence of obesity (BMI≥30kg/m^2), diabetes (RBG≥11.1mmol/L) and hypercholesterolemia (TSC≥6.2mmol/L) was 106 (19.6%), 80(14.8%), and 140 (25.9%) respectively in the population studied (see Table 1). The prevalence of hypertension (SBP≥140mmHg and/or DBP≥90mmHg) was 163(30.2%). The number of female participants who had hypercholesterolemia was significantly higher than the male participants (*P*=.001, Table 1).

Table 2. Gender differences in mean of modifiable cardiovascular disease risk factors

Risk factors	Total (n=540)	Male (n=334)	Female (n=206)	*P*-value
Age mean(SD), years	35.67(11.08)	35.62(10.40)	35.25(12.12)	0.895
Height mean(SD), m	1.69(0.08)	1.71(0.08)	1.65(0.08)	0.000*
Weight mean(SD), kg	73.84(14.45)	74.69(13.79)	72.47(15.40)	0.084
BMI mean(SD), kg/m^2	25.89(4.80)	25.45(4.30)	26.62(5.45)	0.009*
SBP mean(SD), mmHg	123(19.55)	124.19(18.99)	121.12(20.32)	0.075
DBP mean(SD), mmHg	80.11(12.91)	80.92(12.90)	78.81(12.86)	0.066
TSC mean(SD), mmol/L	5.06(2.01)	4.79(1.84)	5.51(2.18)	0.000*
RBG mean(SD), mmol/L	8.36(3.43)	8.29(3.54)	8.45(3.25)	0.084

*SD–standard deviation, BMI–body mass index, SBP–systolic blood pressure, DBP–diastolic blood pressure, TSC–total serum cholesterol and RBG–random blood glucose. *P<.01 was considered significant*

Gender differences in smoking status and hypercholesterolemia remained statistically significant after adjusting for age using odds ratios. However, gender difference in obesity became significant after adjusting for age. There was 66.8% increase in the odds of male participants been obese to female participants been obese after adjusting for age compared with a 41.1% increase before adjustment (Table 3).

Table 3. Crude and age-adjusted odd ratios for CVD risk factors (male:female)

CVD risk factors	Crude odd ratio			Adjusted odd ratio		
	OR	95% CI	P-value	OR	95% CI	*P*-value
Smoking status	6.676	2.349 -18.973	0.001*	6.712	2.315-19.457	0.001*
Hypertension	1.364	0.927-2.005	0.114	1.471	0.982-2.204	0.062
Hypercholesterolemia	2.102	1.422-3.108	0.001*	2.224	1.497-3.344	0.001*
Diabetes	0.968	0.593-1.581	0.897	1.004	0.602-1.672	0.989
Obesity	1.410	0.995-1.997	0.053	1.668	1.128-2.466	0.001*

*OR–odds ratio, CI–confidence interval, *P<.01 is considered significant*

3.3 Co-morbidities of CVD Risk Factors

In this apparently healthy population only 212(39.3%) had no existing CVD risk factor, 180(33.3%) had one CVD risk factor, 102(18.9%) had two risk factors, 36(6.7%) had three risk factors and only 10(1.9%) had four existing CVD risk factors (see Table 4). The various combinations of the modifiable CVD risk factors existing in the population studied are depicted in (Table 4). The male participants differ significantly from the female participants in having one or two CVD risk factors ($p<0.05$). Hypertension or smoking was more common in the male [hypertension 55 (16.5%), smoking 21(6.3%)] than the female [hypertension 16 (7.8%), smoking 3(1.5%)], $P<0.05$ (Table 4).

The combination of obesity and hypercholesterolemia was more common in the female gender than in the male {male: 3(0.9%); female 10(4.9%), $P=.007$}. Also the combination of diabetes and hypercholesterolemia was more common in the female {male: 5(1.5%); female 11 (5.3%), $P=.016$)}.

Table 4. Gender differences in the prevalence of multiple cardiovascular disease risk factors

Number of CVD risk factor	Type of CVD risk factors present					Total n=540	Male n=334	Female n=206	*P*-value
	Smoking	Obesity	Hypertension	Diabetes	Hypercholesterolemia				
0	—	—	—	—	—	212(39.3)	130(38.9)	82(39.8)	0.928
1	╪	—	—	—	—	24(4.4)	21(6.3)	3(1.5)	0.009*
	—	╪	—	—	—	28(5.2)	15(4.5)	13(6.3)	0.425
	—	—	╪	—	—	71(13.2)	55(16.5)	16(7.8)	0.004*
	—	—	—	╪	—	16(3.0)	12(3.6)	4(1.9)	0.310
	—	—	—	—	╪	41(7.6)	20(6.0)	21(10.2)	0.094
						180(33.3)	123(36.8)	57(27.7)	0.031*
2	╪	╪	—	—	—	5(0.9)	5(1.5)	0(0.0)	0.162
	╪	—	╪	—	—	5(0.9)	5(1.5)	0(0.0)	0.162
	—	╪	╪	—	—	17(3.2)	8(2.4)	9(4.4)	0.214
	╪	—	—	╪	—	3(0.6)	3(0.9)	0(0.0)	0.291
	—	╪	—	╪	—	5(0.9)	3(0.9)	2(1.0)	1.000
	—	—	╪	╪	—	7(1.3)	6(1.8)	1(0.5)	0.260
	╪	—	—	—	╪	4(0.7)	3(0.9)	1(0.5)	1.000
	—	╪	—	—	╪	13(2.4)	3(0.9)	10(4.9)	0.007**
	—	—	╪	—	╪	27(5.0)	14(4.2)	13(6.3)	0.311
	—	—	—	╪	╪	16(3.0)	5(1.5)	11(5.3)	0.016*
						102(18.9)	55(16.5)	47(22.8)	0.071
3	╪	╪	╪	—	—	1(0.2)	1(0.3)	0(0.0)	1.000
	—	╪	╪	╪	—	6(1.1)	2(0.6)	4(1.9)	0.208
	—	╪	╪	—	╪	11(2.0)	3(0.9)	8(3.9)	0.025*
	—	╪	—	╪	╪	10(1.9)	5(1.5)	5(2.4)	0.517
	—	—	╪	╪	╪	8(1.5)	6(1.8)	2(1.0)	0.716
						36(6.7)	17(5.1)	19(9.2)	0.075
4	╪	╪	╪	—	╪	1(0.2)	1(0.3)	0(0.0)	1.000
	—	╪	╪	╪	╪	9(1.7)	8(2.4)	1(0.5)	0.163
						10(1.9)	9(2.7)	1(0.5)	0.098

*Figures represent n(%), CVD – cardiovascular disease, ╪ - presence of CVD risk factor,— - absence of CVD risk factor. *P<.05 and **P<.01 were considered significant*

The proportion of obese participants who also had hypertension and hypercholesterolemia was significantly higher in the female {male 3 (0.9%), female 8 (3.9%); *P*=.025}. There were no significant differences in the gender when any four combinations of the five CVD risk factors studied were present in the population (*P*>.05).

The prevalence of a combination of three or four CVD risk factors varied from 0.2 to 2.0% and 0.2 to 1.7% respectively. The highest combinations of three or four CVD risk factors were obesity, hypertension and hypercholesterolemia; and obesity, hypertension, diabetes and hypercholesterolemia respectively (Table 4).

3.4 Correlates of CVD Risk Factors

Table 5 shows the correlation between various CVD risk factors; smoking, BMI, SBP, DBP, RBG and TSC. Body mass index (BMI) showed significantly positive correlations with other CVD risk factors (*P*<.01). Total serum cholesterol showed a moderately strong positive correlation with RBG (r=0.333) without any gender difference (male: r=0.320, female: r=0.361; Z_{obs}=-0.505). Smoking also showed a weak correlation with other CVD risk factors considered in this study. The strongest positive correlation was seen between SBP and DBP in both gender (male: r=0.770, female: r=0.784).

Table 5. Gender differences in the correlates of cardiovascular disease risk factors before and after adjusting for age

Correlates of CVD risk factors	Correlation coefficients of covariates of CVD risk factors							
	Total		Male		Female		Z_{obs}	
	Non-age adjusted	Age adjusted	Non-age adjusted	Age adjusted	Non-age adjusted	Age adjusted	Non-age adjusted	Age adjusted
SMO-BMI	0.039	0.013**	0.029	-	0.005	-	0.280	-
SMO-SBP	0.042	-0.087*	0.073	-	0.015	-	0.673	-
SMO-DBP	0.021	-0.085*	0.038	-	0.036	-	0.056	-
SMO–TSC	0.091*	0.180*	0.074	-	0.048	-	0.280	-
SMO–RBG	0.047	0.026	0.055	-	0.006	-	0.561	-
BMI–SBP	0.254**	0.093*	0.257**	0.115*	0.279**	0.096	-0.370	0.236
BMI–DBP	0.239**	0.130**	0.220**	0.128*	0.294	0.165	0.897	-0.404
BMI–TSC	0.272**	0.176**	0.294**	0.229**	0.218**	0.065	0.897	1.896
BMI–RBG	0.215**	0.159**	0.211**	0.169**	0.222**	0.141*	-0.123	0.348
SBP–DBP	0.777**	0.753**	0.770**	0.750**	0.784**	0.754**	-0.426	-0.123
SBP–TSC	0.154**	0.047	0.148**	0.060	0.201**	0.071	-0.583	-0.112
SBP–RBG	0.098*	0.031	0.097	0.041	0.106	0.021	-0.056	0.236
DBP-TSC	0.117**	0.039	0.110*	0.050	0.166*	0.063	-0.639	0.168
DBP-RBG	0.097*	0.050	0.071	0.032	0.150*	0.088	-0.909	-0.673
TSC-RBG	0.333**	0.302**	0.320**	0.297**	0.361**	0.315**	-0.505	-0.180

*SMO–smoking status, BMI–body mass index, SBP–systolic blood pressure, DBP–diastolic blood pressure, TSC–total serum cholesterol and RBG–random blood glucose; figures represent Pearson correlation coefficients before and after adjusting for age. *P<0.05 and **P<0.01 (2-tailed). Gender differences in correlation coefficient is considered significant when 1.96≤ Z_{obs} ≤–1.96*

Correlations between risk factors were adjusted for age to remove the effect of the obvious confounder (Table 5). After adjusting for age there was no correlation between smoking and other risk factors in the gender. Also, the values of the correlation coefficients reduced appreciably between other risk factors except the correlation coefficients between TSC and RBG, SBP and DBP, BMI and TSC which only changed slightly. Though the correlation between BMI and TSC was significantly reduced in the female (r=0.065) compared with the

male (r=0.229) after adjusting for age; the gender difference failed to reach statistical significance (Z_{obs}=1.896). (Fig. 1) shows gender differences in the shared variance between BMI and TSC, and RBG and TSC.

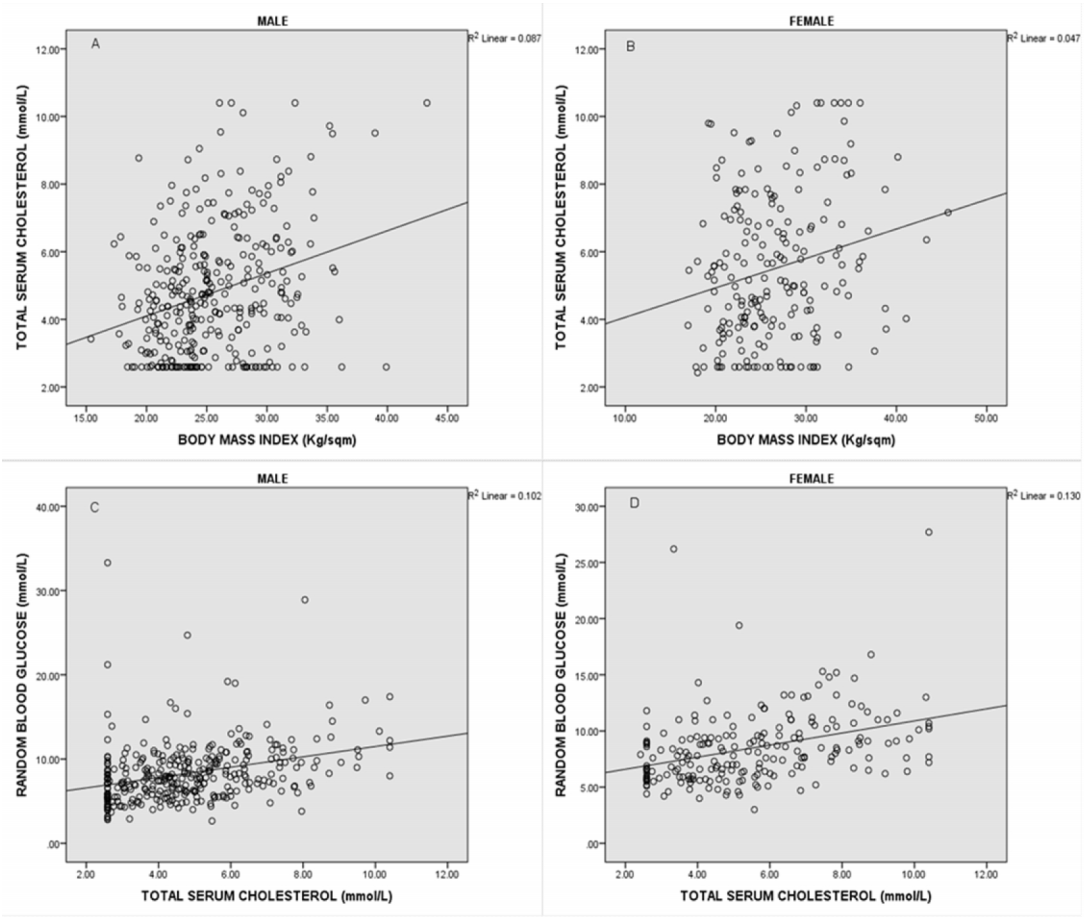

Fig. 1. Shared variance between BMI and TSC (A and B) and RBG and TSC (C and D). 8.7% and 4.7% variance in TSC is explained by BMI in males (A) and females (B) respectively. And, 10.2% and 13% of variance in TSC is explained by RBG in males (C) and females (D) respectively

4. DISCUSSION

Most studies in Nigeria described the prevalence of CVD risk factors in populations with hypertension, diabetes, metabolic syndrome and the aged [23–25]; our study described gender differences in the prevalence CVD risk factors and how these factors correlates in a seemingly healthy population without previously known non-communicable diseases. We also described the prevalence of multifactorial risks of developing CVD in the same population.

The prevalence of obesity (19.6%) in the study population is consistent with other studies in urban areas in SSA where the prevalence of obesity ranged from 19.2% to 26.9% [25–28]. Findings from rural communities showed a lower prevalence between 10.9% and 11.7% in Nigeria and Cameroun respectively [28,29]. In all these studies, the female participants mean BMI significantly differ from that of male participants. Urbanization, adoption of western diets and sedentary lifestyle may explain the discrepancy in the level of obesity reported for urban and rural community. Obesity in African context is wrongly perceived as a sign of affluence, and it is socially acceptable that women are obese. Gender difference in BMI can be explained partially by the influence of gonadal steroids on body composition and appetite, behavioural and socio-cultural factors. Also higher obesity in women is associated with high total fertility rate [30,31]. Since obesity is a leading cause of hypertension, diabetes and hypercholesterolemia, and prospective cohort studies have reported positive correlation between BMI and CVD mortality [32–34] efforts should be geared towards reducing physical inactivity, promotion of healthy diet and reduction in body weight. These efforts should address the socio-cultural and economic reasons for gender specific weight gain.

About 9.3% of the females in our study were smokers. This finding is similar to others [35,36] but another study [26] conducted in Katsina state in the northern part of Nigeria in 2006 reported a lower overall prevalence of smokers (4%) but higher prevalence for the female smokers (21%). Comparing this with our study it shows that there is a lower prevalence of female smokers in the western part of the country. Female smokers are generally frowned at in Nigerian society, hence, the low number of female smokers compared to the United Kingdom [37]. The increase in the overall prevalence of smokers in the country is a trend that needs to be urgently curtailed through restrictions on smoking and education on its consequences.

We found the 30.2% prevalence of hypertension in our study population to be comparable with the findings in other studies in the country [25,38–43]. The prevalence of hypertension in these studies, conducted between 1997 and 2006 was between 7% and 36.6%. Most of these studies were conducted in populations with hypertension, diabetes, metabolic syndrome and the aged; while our study was carried out in a population without previously known non-communicable disease. Thus our finding suggests that the overall prevalence of hypertension should be higher than 30.2%. This shows that there has been an increase in the prevalence of hypertension over the years and since hypertension is the leading cause of CVD and is modifiable; urgent attention should be given to its prevention, screening, detection and treatment.

There was a high prevalence of hypercholesterolemia in the study population. In agreement with other studies in SSA where reported prevalence was from 5% to 25% [26,36,44], females have a significantly higher proportion of TSC level than the males. This may be as a result of higher BMI observed in the females and the fact that cholesterol tends to rise in females shortly before and after menopause [45]. Hypercholesterolemia causes atherosclerosis leading to coronary heart disease development. This may partially explain why African women have higher incidences of CVD mortality than men [46].

Though there was no gender difference in the prevalence of diabetes in our study; the overall prevalence of diabetes, 14.8%, is higher than the findings of other workers in the country which was between 1% and 5.3% [25,26,42,47]. The increase in the prevalence of diabetes agrees with the projection of increased incidence of diabetes globally [48].

We found a moderately strong positive correlation between BMI and TSC, and TSC and RBG which were unaffected by the removal of confounder. These positive correlations were also observed in similar studies [26,36,49]. Also, the association of BMI with SBP and DBP is consistent with other findings in the urban regions of SSA [36,50–52]. Obesity places a high metabolic demand on the body which causes increase in cardiac output and peripheral resistance resulting in increase in blood pressure. Though in this study females have higher mean BMI than males, there was no gender difference in the prevalence of hypertension. Perhaps obesity has a different effect on females than males in relation to hypertension.

Almost one-third of the population had multifactorial risk of developing CVD. The presence of two or more CVD risk factors in this seemingly healthy population was more common in the female than in the males. , hypertension as a single CVD risk factor was more common in the male. Participants who were obese and had hypercholesterolemia; diabetic and had hypercholesterolemia or obese with hypertension and hypercholesterolemia were mostly females. Though, we could not demonstrate a causal relationship between these CVD risk factors in our study; the presence of multiple CVD risk factors is related to poor CVD outcomes such as myocardial infarction, coronary heart disease and stroke in Africa and globally [13]. The variation in the prevalence of combinations of three or four CVD risk factors found in this study is consistent with another study in Japan [53]. These risk factors are found in metabolic syndrome and they tend to cluster as established by Aizawa et al. [53]. The demonstration of the presence of these multiple CVD risk factors in a seemingly healthy adult population warrants an urgent intervention to curb the onset of the epidemic of cardiovascular diseases in the country.

4.1 Limitation of the Study

We acknowledge that our study has several limitations which should be put into consideration when interpreting the results. First, the non-randomized cross-sectional study design does not allow for the determination of a causal relationship between variables. This also limits the extrapolation and generalizability of the results to the total population. Possible selection bias might have resulted in the participation of more males and this should be considered during interpretation. Second, the small sample size of 540 might have failed to detect other gender related disparities and increase the probability of type 2 error. Third, the population sample excludes those with known non communicable diseases which reduced the level of prevalence of CVD risk factors detected and number of participation in the study. Fourth, other CVD risk factors like homocysteinemia, high density lipoprotein, microalbuminemia C-reactive protein and low density lipoprotein were not screened for, and their relative contribution to the prevalence of CVD risk factor could not be ascertained. However, to the best of our knowledge, this is the first time that the prevalence of multiple CVD risk factors in a seemingly healthy adult population (without previously known CVD) will be addressed. The findings of this study provide researchers with a template for further expanded studies and policy makers with information on planning programs for prevention, detection and control of CVD risk factors.

5. CONCLUSION

We noticed a high prevalence of CVD risk factors among our study population with females having higher prevalence of hypercholesterolemia and multiple CVD risk factors than the males. Adjusting for age had no significant effect on the covariates of modifiable CVD risk factors. There is a need for urgent formulation of policies to address the continuous increase

in the prevalence of CVD risk factors and the looming epidemic of cardiovascular diseases through programs targeting prevention, systematic screening, interventions and control.

CONSENT

Not applicable.

ETHICAL CONSIDERATION

For each participant who met the inclusion criteria, the detail and rationale of the study exercise was explained to them and verbal informed consent was obtained from them. The latest review of the principles of Helsinki declaration of 1968 [49] was strictly adhered to throughout the duration of the study at all the centers used.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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