Original Article

Prevalence and clusters of modifiable cardiovascular disease risk factors among intra-city commercial motor vehicle drivers in a Nigerian metropolitan city

Segun J. Showande[1] and Ibimolade O. Odukoya[1]

Ghana Med J 2020; 54(2): 100-109 DOI: http://dx.doi.org/10.4314/gmj.v54i2.8

[1]**Department of Clinical Pharmacy and Pharmacy Administration, Faculty of Pharmacy, University of Ibadan, Ibadan, Nigeria**

Corresponding author: Segun J. Showande **E-mail:** pharmseg@yahoo.com
Conflict of interest: None declared

SUMMARY

Background: Commercial motor vehicle drivers (CMVDs) have worst health profiles among different occupations, yet the presence of clusters of cardiovascular disease (CVD) risk factors in this group have not been described in a resource-limited setting.
Objectives: The prevalence of CVD risk factors and the clusters among CMVDs was evaluated.
Design: A cross-sectional descriptive study.
Setting: Four motor parks in three local government areas of Ibadan city, Nigeria.
Participants: Consented and conveniently sampled 152 intra-city CMVDs aged ≥ 18 years.
Main outcome measures: Prevalence of CVD risk factors (hypertension, diabetes, high triglyceride, low HDLc, high waist-hip ratio, central obesity, physical inactivity, smoking, alcohol, and overweight/obesity) and their clusters were determined.
Results: All participants were male from 20 – 77 years old. Most of the CMVDs were physically inactive (80, 52.6%), take alcohol (78, 51.3%), and few smokes (35, 12.4%). The prevalence of hypertension, diabetes, hypertriglyceridemia, obesity, and central obesity were 36.2%, 5.9%, 23.7%, 4.6%, and 5.3%, respectively. Four clusters of CVD risk factors in the CMVDs with the prevalence of 36.2%. 33.5%, 17.1% and 13.2% were identified with significant differences ($p<0.05$) in the risk factors.
Conclusion: The prevalence of diabetes, obesity, central obesity, and smoking was low while the prevalence of hypertension and hypertriglyceridemia was moderate among the CMVDs, but the prevalence of alcohol intake and physical inactivity were high. Four distinct clusters of CVD risk factors were observed among the drivers.

Keywords: Cardiovascular diseases, Risk factors, Motor vehicles, Commercial vehicle drivers, Nigeria.
Funding: The study was self-funded.

INTRODUCTION

The burden of non-communicable diseases (NCDs) otherwise referred to as "invisible epidemic", is on the increase and is a major contributor to poverty and underdeveloped economies.[1] These diseases include cardiovascular diseases (CVDs), diabetes, chronic respiratory diseases, and cancer. Over 85% of premature death due to NCDs occur among people between the age of 30 and 69. Most of these deaths occur in low and medium-income countries. Cardiovascular diseases account for most of the death due to NCDs.[2]

Cardiovascular diseases are a subset of NCDs and share similar risk factors which include age, gender, high blood pressure, hyperlipidemia, diabetes mellitus, sedentary lifestyle, smoking, family history of CVD, and obesity.
Though some of these CVD risk factors such as age, gender, and family history of CVD are non-modifiable, others can be modified through lifestyle and social changes.
The prevalence of these modifiable CVD risk factors have been described in different settings and populations, such as in seemingly healthy individuals [3], children and adolescents[4], urban and rural populations[5,6], low and high-income countries[7], different ethnic groups[8], and commercial drivers.[9,10]

Among different occupations, commercial drivers have the worst health[11] with greater morbidity in cardiovascular, gastrointestinal, and musculoskeletal diseases.[12,13] They are referred to as vulnerable group[14] because they belong to lower socio-economy cadre with poor education and little or no healthcare provision especially those in sub-Saharan African.[15]
In the US, male commercial motor vehicle drivers (CMVDs) have a lower life expectancy, 55 to 63 years, in comparison with 75 years for males in the general population.

This is caused by the increased morbidity and mortality among CMVDs that may be associated with their job and poor lifestyle choices.[16,17] Ischaemic Heart Disease is a prominent CVDs among commercial vehicle drivers[12].

The risk factors in CVDs usually occur in clusters.[18] Clusters of CVD risk factors are a better measure of cardiovascular health and the presence of two or more clusters increases the risk and incidence of CVDs.[18]. Several studies have reported prevalence of clusters of CVD risk factors in the general population.[19–21] Few studies have identified cluster types based on sleep pattern[22], behavioural characteristics[23], and cardiometabolic health[24] in CMVDs, yet little is known about clusters of CVDs risk factors among CMVDs; though the prevalence of these risk factors have been well described in this group.[25,26] Evidence-based practices have shown that chronic diseases such as hypertension, diabetes, and hyperlipidemia are better treated together since they often occur in clusters.[27] Therefore, it is important to describe the presence or absence of these clusters in CMVDs especially in resource-limited nations in sub-Saharan Africa, such as Nigeria. Hence, this study determined the prevalence of modifiable CVD risk factors and its clusters among CMVDs in a metropolitan city in Nigeria.

METHODS

Study site and study population

The study was carried out in Ibadan, the largest city in Nigeria geographically. The population of the inhabitants who are mostly Yoruba was estimated to be 3 million with other ethnic groups. It is one of the commercial nerve centers of the nation. Ibadan city is divided into five urban and six semi-urban local government areas (LGAs).[28] Convenient sampling method was used to select one and two LGAs from the semi-urban and urban LGAs, respectively. This study was conducted among CMVDs in four selected motor parks (Sango, Iwo road, Ojoo, and Agodi gate) from the three selected LGAs in Ibadan metropolis, Oyo state. These parks were also conveniently selected because of their large sizes. The target population for this study was CMVDs in Oyo state, Nigeria.

Sample size determination

The sample size was determined with the formula $N > 50 + 8m$[29]**,** where 'N' is the sample size and 'm' is the number of independent variables. The independent variables were the eleven CVD risk factors considered in the study (systolic blood pressure, diastolic blood pressure, body mass index, alcohol, waist circumference, waist-hip ratio, triglyceride, high-density lipoprotein cholesterol, fasting blood glucose, physical activity, and smoking). Based on the calculated sample size of 138, a 10% non-response rate (approximately 14) was added and the estimated sample size was 152.

Study design, sampling strategy and study period

A cross-sectional study among CMVDs. Forty participants were purposively targeted from each of the four parks. The study was conducted from November to December 2014 on Saturdays from 7:30 am to 9:30 am. Prior to each day of the study, the officials in each motor park were intimated with the study detail. They, in turn, mobilized their members. Participants were instructed to come fasting on the day of the study. Those who met the inclusion criteria and signed the informed consent form were selected based on first come first served.

Inclusion criteria and exclusion criteria

All consented male CMVDs ≥ 18 years and who had not taken any meal, alcoholic drink or fruit juice on the day of the study were included. Bus conductors, union leaders, and other park officials who were not active drivers, and tax collectors at the park were excluded from the study. Others excluded were motor park traders, mostly women, and automobile artisans.

Data collection procedure

Interviewer-guided structured questionnaire was administered to obtain information on demographics, lifestyle habits such as smoking and alcohol consumption, family history of diabetes, hypertension, and hyperlipidemia. Anthropometric measures, height, weight, hip, and waist circumference were determined along with other CVD risk factors.

Body mass index

The height of participants was measured with a Seca 213 Stadiometer (Medisave, Weymouth, UK). The height was measured to the nearest centimeter. The age, height, and sex of the participants were recorded on Omron body analyzer (Omron, serial number; 1665466-8B, China) which was used to determine body weight in kg, and body mass index (BMI) in kg/m^2. Weight was measured with the participant standing barefooted on the analyzer and wearing light clothing. Furthermore, BMI was categorized as underweight (18.50 kg/m^2), normal (18-50 - 24.99 kg/m^2), overweight (25 - 29.99 kg/m^2) and obese ≥ 30 kg/m^2.[30]

Waist-Hip ratio/ Central obesity

Waist and hip circumferences were measured with a measuring tape. WHO STEPS protocol was followed to measure waist circumference of participants.

Measurement was made at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest.[31,32] Hip circumference was measured around the widest part of the buttocks.[32] Waist-hip ratio is substantially increased when it is ≥ 0.90 (for men).[32] Waist circumference greater than 102 cm was categorized as central obesity.[33]

Blood pressure
Blood pressure was measured by taking two different readings at 5 minutes interval with an Omron blood pressure monitor (Omron, serial number; 07379607, China). Appropriate cuff was placed on the left upper arm at chest level of participants to measure the blood pressure after resting for 10 minutes. The average of the two readings was recorded. Blood pressure was categorized according to the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure (JNC VII.).[34] Hypertension was defined as SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg. Also, hypertensive participants and those on antihypertensive medications were classified as having hypertension.

Fasting blood glucose
Fingertip prick method was used to determine fasting blood glucose (FBG) level using Accu-Chek Active glucometer and test strips (Roche Diagnostics, serial number; 07553731845, China). According to International Diabetes Federation, IDF,[35] FBG< 100 mg/dL was categorized as normal, FBG 100 - 126 mg/dL was categorized as pre-diabetes and FBG values > 126 mg/dL was categorized as diabetes. Participants who had diabetes mellitus and/or taking oral hypoglycemic drugs or insulin were also categorized as having diabetes even if their FBC was < 100 mg/dL during the study.

Fasting lipid profile
Venous blood sample (5 ml) was collected from each participant after an overnight fast of about 14 h. The blood was centrifuged at 3500 *g* for 10 minutes. Plasma samples collected were stored at -20^{0}C until ready for analyses. Triglycerides and high-density lipoprotein cholesterol were determined with the aid of Randox kits (Randox Laboratories, Crumlin, UK).

According to National Cholesterol Education Program (NCEP) Expert Panel[33] fasting lipid profile was classified as low (< 40 mg/dL) and high (≥ 60 mg/dL) for high density lipoprotein cholesterol and as normal (< 150 mg/dL), borderline high (150 – 199 mg/dL), high (200 - 499 mg/dL), and very high (≥ 500 mg/dL) for triglyceride. Participants were also categorized as having hypercholesterolemia and hypertriglyceridemia if on "statins" or other similar medications.

Metabolic syndrome
Metabolic syndrome was considered present in individuals with central obesity, and any two of the following four factors; triglyceride ≥ 150 mg/dl, blood pressure ≥ 130/85 mmHg, fasting blood glucose ≥ 110 mg/dl, and reduced high density lipoprotein cholesterol < 40 mg/dl.

Physical activity
Physical activity (PA) was determined using interviewer-administered international physical activity questionnaire short form, IPAQ-SF.[36] Physical activities which included walking, moderate-intensity activities, and vigorous-intensity activities were measured across four domains of leisure time, domestic and gardening, work-related and transport-related PAs in the past 7-days. As a continuous variable PA was expressed as MET-min per week, while as categorical variable, it was expressed as low, moderate, and high.

- For low PA, no activity was reported or not enough to meet the criteria for moderate or high PA.
- For moderate PA, a minimum of 3 days of vigorous activities for 20 min per day or > 5 days of combination of walking, moderate-intensity, or vigorous-intensity activities with a minimum of at least 600 MET-minutes/week.
- High PA was achieved with either a minimum of 3 days of vigorous-intensity activities equivalent to a minimum of 1500 MET-min per week or > 7 days of combined walking, moderate-intensity or vigorous-intensity activities equivalent to a minimum of 3000 MET-min per week.[36]

Data analysis
Data were subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS) Version 25.0 and presented as means and standard deviations for continuous variables and proportions for categorical variables. TwoStep cluster analysis was performed to determine the number of clusters present in the population using the eleven CVD risk factors measured. Two of the risk factors, smoking and alcohol intake, were entered as categorical variable while nine risk factors (systolic blood pressure, diastolic blood pressure, body mass index, waist circumference, waist-hip ratio, triglyceride, high-density lipoprotein cholesterol, fasting blood glucose, and physical activity) were entered as continuous variable. Once the number and types of CVD risk factors clusters in the CMVDs were identified,

Chi-Square test was used to determine the association between dichotomized CVD risk factors (smoking, alcohol consumption, central obesity, high waist to hip ratio, diabetes, physical inactivity, hypertension, high triglyceride, low HDLc, and overweight/obese) and the cluster types and also to detect association between religion and alcohol intake among the CMVDs. Relationship between age, occupation, and educational status of the CMVDs with CVD risk factors cluster types were evaluated with Chi-Square test. All statistical tests were considered significant at $P < 0.05$.

Ethics approval
The protocol for the study was approved by the University of Ibadan and University College joint ethics committee with the approval number UI/EC/14/0310. Informed consent was obtained from all the participants and the study was carried out in accordance with the updated declaration at Helsinki in 1964.[37]

RESULTS

The age range of participants was between 20 and 77 years, 58 participants (38.16%) were ≤ 40 years, and 48 (34.87%) were ≥ 53 years old. Other demographic characteristics are shown in Table 1.

Table 1 Demographic characteristics of commercial motor vehicle drivers in Ibadan metropolis

Demographic characteristics	Categories	Frequency (%)
Age, years	≤ 40	58 (38.16)
	41 - 52	46 (30.26)
	≥ 53	48 (34.87)
Marital status	Single	15 (9.9)
	Married	134 (88.2)
	Divorced/ Separated/ Widowed	3 (2.1)
Occupation	Cab drivers	131 (86.2)
	Bus drivers	21 (13.8)
Ethnicity	Yoruba	147 (96.7)
	Hausa	4 (2.6)
	Ibo	1 (0.7)
Religion	Christianity	48 (31.6)
	Islam	102 (67.1)
	Traditional	2 (1.3)
Educational status*	Primary school completed	93 (61.6)
	Secondary school completed	49 (32.5)
	Tertiary education completed	9 (6.0)

*n=151

Seventy-eight 78 (51.3%) drivers were consuming alcohol at the time of the study. Types of alcoholic drinks consumed by drivers were beers 77 (50.7%), spirits 20 (13.2%), and palm wine 2 (1.4 %). Twenty-seven (9.5%) commercial vehicle drivers were smokers, and 35 (12.4%) had stopped smoking. Among these categories, 51 (33.6%) smoked cigarettes while 9 (5.9%) smoked Indian hemp.

The level of physical activity was low in 80 (52.6%) of the participants, moderate in 68 (44.7%), and high only in 4 (2.6%) of the participants. Some drivers 9 (5.9%) had diabetes, three of which were known type 2 diabetes patients on medications. Table 2 shows the prevalence of other sub-categories of CVD risk factors.

Table 2 Prevalence of cardiovascular disease risk factors among intra-city commercial motor vehicle drivers in Ibadan metropolis

Cardiovascular Disease risk factors	Categories	Frequency (%)
Waist Hip ratio (WHR)	Normal	143 (94.1)
	High	9 (5.9)
Body Mass Index (BMI), kg/m^2	Underweight	4 (2.6)
	Normal	101 (66.4)
	Overweight	40 (26.3)
	Obese	7 (4.6)
Fasting Blood Glucose (FBG), mg/dL	Normal	112 (73.7)
	Prediabetes	31 (20.4)
	Diabetes	9 (5.9)
Physical activity	Low	80 (52.6)
	Moderate	68 (44.7)
	High	4 (2.6)
Systolic Blood Pressure (SBP), mmHg	Normal	57 (37.5)
	Prehypertension	65 (42.8)
	Stage I hypertension	21 (13.8)
	Stage II hypertension	9 (5.9)
Diastolic Blood Pressure (DBP), mmHg	Normal	64 (42.1)
	Prehypertension	41 (27.0)
	Stage I hypertension	29 (19.1)
	Stage II hypertension	18 (11.8)
Hypertension	Yes	55 (36.2)
	No	97 (63.8)
Triglyceride (TG), mg/dL	Normal	78 (57.3)
	Borderline	38 (25.0)
	High	35 (23.0)
	Very high	1 (0.7)
High Density Lipoprotein cholesterol (HDLc), mg/dL	Low	48 (31.6)
	Borderline	56 (36.8)
	High	48 (31.6)
Smoking	Had smoked	27(9.5)
	Currently smoking	35 (12.4)
	Never smoked	90 (31.5)
Alcohol	Had taken alcohol	10 (6.6)
	Currently taking alcohol	78 (51.3)
	Never took alcohol	64 (42.1)
Central obesity	Normal	144 (94.7)
	High	8 (5.3)

There were 3 (2.0%) previously diagnosed hypertensive participants, 2 (1.3%) were on medications. All the hypertensive and diabetes mellitus CMVDs had high SBP and/or DBP and FBG during the study.

Four distinct clusters of CVD risk factors were obtained after the TwoStep cluster analysis:

- Cluster 1: Non-smokers, physically inactive CMVDs with low level of HDLc,
- Cluster 2: Non-smokers, diabetic CMVDs with central obesity,
- Cluster 3: Smokers, non-diabetic CMVDs without central obesity,
- Cluster 4: Obese, non-smokers physically inactive, hypertensive CMVDs with central obesity.

Cluster 1 (55, 36.2%) was the largest among the four clusters of drivers. The CMVDs in this cluster were non-smokers, had no central obesity, only 1 (11.1%) had diabetes while almost half of them were physically inactive (Table 3). This cluster had the highest number of CMVDs with low level of HDLc 20 (41.7%) across the four clusters. Few of them were overweight/obese 7 (14.9%).

Cluster 2 (20, 13.2%) had non-smokers and diabetic CMVDs among the four clusters of drivers. This cluster also had half of the drivers with central obesity (Table 3). About one-quarter of those who had hypertension 14 (25.5%) and those who were overweight/obese 13 (27.7%) were in this cluster. The members of this cluster were the oldest (54.50 ± 9.92 years) CMVDs. Cluster 3 (26, 17.1%) members were non-diabetic smokers without central obesity (Table 3).
Most of the members take alcohol (Table 3) and few had hypertension 5 (9.1%) and were physically inactive 9 (11.3%) in comparison with other clusters. Commercial motor vehicle drivers in cluster 3 were the youngest 40.42 ± 10.83.

Cluster 4 (51, 33.5%) was the second-largest cluster of the CMVDs. They were drivers who take alcohol, were physically inactive, and overweight (Table 3). Almost half of the drivers had hypertension 21 (38.2%) compared to drivers in other clusters. Table 3 shows other differences in the CVD risk factors among the four clusters of CMVDs.

Table 4 shows that there were statistically significant differences in the distribution of age and education among CMVDs in the four clusters. Drivers with primary school education belonged to cluster 4 while the fairly-educated drivers with secondary or tertiary education were in Cluster 1.

Table 3 Distribution of risk factors across the four CVD risk factors clusters in commercial motor vehicle drivers

CVD risk factors	Category	Cluster 1 N = 55	Cluster 2 N = 20	Cluster 3 N = 26	Cluster 4 N = 51	P-value
Smoking, n (%)	Yes	0 (0.0%)	0 (0.0%)	26 (96.3%)	1 (3.7%)	<0.001[a]
	No	55 (44.0%)	20 (16.0%)	0 (0.0%)	50 (40.0%	
Alcohol, n (%)	Yes	3 (3.8%)	4 (5.1%)	20 (25.6%)	51 (65.4%)	<0.001[b]
	No	52 (70.3%)	16 (21.6%)	6 (8.1%	0 (0.0%)	
Central obesity, n (%)	Yes	0 (0.0%)	4 (50.0%)	0 (0.0%)	4 (50.0%)	0.003[a]
	No	55 (38.2%)	16 (11.1%)	26 (18.1%)	47 (32.6%)	
Waist-Hip ratio, n (%)	Yes	2 (22.2%)	2 (22.2%)	3 (33.3%)	2 (22.2%)	0.404[a]
	No	53 (37.1%)	18 (12.6%)	23 (16.1%)	49 (34.3%)	
Diabetes, n (%)	Yes	1 (11.1%)	7 (77.8%)	0 (0.0%)	1 (11.1%)	<0.001[a]
	No	54 (37.8%)	13 (9.1%)	26 (18.2%)	49 (34.3%)	
Physical inactivity, n (%)	Yes	25 (31.3%)	11 (13.8%)	9 (11.3%)	35 (43.8%)	0.020[b]
	No	30 (41.7%)	9 (12.5%)	17 (23.6%)	16 (22.2)	
Hypertension, n (%)	Yes	15 (27.3%)	14 (25.5%)	5 (9.1%)	21 (38.2%)	0.001[b]
	No	40 (41.2%)	6 (6.2%)	21 (21.6%)	30 (30.9%)	
High Triglyceride, n (%)	Yes	8 (22.2%)	4 (11.1%)	8 (22.2%)	16 (44.4%)	0.165[a]
	No	47 (40.5%)	16 (13.8%)	18 (15.5%)	35 (30.2%)	
Low HDLc, n (%)	Yes	20 (41.7%)	6 (12.5%)	8 (16.7%)	14 (29.2%)	0.797[b]
	No	38 (33.7%)	14 (13.5%)	18 (17.3%)	37 (35.6%)	
Overweight/Obese, n (%)	Yes	7 (14.9%)	13 (27.7%)	4 (8.5%)	23 (48.9%)	<0.001[b]
	No	48 (45.7%)	7 (6.7%)	22 (21.0%)	28 (26.7%)	

P<0.05 was considered significant, [a]P-value of Pearson Chi-Square Exact significance (2-sided), [b]P-value of Pearson Chi-Square Asymptotic significance (2-sided), High density lipoprotein cholesterol (HDLc).

Table 4 Association of socio-demographic characteristics with clusters o f cardiovascular disease risk factors in commercial motor vehicle drivers

Demographic variable	Categories	Cluster 1	Cluster 2	Cluster 3	Cluster 4	P-value*
Age, years	≤ 40	25 (43.1%)	2 (3.4%)	15 (25.9%)	16 (27.6%)	0.004
	41 - 52	17 (37.0%)	5 (10.9%)	7 (15.2%)	17 (37.0%)	
	≥ 53	13 (27.1%)	13 (27.1%)	4 (8.3%)	18 (37.5%)	
Occupation	Cab driver	46 (35.1%)	19 914.5%)	19 (14.5%)	47 (35.9%)	0.072**
	Bus driver	9 (42.9%)	1 (4.8%)	7 (33.3%)	4 (19.0%)	
Education	Primary	23 (24.5%)	16 (17.0%)	21 (22.3%)	34 (36.2%)	0.001
	Secondary/Tertiary	32 (55.2%)	4 (6.9%)	5 (8.6%)	17 (29.3%)	

P<0.05 was considered significant, * P-value of Pearson Chi-Square Asymptotic significance (2-sided), ** P-value of Pearson Chi-Square Exact significance (2-sided),

DISCUSSION

From the results of the study, most of the CMVDs were > 40 years old. This is comparable with two other studies from Abuja and Sokoto in Nigeria, where majority of the

CMVDs were older than 50 years.[34, 39] Since age is positively correlated with some CVD risk factors[40], it is likely that the prevalence of CVD risk factors in this CMVDs may be high. However, this was not the case. The prevalence of diabetes mellitus was low (5.9%) among these CMVDs. But Odeyinka and Ajayi,[37] reported a lower prevalence of 3.4% among similar CMVDs in Ibadan, Nigeria. The probable reason for this difference was the presence of more participants in this study (about 38) per motor park than in Odeyinka and Ajayi's[41] study where 15 drivers per motor park participated.

Obesity is a risk factor for the development of diabetes and less than one-twentieth of the CMVDs were found to be obese. This is considerably lower than 7.8% - 13.9% reported for the general adult population in Nigeria[3,42]; and other nations where more than 50% of commercial drivers were obese.[11] Poor sleep and long hours of driving have been suggested to be responsible for obesity in CMVDs[11,12] Also, obesity more prevalent among people of middle and lower socioeconomic status.[43] Commercial motor vehicle drivers in the present study belong to the lower socioeconomic status according to their job description.

Closely related to obesity is the level of physical activity. The lower the level of physical activity, the more the propensity to become obese especially when this is coupled with poor dietary habits.[44] More than half of the CMVDs had low level of physical activity; perhaps due to the long wait in-between shuttles. A similar level of physical activity was observed among long-distance truck drivers in Brazil where 72.8% had low level of physical activity.[45] Increased physical activity through aerobic exercises while the CMVDs are waiting at the park, and modifications in their diet may reduce the level of obesity and slow down the progression to metabolic syndrome. Surprisingly, few of the CMVDs in this study had metabolic syndrome.

More than half (51.3%) of the CMVDs take alcohol. This is lower than the prevalence of alcohol consumption reported in commercial drivers in Brazil (66.8%), Ile-Ife and Calabar in Nigeria (67% and 84%, respectively).[45–47] The higher number of CMVDs who practice Islam, a religion that frowns at the consumption of alcohol, may explain the lower prevalence of alcohol intake among this study participants compared with others. However, there are conflicting reports. Abiona et al[47] reported that the two major religions in Nigeria, Islam, and Christianity, do not seem to be a deterrent to alcohol consumption among CMVDs in Ile-Ife. This present study also found no association between religion and alcohol consumption. However, another study found a link between religiosity and the intake of alcohol. Okpataku[48] stated that Christianity was a strong predictor of alcohol use. Though, alcohol sales are generally available to drivers at motor parks because of the poor restriction and regulation; fewer drivers consume it in Ibadan.
This might be due to incessant government-sponsored public awareness on the antecedents of alcohol consumption while driving. Heavy drinkers are prone to road accidents and have an increased chance of developing hypertension.

Drivers do not only consume alcohol but sometimes smoke. About one-tenth of the CMVDs were smokers. Generally, smoking prevalence tends to be lower in sub-Saharan Africa than in Europe, America, and Asia.[49,50] Smokers are perceived as irresponsible especially in the southwestern part of Nigeria. Smoking has been linked with hypertension[51] and the prevalence of hypertension was moderately high in this group of CMVDs. This is comparable with similar studies from other parts of Nigeria.[39,52–54] however, the prevalence of hypertension in this CMVDs was higher than in the general population of Nigerian.[3,55] This might have ensued from the unhealthy lifestyle of drivers and the inaccessibility of most drivers to medical facilities because of their low socioeconomic status.

This study found four distinct clusters of CMVDs in Ibadan metropolis, Nigeria while a study carried out by Olsen et al in U.S.A reported finding five clusters among truck drivers in relation to behaviours modifying energy balance.[56] The first cluster found consisted of CMVDs who were physically inactive and had low HDLc and hypertriglyceridemia. These drivers are prone to the development of atherosclerosis and subsequently CVDs. This group of drivers may benefit from early intervention with HMG-CoA reductase inhibitors. The occurrence of CVDs and all-cause mortality tend to increase with increased clustering of CVDs risk factors.[57]

The second cluster had the oldest CMVDs who had diabetes and hypertension. This set of drivers also had central obesity and hypertriglyceridemia and could, therefore, be described as having metabolic syndrome. The presence of hyperlipidemia in obesity has been linked with insulin resistance and consequently the development of diabetes mellitus.[58] Since these CVD risk factors tend to occur in clusters, management guidelines suggest a holistic approach to metabolic syndrome management.[59] Hence, CMVDs in this cluster may benefit from a multifaceted approach to the management of the CVD risk factors.

Two studies in Nigeria also described the presence of hypertension and diabetes together in commercial drivers,[41,53] buttressing the existence of this cluster among CMVDs in Nigeria.

The third cluster described young physically inactive CMVDs who take alcohol, smoke, had hypertriglyceridemia, and low HDLc. The presence of clusters of CVD risk factors may begin from youthful age[60] and this may be showing up in these young CMVDs. Criqui et al reported that the effect of CVD risk factors may be more synergistic than additive.[61] With the presence of the risk factors in this cluster of CMVDs, CVDs may develop early. As noticed in this study, there was an association between age and the cluster types in CMVDs. This was also corroborated by the report of Barreto et al, that CVD risk factor cluster patterns vary with age.[62] This pattern was noticed with clusters 2 and 3 of CMVDs in this study. Cluster 3 had young CMVDs with fewer CVD risk factors while cluster 2 had older CMVDs with more CVD risk factors.

The last type of cluster observed in the CMVDs described overweight drivers who take alcohol, had hypertension, and hypertriglyceridemia. The presence of hypertension and hypertriglyceridemia may predispose the CMVDs to CVDs. Early screening, detection, and commencement of management programs may slow down the progression of these clusters of CVD risk factors to CVDs and mitigate against increase mortality and morbidity in this population. Commercial motor vehicle drivers with clusters of CVD risk factors that may predispose them to early development of CVDs and who are not on treatment should be denied renewal of their drivers' license or the registration for one. This may forestall road accidents precipitated by sudden cardiovascular disease attacks among CMVDs.

Strength and limitation of the study

This seems to be the first study examining the prevalence of CVD risk factor clusters among intra-city CMVDs in a metropolitan city of a resource-limited nation. The findings are essential in formulating health policies to cater to this seemingly neglected low socioeconomic class. Despite the strength of this study, there are some limitations to take note of in the interpretation of the results presented. The convenience sampling method and the small sample size of the study may limit the generalizability of the study to other commercial motor vehicle drivers in other states and the country at large. However, the similarities between this study and others show that it may be representative. The cross-sectional study design used hindered causal determination of the cluster types of CMVDs. Self-report was also used to determine the smoking status, alcohol consumption, and physical activity; the prevalence of these CVD risk factors might have been under- or over-reported because of self-report bias. Some drivers might have failed to participate for the fear of blood been drawn from them. This selection bias might have reduced the number of participants as only interested individuals participated. Also, the mandatory fasting before the determination of blood glucose level disqualified some participants who had, had their breakfast before the commencement of the study.

CONCLUSION

The prevalence of type 2 diabetes mellitus, obesity, central obesity, and smoking were low among commercial motor vehicle drivers while the prevalence of hypertension, low- high density lipoprotein cholesterol, and hypertriglyceridemia were moderate, but the prevalence of alcohol and physical inactivity were high. Four distinct clusters of CVD risk factors were observed among the drivers.

ACKNOWLEDGMENT

We wish to thank all the chairmen of Road Transport Workers of the four motor parks who mobilised their members for this study. We also thank Mr. Oluwaseyi Olalemi who assisted in taking anthropometric data of the participants.

REFERENCES

1. World Health Organization. Global Status Report on noncommunicable diseases 2014. "Attaining the nine global noncommunicable diseases targets; a shared responsibility". WHO Press, Geneva, Switzerland; 2014. [cited 2019 Feb 11]. Available from: https://apps.who.int/iris/bitstream/handle/10665/148114/9789241564854_eng.pdf?sequence=1
2. World Health Organization. Fact sheets - Non communicable diseases. 2018 [cited 2019 Oct 11]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases
3. Showande SJ, George OA, Adekunle OO. Gender Related Differences in the Prevalence and Correlates of Modifiable Cardiovascular Disease Risk Factors among Seemingly Healthy Adult Nigerians-A Cross Sectional Study. *Br J Med and Med Res.* 2014; 4(25):4325 -40
4. Rodrigues T de L, Custódio PM, Henrique PG, Augusto DSS. Muscular Fitness and Cardiovascular Risk Factors in Children and Adolescents: A Systematic Review. *J Strength Cond Res*. 2018. [cited 2019 Feb 11]. Available from: https://sci-hub.tw/http://europepmc.org/abstract/med/30273286
5. Miranda JJ, Gilman RH, Smeeth L. Differences in cardiovascular risk factors in rural, urban and rural-

to-urban migrants in Peru. *Heart.* 2011; 97(10):787–96.

6. Torun B, Stein AD, Schroeder D, Grajeda R, Conlisk A, Rodriguez M, et al. Rural-to-urban migration and cardiovascular disease risk factors in young Guatemalan adults. *Int. J. Epidemiol*. 2002; 31(1):218–26.
7. Yusuf S, Rangarajan S, Teo K, Islam S, Li W, Liu L, et al. Cardiovascular risk and events in 17 low-, middle-, and high-income countries. *N. Engl. J. Med*. 2014; 371(9):818–27.
8. Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review. *Ethn. Dis.* 2007; 17(1):143.
9. Howard ME, Desai AV, Grunstein RR, Hukins C, Armstrong JG, Joffe D, et al. Sleepiness, sleep-disordered breathing, and accident risk factors in commercial vehicle drivers. *Am. J. Respir. Crit. Care Med.* 2004; 170(9):1014–21.
10. Sieber WK, Robinson CF, Birdsey J, Chen GX, Hitchcock EM, Lincoln JE, et al. Obesity and other risk factors: the national survey of US long-haul truck driver health and injury. *Am J Ind Med.* 2014; 57(6):615–26.
11. Crizzle AM, Bigelow P, Adams D, Gooderham S, Myers AM, Thiffault P. Health and wellness of long-haul truck and bus drivers: A systematic literature review and directions for future research. *J Transp Health.* 2017; 7:90–109.
12. Apostolopoulos Y, Sönmez S, Shattell MM, Belzer M. Worksite-induced morbidities among truck drivers in the United States. *AAOHN J.* 2010; 58(7):285–96.
13. Jones D, Switzer-McIntyre S. Falls from trucks: a descriptive study based on a workers compensation database. *Work*. 2003; 20(3):179–84.
14. Amadi CE, Grove TP, Mbakwem AC, Ozoh OB, Kushimo OA, Wood DA, et al. Prevalence of cardiometabolic risk factors among professional male long-distance bus drivers in Lagos, south-west Nigeria: a cross-sectional study. *Cardiovasc J Afr*. 2018 ; 29(2):106–14.
15. Lalla-Edward ST, Fobosi SC, Hankins C, Case K, Venter WDF, Gomez G. Healthcare Programmes for Truck Drivers in Sub-Saharan Africa: A Systematic Review and Meta-Analysis. Goldenberg SM, editor. *PLoS One.* 2016; 11(6):e0156975.
16. Heron MP, Hoyert DL, Xu J, Scott C, Tejada-Vera B. Deaths: preliminary data for 2006. National vital statistics reports. 2008; 56(16):1–52.
17. Saltzman GM, Belzer MH. Truck driver occupational safety and health; 2003 conference report and selective literature review. Revised February 8, 2007. [cited 2019 Oct 11]. Available from https://www.cdc.gov/niosh/docs/2007-120/pdfs/2007-120.pdf
18. Wildman RP. The Obese Without Cardiometabolic Risk Factor Clustering and the Normal Weight With Cardiometabolic Risk Factor Clustering: Prevalence and Correlates of 2 Phenotypes Among the US Population (NHANES 1999-2004). *Arch Intern Med.* 2008; 168(15):1617-24.
19. Kong X-L, Ma X-J, Zhang C-Y, Xu D-M. Clustering of major cardiovascular risk factors is associated with arterial stiffness in adults. *Chronic Dis Transl Med*. 2018; 4(4):254–9.
20. Tran D-MT. College Students' Perception of Current and Projected 30-Year Cardiovascular Disease Risk Using Cluster Analysis with Internal Validation. *J Community Health*. 2018; 44(3), 500-6
21. Tran D-MT, Kupzyk KA, Zimmerman LM. Using Cluster Analysis to Identify Subgroups of College Students at Increased Risk for Cardiovascular Disease. *J Nurs Meas*. 2018; 26(3):470–82.
22. Chen GX, Fang Y, Guo F, Hanowski RJ. The influence of daily sleep patterns of commercial truck drivers on driving performance. *Accid Anal Prev*. 2016; 91:55–63.
23. Wu C, Sun C, Chu D, Huang Z, Ma J, Li H. Clustering of Several Typical Behavioral Characteristics of Commercial Vehicle Drivers Based on GPS Data Mining: Case Study of Highways in China. *Transp Res Rec.* 2016 ; 2581(1):154–63.
24. Varela-Mato V, O'Shea O, King JA, Yates T, Stensel DJ, Biddle SJ, et al. Cross-sectional surveillance study to phenotype lorry drivers' sedentary behaviours, physical activity and cardio-metabolic health. *BMJ Open*. 2017; 7(6):e013162.
25. Hirata RP, Sampaio LMM, Leitao Filho FSS, Braghiroli A, Balbi B, Romano S, et al. General characteristics and risk factors of cardiovascular disease among interstate bus drivers. *Sci. World J.* 2012;2012.
26. Mansur A de P, Rocha MA, Leyton V, Takada JY, Avakian SD, Santos AJ, et al. Risk Factors for Cardiovascular Disease, Metabolic Syndrome and Sleepiness in Truck Drivers. Arquivos Brasileiros de Cardiologia. 2015 [cited 2019 Feb 19]. Available from: http://www.gnresearch.org/doi/10.5935/abc.20150132
27. Schroeder EB, Hanratty R, Beaty BL, Bayliss EA, Havranek EP, Steiner JF. Simultaneous Control of Diabetes, Hypertension, and Hyperlipidemia in Two Health Systems. *Circ Cardiovasc Qual Outcomes*. 20121 ;5(5):645–53.
28. http://ibadanlanda.org/Local_Government.html [Internet]. ibadanlanda. [cited 2019 May 30]. Available from: http://ibadanlanda.org/Local_Government.html
29. Tabachnick BG, Fidell LS. Using Multivariate Statistics. New York: Allyn and Bacon; 2007.

30. World Health Organization. BMI Classification [Internet]. World Health Organization; 2006. [cited 2019 Feb 19]. Available from: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html
31. WHO. WHO STEPS Surveillance Manual: The WHO STEPwise approach to chronic disease risk factor surveillance. World Health Organization, Geneva, Switzerland; 2005.
32. World Health Organization. Waist Circumference and Waist-Hip Ratio Report of a WHO Expert Consultation [Internet]. World Health Organization, Geneva, Switzerland; 2011. [cited 2019 Feb 22]. Available from: https://apps.who.int/iris/bitstream/handle/10665/44583/9789241501491_eng.pdf?sequence=1
33. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) Final Report. *Circulation*. 2002; 106(25):3143–421.
34. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. *JAMA*. 2003; 289(19):2560–71.
35. International Diabetes Federation Guideline Development Group. Global guideline for type 2 diabetes. *Diabetes Res. Clin. Pract*. 2014;104(1):1-52.
36. IPAQ. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) – Short and Long Forms. 2005 [cited 2019 Mar 11]. Available from: www.ipaq.ki.se
37. General Assembly of the World Medical ssociation. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *J Am Coll Dent*. 2014; 81(3):14.
38. Awoleye O, Harris-Jackson T, Hernandez N, Thron C, Olukolade R. Stress, Health, and Accident Risks for Commercial Drivers in Abuja, Nigeria: Causes and Correlations. *The Nigerian Health Journal.* 2017; 17(2):1-16
39. Erhiano EE, Igbokwe VU, El-Khashab MM, Okolo RU, Awosan KJ. Prevalence of hypertension among commercial bus drivers in Sokoto, Sokoto State Nigeria. *Journal of Medicine and Medical Sciences*. 2015;2:34–9.
40. Neaton JD. Serum Cholesterol, Blood Pressure, Cigarette Smoking, and Death From Coronary Heart Disease Overall Findings and Differences by Age for 316099 White Men. *Arch Intern Med*. 1992.1; 152(1):56-64.
41. Odeyinka OT, Ajayi IO. Prevalence of hypertension and diabetes and their determinants among commercial drivers in Ibadan metropolis, South-Western Nigeria. *Nig J Cardiol.* 2017; 14(2):75-83.
42. WHO. Atlas of African Health Statistics 2018. Universal health coverage and the Sustainable Development Goals in the WHO African Region. [cited 2019 Feb 22]. Available from: https://apps.who.int/iris/bitstream/handle/10665/311460/9789290234135-eng.pdf?sequence=1&isAllowed=y
43. Manios Y, Panagiotakos DB, Pitsavos C, Polychronopoulos E, Stefanadis C. Implication of socio-economic status on the prevalence of overweight and obesity in Greek adults: the ATTICA study. *Health Policy*. 2005; 74(2):224–32.
44. Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. *The Lancet.* 2010; 376(9754):1775–84.
45. Sangaleti CT, Trincaus MR, Baratieri T, Zarowy K, Ladika MB, Menon MU, et al. Prevalence of cardiovascular risk factors among truck drivers in the South of Brazil. *BMC Public Health*. 2014;14(1):1063.
46. Bello S, Ndifon WO, Mpama EA, Oduwole OO. Pattern of alcohol use among drivers of commercial vehicles in Calabar, Nigeria. *East Afr Med J.* 2011; 88(3):75–9.
47. Abiona T, Aloba O, Fatoye F. Pattern of alcohol consumption among commercial road transport workers in a semi-urban community in South Western Nigeria. E Af Med J. 2006; 83(9):494-9.
48. Okpataku CI. Sociodemographic correlates of substance use among long distance commercial vehicle drivers. *J Med Trop* 2016;18:6-11.
49. Ng M, Freeman MK, Fleming TD, Robinson M, Dwyer-Lindgren L, Thomson B, et al. Smoking prevalence and cigarette consumption in 187 countries, 1980-2012. *JAMA* 2014; 311(2):183–92.
50. van Walbeek C. Recent trends in smoking prevalence in South Africa-some evidence from AMPS data. *S. Afr. Med. J.* 2002; 92(6):468–72.
51. Niskanen L, Laaksonen DE, Nyyssönen K, Punnonen K, Valkonen V-P, Fuentes R, et al. Inflammation, Abdominal Obesity, and Smoking as Predictors of Hypertension. *Hypertension.* 2004; 44(6):859–65.
52. Adedokun AO, Ter Goon D, Owolabi EO, Adeniyi OV, Ajayi AI. Driving to Better Health: Screening for Hypertension and Associated Factors Among Commercial Taxi Drivers in Buffalo City Metropolitan Municipality, South Africa. *The Open Public Health Journal.* 2017; 10(1):303-12.

53. Olusegun SO, Ikeoluwapo OA. Prevalence of hypertension and associated risk factor among interstate commercial drivers in Jabi Park Abuja. *International Journal of Medicine and Medical Sciences*. 2016; 31;8(7):75–83.
54. Tobin EA, Ofili AN, Asogun DA, Igbinosun PO, Igba KO, Idahosa AV. Prevalence of hypertension and associated factors among inter-city drivers in an urban city in South-South Nigeria. *Int J Res Med*. 2013; 2(3):5–12.
55. Sani MU, Wahab KW, Yusuf BO, Gbadamosi M, Johnson OV, Gbadamosi A. Modifiable cardiovascular risk factors among apparently healthy adult Nigerian population-a cross sectional study. *BMC research notes.* 2010;3(1):1.
56. Olson H, Betton G, Robinson D, Thomas K, Monro A, Kolaja G, et al. Concordance of the Toxicity of Pharmaceuticals in Humans and in Animals. *Regul Toxicol Pharmacol*. 2000; 32(1):56–67.
57. Gu D, Gupta A, Muntner P, Hu S, Duan X, Chen J, et al. Prevalence of cardiovascular disease risk factor clustering among the adult population of China: results from the International Collaborative Study of Cardiovascular Disease in Asia (InterAsia). *Circulation.* 2005; 112(5):658–65.
58. Wellen KE, Hotamisligil GS. Inflammation, stress, and diabetes. *J Clin Invest.* 2005; 115(5):1111–9.
59. Mooradian AD. Cardiovascular Disease in Type 2 Diabetes Mellitus: Current Management Guidelines. *Arch Intern Med*. 2003; 163(1):33–40.
60. Chu NF, Rimm EB, Wang DJ, Liou HS, Shieh SM. Clustering of cardiovascular disease risk factors among obese schoolchildren: the Taipei Children Heart Study. *Am J Clin Nutr*. 1998; 67(6):1141–6.
61. Criqui MH, Barrett-Connor E, Holdbrook MJ, Austin M, Turner JD. Clustering of cardiovascular disease risk factors. *Prev. Med.* 1980;9(4):525–33.
62. Barreto SM, Passos VMA, Firmo JOA, Guerra HL, Vidigal PG, Lima-Costa MFF. Hypertension and clustering of cardiovascular risk factors in a community in Southeast Brazil: the Bambuí Health and Ageing Study. *Arq Bras Cardiol.* 2001;77(6):576–81.