International Journal of Science Academic Research
Vol. 05, Issue 12, pp.8699-8707, December, 2024
Available online at http://www.scienceijsar.com
ISSN: 2582-6425

Research Article

COMPARATIVE ASSESSMENT OF BODY MASS INDEX, AND LIPID PROFILE AMONG COMMERCIAL BUS DRIVERS IN EKPOMA, NIGERIA

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Received 09th October 2024; **Accepted** 05th November 2024; **Published online** 16th December 2024

Abstract

Commercial drivers are a 'high-risk' population where fitness on duty is important in enabling them to adequately respond to their job responsibilities. Therefore, this study is aimed at assessing the Body Mass Index and Plasma levels of lipid profile among Commercial Bus Drivers in Ekpoma. A total of one hundred (100) subjects were recruited for this study which comprised of sixty-five (65) drivers from different transport companies in Ekpoma and thirty-five (35) samples from Non drivers (control). A well-structured questionnaire was designed to obtain socio-demographic information, dietary intake, nutritional status and general health information. Blood samples (5mls) were collected by vene-puncture into an accurately labelled lithium heparin container for both subjects and control and were analyzed in the laboratory using standard methods. The results showed that the levels of BMI were significantly higher ($p<0.05$) in commercial bus drivers (26.39± 5.33 kg/m2) compared with the control (21.21± 2.93 kg/m2). The levels of total cholesterol were significantly higher ($p<0.05$) in commercial bus drivers (174.88 ± 41.93 mg/dl) compared with the control (139.10± 22.75 mg/dl). The Triglyceride levels were not significantly different ($p>0.05$) in commercial bus drivers (111.62±49.47 mg/dl) as compared to the control (112.39± 28.47 mg/dl). HDL levels were significantly higher ($p<0.05$) in commercial bus drivers (106.42± 20.76 mg/dl) as compared to the control (69.23± 11.67 mg/dl). LDL levels were not significantly different ($p>0.05$) in commercial bus drivers (50.14± 30.59 mg/dl) as compared to the control (50.46 ± 22.41). VLDL levels were not significantly different ($p>0.05$) in commercial bus drivers (22.31 ± 10.05mg/dl) as compared to the control (22.89± 5.73 mg/dl). The results of this study have revealed that commercial drivers are exposed to high cardiovascular risks which could be attributed to the nature and structure of their work.

Keywords: Body Mass Index, Lipid Profile, Commercial, Bus, Drivers.

INTRODUCTION

Driving is the controlled use of a motor vehicle, such as a truck, bus, motorbike, or car (Dorn & Stephen, 2010). An individual who operates buses for a living is known as a bus driver, bus operator, autobus driver, or omnibus driver. Long-distance drivers are more likely to lead sedentary lifestyles, which may lead to occupational stress. The phrase "occupational stress" refers to continuous tension associated with one's place of employment. Stress might stem from conditions rooted in personality conflicts or company culture, or it can stem from the duties of the work itself. If professional stress is not adequately managed, it can have negative effects on one's physical and emotional health, just like other types of strain.In contemporary culture, one of the main causes of morbidity and death is cardiovascular disease (CVD), with hypertension being one of its main components (Rosenthal & Alter, 2012). The primary preventive strategy is identifying and modifying risk factors linked to cardiovascular disease.

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The American Heart Association does not currently mention work stress as one of the established risk factors for coronary heart disease (CHD), however stress response is recognized as a potential contributing factor (Greenland *et al.,* 2010).Recently, there has been a lot of focus on the part that occupational stress plays in the genesis of cardiovascular disease. A significant socioeconomic factor is occupation, which when combined with extended work-related stress may have a direct impact on the autonomic nervous system and neuroendocrine activity. These effects can lead to the development of lipid disorders, hypertension, and an increased risk of diabetes mellitus (Nagaya *et al.,* 2006; Festus *et al.,* 2016). Bus driving is one of the many occupations that has its own set of risks (Krause *et al.,* 1997). Many established risk factors, including ergonomics, whole body vibrations, extended sitting, twisting, bending, and occasionally substantial weight lifting, are associated with driving (Krause *et al.,* 1997). The majority of drivers work nights and shifts, which has a detrimental impact on their health and can lead to issues with their gastrointestinal tract, mental health, female reproductive system, metabolism, cardiovascular disease, obesity, diabetes mellitus, and sleep quality (Atkinson *et al.,* 2008; Lowden *et al.,* 2010). About 30% of fatalities worldwide are caused by atherosclerotic cardiovascular disease (CVD), which is distinguished by coronary heart disease (CHD) and stroke. CVD is the leading cause of preventable and early mortality worldwide. By 2030, there will be a nearly 50% increase in this (SIGN, 2007). Approximately 150 million disability adjusted life years (DALYS) are caused by it worldwide, making it a significant cause of mass disability and a substantial cause of productivity loss (World Health Organization, 2015). Additionally, because of their obesity, bus drivers in particular have higher rates of sickness, mortality, and absenteeism (Tuchsen *et al.,* 2006). According to Malinauskiene (2003), one of the primary risk factors for this condition is hypertension, which is prevalent in professional drivers (Albright *et al.,* 1992). According to Boggild & Knutsson (1999), drivers who work shifts are 40% more likely to develop cardiovascular disease than those who work day shifts. The correlation between shift work and cardiovascular illness can be explained by circadian misalignment brought on by the reversal of working hours, sleep schedules, and meal timing (Esquirol *et al.,* 2009; Marqueze *et al.,* 2012). This correlation may also be influenced by other variables, such as dietary modifications, social interactions, and workplace social support. A panel of blood tests known as a "lipid profile" is used as a first, general medical screening method for abnormalities in lipids, such as triglycerides and cholesterol (Omolumen *et al.,* 2024). According to Sidhu and Naugler (2012), the test findings can be used to identify certain genetic diseases as well as estimate the risks of developing cardiovascular disease, some types of pancreatitis, and other illnesses. To assess the risk of coronary heart disease, lipid profiles are frequently arranged in combination (Ugonabo *et al.,* 2007; Nnodim *et al.,* 2012). It is a reliable predictor of the likelihood of a heart attack or stroke brought on by artery hardening or blockage (atherosclerosis). Triglycerides (TG), fatty acids, cholesterol, and phospholipids are examples of lipids that are thought to be vital to human health (Festus *et al.,* 2016). They also form the foundation of cell membranes (phospholipids), function as a precursor to steroid hormones, bile acids, and vitamin D, and are a component of cell membranes, influencing their fluidity and activating the enzymes (cholesterol) that are found there (Sociedade, 200; Iyamu *et al.,* 2023).

The body mass index (BMI) and other basic indicators are widely used in the literature to diagnose overweight and obesity (WHO, 1998; Obodo *et al.,* 2020). This indicator has been routinely used in epidemiological studies, despite its limitations, for the diagnosis and assessment of secular trends in childhood and adult overweight/obesity (Monteiro *et al.,* 2000). The severity of the issue has prompted a thorough search for ever more straightforward, accurate, and sensitive ways to correctly identify extra body fat and link it to important health issues in order to eventually support the adoption of preventative and therapeutic measures. Despite the availability of advanced tools such as computed imaging methods for accurate body fat assessment, their application in epidemiological investigations is still limited (Monteiro *et al.,* 2000). Professional drivers are more likely to develop CVD than other occupational groups. In their 1993 study, Morris et al, found that bus drivers had a higher risk of CHD. Professional drivers both short- and long-distance drivers suffer more from CVD-related illnesses and deaths, according to several other occupational epidemiological studies (Hannerz & Tuchsen, 2001). Due to the high prevalence of CVD risk factors in this group, including obesity, hypertension, diabetes, sedentary lifestyles, smoking, and unhealthy diets, there is an excess of risk for CVD morbidity and death (WHO, 2003; Sangaleti *et al.,* 2014).Obesity is linked to lower engagement in work-related activities, higher rates of absenteeism, and worse productivity, all of which lead to higher resource consumption (Finkelstein *et al.,* 2005; Schmier *et al.,* 2006). Clinical trials conducted in the last few decades have reported on the risk factors that lead to the development of cardiovascular disease. These include non-modifiable factors like age, gender, and genetic predisposition, as well as modifiable factors like smoking habits, hypertension, age, and cholesterol concentrations of LDL and HDL (Tuchsen *et al.,* 2006; Despres *et al.,* 2008; Omolumen *et al.,* 2020; Airhomwanbor *et al.,* 2023). This study is aimed at investigating the BMI and plasma levels of lipid profile among Commercial Bus Drivers in Ekpoma.

MATERIALS AND METHODS

Area of Study

This study was carried out in Ekpoma, Headquarter of Esan West Local Government area of Edo State. It is located at latitude 6^{o} 45^{I}N and longitude 6^{o} 08^{I}E. It is moderately populated with the peoples' occupation being farming and trading. The main sources of water in the locality are rainfall and well. The well is augmented by irrigation scheme provided by the Government for public use. University is situated in this region. It is usually cold at night and very hot during the day. It also has undulating topography (World Gazetteer, 2015).

Study Population

The subjects used in this study are commercial bus drivers who drive from Ekpoma to other places such as Benin, Lagos, Abuja, Warri, Port Harcourt and Bayelsa. A total of one hundred (100) samples wererecruited for this study. This comprise of sixty-five (65) drivers from different transport companies in Ekpoma and thirty-five(35) samples from Non drivers,which served as the control.

Research Design

This research was designed to evaluate BMI and the plasma levels of lipid profile among commercial bus drivers in Ekpoma and make statistical comparison with that of the control group (non-Drivers). A well-structured questionnaire was designed to obtain socio demographic information, dietary intake, nutritional status and general health information.

Inclusion and Exclusion Criteria

Only registered Commercial Bus Drivers in Ekpoma was included in the study. Also,non-driverswere included and they served as the control. While Commercial Bus Drivers in Ekpoma with any major health complications were excluded from the study. Non drivers with any underlying sickness or disease were also excluded in this study.

Sample Collection

Blood samples (5mls) was collected by vene-puncture into an accurately labelled lithium heparin container for both subjects and control. The blood samples were centrifuged with a laboratory centrifuge at 4000rpm for 5 minutes between and the plasma separated into a clean plain container which were labelled corresponding to the initial blood samples containers. They werestored pending laboratory analysis.

SAMPLE ANALYSIS

Body Mass Index Assessment

The weight was measured after removal of shoes while wearing light clothing. Height was measured without shoes in the standing position with the shoulders in relaxed position and arms hanging freely. BMI was calculated as weight (kg)/height in meter.

The classification of BMI according to WHO, (1998) is as follows:

Less than 18.5-Under weight
18.5-24.9 - Healthy weight range
25.0-29.9 - Over weight
More than 30.0-Obese.

Determination of Total Cholesterol

Total cholesterol was determined using the Enzymatic endpoint method (CHOD-PAP) described by (Richmond, 1973).

Principle: Cholesterol esterase hydrolyses esterified cholesterol to free cholesterol. The free cholesterol is oxidized in the presence of cholesterol oxidase to form hydrogen peroxide which further reacts with phenol and 4-aminoantipyrine by the catalytic action of peroxidase to form red quinoneimine dye complex. The intensity of the colour form is proportional to the amount of cholesterol present in the sample.

Equation of reaction

$$\text{Cholesterol ester} + H_2O \xrightarrow{\textit{cholesterol esterase}} \text{cholesterol} + \text{fatty acid}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\textit{cholesterol oxidase}} \text{cholestene-3-one} + 2H_2O_2$$

$$2H_2O_2 + \text{phenol} + \text{4-aminoantipyrine} \xrightarrow{\textit{peroxidase}} \text{quinoneimine} + 4H_2O$$

Procedure: Ten microliters of distilled water, standard and sample were dispensed into test tubes labelled blank, standard, and sample respectively. One milliliter of cholesterol reagent was added into the respective tubes, and the contents mixed and incubated at 37^0C for 5minutes. The absorbance of standard and samples were measured against blank at the wavelength of 500nm using spectrophotometer.

Formula: $\text{TC conc. (mmol/dl)} = \frac{\text{Abs of test}}{\text{Abs of Std.}} \times \frac{\text{Conc. Of Std. (5.25mmol/l)}}{1}$

Determination of Triglycerides

Triglyceride was determined using the colorimetric method described by Trinder, (1969).

Principle: Lipoprotein lipase hydrolyses triglyceride to glycerol and fatty acids. The glycerol formed with ATP in the presence of glycerol kinase forms glycerol-3-phosphate which is oxidized by the enzyme glycerol phosphate oxidase to form hydrogen peroxide. Hydrogen peroxide further reacts with phenolic compound and 4 – aminoantipyrine by the catalytic action of peroxidase to form a red coloured quinoneimine dye complex. Intensity of the colour formed is directly proportional to the amount of triglycerides present in the sample.

Equation of the reaction:

$$\text{Triglyceride} + H_2O \xrightarrow{\text{lipoprotein lipase}} \text{Glycerol} + \text{Fatty acids}$$

$$\text{Glycerol} + \text{ATP} \xrightarrow{\text{glycerol kinase}} \text{glycerol-3-phosphate} + \text{ADP}$$

$$\text{Glycerol-3-phosphate} + O_2 \xrightarrow{\text{glycerol phosphate oxidase}} \text{dihydroxyacetone} + PO_4^- + H_2O_2$$

$$2H_2O_2 + \text{4- Aminoantipyrine} \xrightarrow{\text{perioxidase}} \text{Red Quinoneimine} + 4H_2O$$

Procedure: Ten microliters of distilled water, standard and sample were dispensed into test tubes labelled Blank, Standard and Samples respectively. One milliliter of triglyceride reagent was added into the respective test tubes; the contents were mixed and incubated in the water bath at 37^0C for 5minutes. The absorbance of standard and samples were measured against the blank at a wavelength of 500nm using spectrophotometer.

Formula: $\text{TG conc. (mmol/dl)} = \frac{\text{Abs of test}}{\text{Abs of Std}} \times \frac{\text{conc. Of Std.(2.21 mmol/l)}}{1}$

Estimation of High-Density Lipoprotein– Cholesterol

This was determined by precipitation method as described by Lopes – Virella *et al.,* (1977).

Principle: Low density lipoprotein (LDL), very low-density lipoprotein (VLDL) and chylomicron fractions of cholesterol are precipitated quantitatively by the addition of phosphotungstic acid in the presence of magnesium ions. After centrifugation, the cholesterol in the HDL fraction which remains in the supernatant, is then determined using the same method for the cholesterol assay.

Procedure

Stage1: Two hundred microliters of standard/sample was dispensed into test tube labelled standard/samples. Five hundred microliters of precipitant was added into the test tubes and mixed well, the content was allowed to stand for 10minutes at room temperature and then centrifuged for 10minutes at 4000rpm, the supernatant was separated and the cholesterol content was estimated using CHOD – PAP method.

Stage 2: One hundred microliters of distilled water, standard, supernatant and sample supernatant were added into test tubes labeled Blank, Standard and Samples respectively. One milliliter of cholesterol reagent was added into the respective test tubes; the contents was mixed and incubated at 37^0C for 5minutes. The absorbances of the standard and the samples were measured against the Blank at the wavelength of 500nm using spectrophotometer.

Formula: $\text{HDL-C conc.(mmol/dl)} = \frac{\text{Abs of Test}}{\text{Abs of Std.}} \times \frac{\text{conc. Of Std. (5.25 mmol/l)}}{1}$

Estimation of Low-Density Lipoprotein-Cholesterol (LDL)

This was determined using the Friedewald formula described by Friedewald *et al.,* (1972).

LDL- cholesterol (mmol/l) = Total cholesterol – (TG/ 2.2+ HDL-cholesterol).

Estimation of Very Low-Density Lipoprotein-Cholesterol (VLDL)

The formula below was employed as described by Tietz, (1999).

VLDL–C = Triglyceride / 5

Statistical Analysis

The Mean and standard deviation of the results obtained was calculated. Student's t- test and Analysis of Variance (ANOVA, LSD) was used for the analysis using Statistical Package for Social Sciences (SPSS) package version 21. Values with $p<0.05$ was considered statistically significant in this study.

RESULTS

Table 1 revealed the socio-demographic characteristics of the respondents. The subjects were categorized into five age groups; 25 -34; 35 - 44; 45 – 54; 55-64 and 65 -74. Majority of the respondents were within ages 25 - 34 years; 22 (33.9%), followed by 45 – 54 years, 17(26.2%), 35- 44years; 14 (21.5%), 55-64 years; 10 (15.4%) and 65-74; 2 (3.1%). Regarding years of experience in driving, 30 (46.2%) of the respondents agree to have had 0-10 years of experience, 13 (20%) have 11-20 years' experience, 6 (9.2%) have 21-30 years' experience while 16 (24.65) have 31 years and above experience. The results also showed that29 (44.6%) of the respondents do not smoke and drink alcohol, 19 (29.2%) of the respondent are smokers, 11 (17.0%) were drinkers while 6 (9.2%) participated in both smoking and drinking. The mean age of the respondents was 42.17±11.57 years. The mean systolic pressure of the respondents was 141.02±22.52 mm/Hg while 90.92±13.94 mm/hg was the mean diastolic pressure.

Table 1. Socio-Demographic Characteristics of the Study Population

Variables		Frequency (N= 65)	Percentages (%)
Age (Years)	25- 34	22	33.9
	35 – 44	14	21.5
	45 – 54	17	26.2
	55-64	10	15.4
	65-74	2	3.1
	TOTAL	65	100
Years of Driving	0-10	30	46.2
	11-20	13	20.0
	21-30	6	9.2
	>31	16	24.6
	TOTAL	65	100
Smoking/Drinking Habit	None Smokers/Drinkers	29	44.6
	Smokers	19	29.2
	Drinkers	11	17.0
	Smokers/Drinkers	6	9.2
	TOTAL	65	100
Age (Mean ±SD)	42.17±11.57		
Systolic (Mean ±SD)	141.02±22.52		
Diastolic (Mean ±SD)	90.92±13.94		

Table 2 presented the BMI and lipid profile levels of commercial bus drivers and the control. The result showed that the levels of BMI were significantly higher ($p<0.05$) in commercial bus drivers (26.39± 5.33 kg/m^2) as compared to the control (21.21± 2.93 kg/m^2).

Table 2. BMI and Lipid Profile levels of Commercial Bus Drivers and Control

Parameters	Control (n=35)	Subjects (n=65)	t value	p value
BMI (kg/m^2)	21.21±2.93	26.39±5.33	5.322	0.000
T. Cholesterol (mg/dl)	139.10±22.75	174.88±41.93	4.684	0.000
Triglyceride (mg/dl)	112.39±28.47	111.62±49.47	0.084	0.933
HDL (mg/dl)	69.23±11.68	106.42±20.76	9.782	0.000
LDL (mg/dl)	50.46±22.41	50.14±30.59	0.054	0.957
VLDL (mg/dl)	22.89±5.73	22.31±10.05	0.311	0.757

Key:N=sample size, $p>0.05$= Not Significant, $p<0.05$= Significant, BMI- Body Mass Index, T. Cholesterol-Total cholesterol, HDL-High Density Lipoproteins, LDL-Low Density lipoproteins VLDL-Very Low-Density Lipoproteins.

The levels of total cholesterol were significantly higher ($p<0.05$) in commercial bus drivers (174.88 ± 41.93 mg/dl) as compared to the control (139.10± 22.75 mg/dl). The Triglyceride levels were not significantly different ($p>0.05$) in commercial bus drivers (111.62±49.47 mg/dl) as compared to the control (112.39± 28.47 mg/dl). HDL levels were significantly higher ($p<0.05$) in commercial bus drivers (106.42± 20.76 mg/dl) as compared to the control (69.23± 11.67 mg/dl). LDL levels were not significantly different ($p>0.05$) in commercial bus drivers (50.14± 30.59 mg/dl) as compared to the control (50.46 ± 22.41). VLDL levels were not significantly different ($p>0.05$) in commercial bus drivers (22.31 ± 10.05mg/dl) as compared to the control (22.89± 5.73 mg/dl). The results in table 3 presented the BMI and lipid profile levels of commercial bus drivers according to their age groups. The result showed that the levels of BMI were higher ($p>0.05$) within ages 45-54 years (27.71± 3.65 kg/m^2) compared with 25-34 years (23.92± 3.71kg/m^2), 35-44 years (27.64± 7.43 kg/m^2), 55-64 years (27.66± 3.65 kg/m^2) and 65-74 years (27.24±7.97 kg/m^2). Levels of Total cholesterol were significantly higher ($p<0.05$) within age 35-44 years (189.93± 45.20 mg/dl), 45-54 years (193.19± 40.49 mg/dl), 55-64 years (170.60± 40.36 mg/dl) and 65-74 years (202.44± 17.06 mg/dl) compared with 25-34 years (150.59± 31.78kg/m^2). Triglyceride levels were significantly higher ($p<0.05$) within age 35-44 years (131.88± 56.83 mg/dl), and 45-54 years (121.67± 52.54 mg/dl) compared with 55-64 years (121.67± 59.75 mg/dl), 65-74 years (83.67± 67.15 mg/dl) and 25-34 years (88.93± 25.55 mg/dl). HDL levels were not significantly different ($p>0.05$) within age groups 25-34 years (98.95± 17.94 mg/dl), 35-44 years (106.29± 24.06 mg/dl), 45-54 years (111.12± 15.25 mg/dl), 55-64 years (112.50± 22.47 mg/dl) and 65-74 years (119.00± 52.33 mg/dl). Also, LDL levels were not significantly different ($p>0.05$) within age groups 25-34 years (44.03± 25.93 mg/dl), 35-44 years (61.65± 30.53mg/dl), 45-54 years (56.26± 35.78 mg/dl), 55-64 years (33.78± 19.73 mg/dl) and 65-74 years (66.71± 55.95 mg/dl). VLDL levels were significantly higher ($p<0.05$) within age groups 35-34 years (26.77± 11.11 mg/dl), 45-54 years (24.38± 10.49 mg/dl) compared with 25-34 years (17.50± 5.51 mg/dl), 55-64 years (24.30± 12.08 mg/dl) and 65-74 years (16.50± 13.44 mg/dl).

The results in table 4 presented the lipid profile levels of commercial bus drivers according to BMI categorization. The result showed that the levels of Total cholesterol were significantly higher ($p<0.05$) in BMI groups Obese (201.14± 40.74 mg/dl), Overweight (169.46± 34.35 mg/dl) and Healthy (172.85± 40.31 mg/dl) compared with underweight groups (96.20± 5.37 mg/dl).

Table 4. Lipid Profile Levels of Commercial Bus Drivers according to BMI Categorization

Parameters	Underweight (n=02) <18.5 (3.1%)	Healthy (n=35) 18.5-24.9 (53.8%)	Overweight (n=16) 25.0-29.9 (24.6%)	Obese (n=12) >30 (18.5%)	F-value	P value
TC (mg/dl)	96.20±5.37[a]	172.85±40.31[b]	169.46±34.35[b]	201.14±40.74[ab]	4.741	0.005
TG (mg/dl)	72.79±10.20[a]	106.46±51.19[a]	111.33±60.16[a]	115.75±45.61[a]	0.520	0.670
HDL (mg/dl)	69.50±0.71[a]	103.74±17.40[b]	112.69±20.95[b]	112.00±24.76[b]	3.429	0.022
LDL (mg/dl)	11.14±1.22[a]	54.17±28.04[b]	35.10±20.57[a]	64.97±39.23[b]	4.014	0.011
VLDL (mg/dl)	13.00±0.02[a]	23.17±9.24[a]	22.31±12.05[a]	21.38±10.35[a]	0.681	0.567

Note: Values in a row with a different superscript are significantly different at p<0.05

Table 5. BMI and Lipid Profile Levels of Commercial Bus Drivers according to Years of Driving Experience

Parameters	0-10years (n=30)	11-20 years (n=13)	21-30years (n=6)	31yrs& above (n=16)	F-value	P value
BMI (kg/m^2)	24.08±3.08[a]	27.91±7.60[b]	27.31±3.85[a]	29.15±5.52[b]	4.302	0.008
TC (mg/dl)	160.76±37.50[a]	193.76±36.91[b]	187.03±52.40[a]	181.44±44.31[a]	2.471	0.070
TG (mg/dl)	96.23±39.73[a]	148.75±47.46[b]	104.40±49.70[a]	113.03±56.17[a]	3.894	0.013
HDL (mg/dl)	103.93±19.08[a]	105.23±16.67[a]	109.83±20.11[a]	110.75±27.18[a]	0.432	0.731
LDL (mg/dl)	46.44.24.38[a]	57.96±32.74[a]	56.32±32.15[a]	48.43±39.28[a]	0.516	0.673
VLDL (mg/dl)	19.17±8.14[a]	29.85±9.49[b]	21.00±10.16[a]	22.58±11.26[a]	3.924	0.013

Note: Values in a row with a different superscript are significantly different at p<0.05

Table 6. BMI and Lipid Profile Levels of Commercial Bus Drivers according Smoking and Drinking Habits

Parameters	None Smokers/ Drinkers (n=29)	Smokers Only (n=19)	Drinkers Only (n=11)	Smokingand Drinkers (n=06)	F-value	P value
BMI (kg/m^2)	26.81± 5.98[a]	27.87± 5.34[a]	23.53± 3.36[a]	24.93± 2.96[a]	1.819	0.153
TC (mg/dl)	149.72±35.08[a]	151.15±20.93[a]	180.96±42.29[b]	185.96±46.29[b]	2.986	0.038
TG (mg/dl)	88.16±22.07[a]	90.36±45.29[a]	112.19±57.96[a]	131.05±42.64[b]	2.285	0.088
HDL (mg/dl)	107.21±20.20[a]	109.00±24.27[a]	103.09±21.07[a]	100.50±11.11[a]	0.358	0.784
LDL (mg/dl)	41.62±30.28[a]	47.43±19.82[a]	43.48±24.44[a]	58.31±35.04[a]	1.308	0.280
VLDL (mg/dl)	17.64±9.00[a]	18.00±5.25[a]	22.33±11.71[a]	26.26±8.56[b]	2.203	0.057

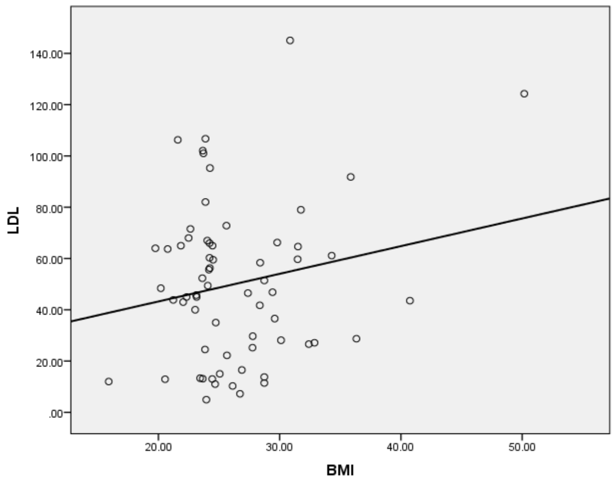
Note: Values in a row with a different superscript are significantly different at p<0.05

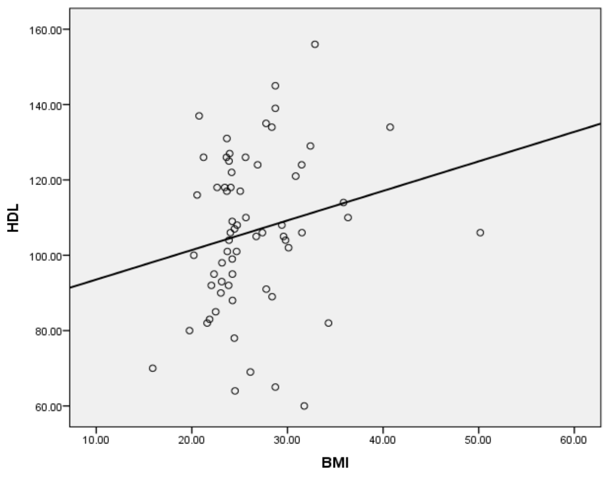
Triglyceride levels were not significantly different (p>0.05) in BMI groups Obese (115.75± 45.61 mg/dl), Overweight (111.33± 60.16 mg/dl), Healthy (106.46± 51.19 mg/dl) and underweight (72.79± 10.20 mg/dl). Levels of HDL were significantly higher (p<0.05) in BMI groups Obese (112.00± 24.76 mg/dl), Overweight (112.69± 20.95 mg/dl) and Healthy (103.74± 17.40 mg/dl) compared with underweight groups (69.50± 0.71 mg/dl). Levels of LDL were significantly higher (p<0.05) in BMI groups Obese (64.97± 39.23 mg/dl), and Healthy (54.17± 28.04 mg/dl) compared with underweight groups (11.14± 1.22 mg/dl) and Overweight (35.10± 20.57 mg/dl). VLDL levels were not significantly different (p>0.05) in BMI groups Obese (21.38± 10.35 mg/dl), Overweight (22.31± 12.05 mg/dl), Healthy (23.17± 9.24 mg/dl) and underweight (13.00± 0.02 mg/dl). The results in table 5 presented the BMI and lipid profile levels of commercial bus drivers according to years of experience. The result showed that the levels of BMI were significantly higher amongst drivers with 11-20 (27.91± 7.60 kg/m^2) and 31 years of experience (29.15± 5.52 kg/m^2) compared with 0-10 years (24.08± 3.08 kg/m^2) and 21-30 years (27.31± 3.85kg/m^2). Total cholesterol were significantly higher (p<0.05) amongst drivers with 11-20 years of driving experience (193.76± 36.91 mg/dl), compared with drivers with 0-10 years (160.76± 37.50 mg/dl), 21-30 years (187.03± 52.40 mg/dl) and 31 years and above (181.44± 44.31 mg/dl). Triglyceride levels were significantly higher (p<0.05) amongst drivers with 11-20 years of driving experience (148.75± 47.46 mg/dl), compared with drivers with 0-10 years (96.23± 39.73 mg/dl), 21-30 years (104.40± 49.70 mg/dl) and 31 years and above (113.03± 56.17 mg/dl). HDL and LDL levels were not significantly different (p>0.05) amongst drivers with the different years of driving experience. VLDL levels were significantly higher (p<0.05) amongst drivers with 11-20 years of driving experience (29.85± 9.49 mg/dl), compared with drivers with 0-10 years (19.17± 8.14 mg/dl), 21-30 years (21.00± 10.16 mg/dl) and 31 years and above (22.58± 11.26 mg/dl). The results in table 6 presented the BMI and lipid profile levels of commercial bus drivers according to smoking and alcohol drinking habits. The result showed that the levels of BMI were not significantly different (p>0.05) amongst drivers who do not smoke nor take alcohol (26.81± 5.98 kg/m^2), smokers only (27.87± 5.34 kg/m^2), drinkers only (23.53± 3.3.36 kg/m^2) and both smoking and drinking (24.93± 2.96kg/m^2). Total cholesterol levels were significantly higher (p<0.05) amongst alcohol drinkers only (180.96± 42.29 mg/dl), and smokers and drinkers (185.96± 46.29 kg/m^2), compared with smokers only (151.15± 20.93 mg/dl) and those who do not take alcohol or smoke (149.72± 35.08 mg/dl). Triglycerides were not significantly different (p>0.05) within the groups; though was significantly (p<0.05) among drivers who both drink alcohol and smoke. Also, HDL, LDL and VLDL levels varied across the drinking and smoking habits of the drivers; though not significantly different (p>0.05); though VLDL was significantly different amongst those drivers who both smoke and drink alcohol. The results in table 7 presented the correlation of BMI with lipid profile levels of commercial bus drivers. The results showed that there is a strong positive correlation between BMI and Total cholesterol (r=0.362; 0.003). A weak positive correlation exists between BMI and TG (r=0.028; 0.824). There is also a strong positive correlation between BMI and HDL (r=0.201; 0.642). A weak positive relationship exists between BMI and LDL (r=0.188; 0.134). The relationship that exists between BMI and VLDL is positive but weak (r=0.035; 0.779). The diagrammatic representation of these relationships is shown below in table 7.

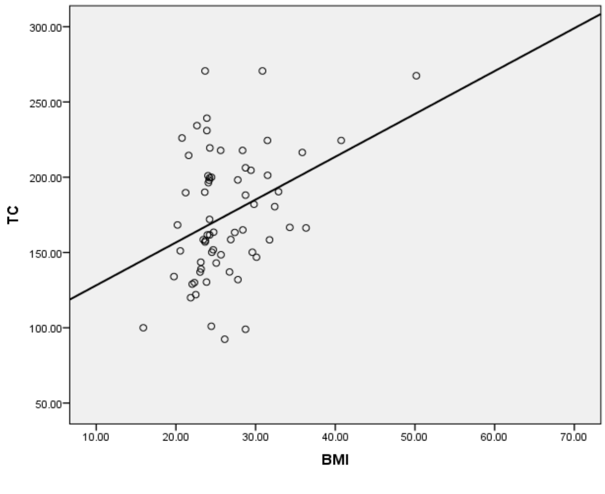
Table 7. Correlation of BMI with Lipid Profile of Commercial Bus Drivers

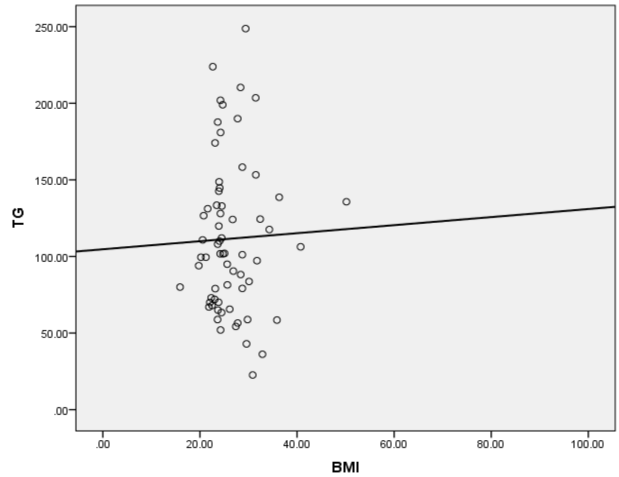
Parameters		(r)	p-value	Remark
	TC (174.88±41.93)	0.362	0.003	SPC
BMI (26.39±5.33)	TG (111.62±49.47)	0.028	0.824	WPC
	HDL (106.42±20.76)	0.201	0.642	SPC
	LDL (50.14±30.59)	0.188	0.134	WPC
	VLDL (22.31±10.05)	0.035	0.779	WPC

Key: BMI= Body Mass Index; SPC=Strong Positive Correlation; WPC= Weak Positive Correlation; r= Correlation Coefficient









Correlation Graphs

DISCUSSION

Given their profession, commercial bus drivers may be subject to certain cardiovascular risks. The majority of drivers have sedentary daily routines and long driving hours, which puts them at risk for a variety of health issues. Consequently, evaluating a driver's lipid profile will be extremely beneficial since it may be used as a first, general medical screening tool for lipid abnormalities and estimate the risk of developing cardiovascular disease, some types of pancreatitis, and other illnesses (Sidhu & Naugler, 2012). The findings demonstrated that commercial bus drivers' systolic and diastolic blood pressure were higher than average. This is consistent with research by Marqueze *et al.,* (2013), which found similar things. This might be explained by the nature of their work, which exposes them to bad eating habits and sedentary lifestyles (Moreno *et al.,* 2006). This population was more susceptible to gastrointestinal, metabolic, and cardiovascular disorders as a result of these traits. But a lot of drivers work irregular shifts, which contributes to their bad eating patterns, such consuming a lot of calories at night (Pasqua& Moreno, 2004).One billion people are thought to have hypertension globally, and the illness is thought to be the cause of 7.1 million fatalities annually. Systolic blood pressure more than 115 mm Hg is responsible for 49% of cases of ischemic heart disease and 62% of cases of cardiovascular disease, according to the World Health Organization (Xie *et al.,* 2011). Additionally, according to Tuchsen *et al.* (2006), arterial hypertension is a significant risk factor for cerebrovascular accidents (strokes).Research has indicated a rise in the incidence of systemic hypertension among drivers who work professionally (Xie *et al.,* 2011). In a study conducted in Brazil on a population of drivers who transport cargo, Cavagioni *et al.,* (2008) found that 59% of the participants had systolic blood pressure greater than 130 mmHg or diastolic blood pressure greater than 85 mmHg. The levels of BMI were significantly higher in commercial bus drivers as compared to the control. It was also recorded in this study that 3.1% of commercial bus drivers were underweight, 53.8% were healthy, 24.6% were overweight and 18.5% were obese. These findings are consistent with research conducted in 2016 by Oyeniyi& Ajayi on commercial drivers, which found that 18.4% of the drivers were obese, 35.8% were overweight, and 20.7% of the drivers were underweight. The study by Whitfield-Jacobson *et al.* (2007), which found that 56.5% of drivers were obese and 85.9% of drivers were overweight, lends additional credence to these findings. This claim is further supported by research conducted in 2006 by Moreno *et al.,* which indicated that 28.3% of 4,878 drivers were obese. The large number of overweight people in both of these studies suggests that obesity and work are related. According to their report, all truck drivers who work day shifts may lead a lifestyle that puts them at risk for obesity. Long hours at work may also contribute to poor food and sedentary lifestyle choices. Many drivers' BMIs indicate that they are overweight or obese. Turner & Reed (2011) discovered that 93.3% of 300 long-haul drivers in their convenience sample were overweight or obese. According to research by Martin *et al.,* (2009), 55% of 2849 US truck drivers had a high rate of obesity. Truck stops were chosen as exemplary locations because they have restaurants and spaces for overnight parking in addition to being on both high- and low-flow routes. Compared to 31% of the overall population, they discovered that 69% of truck drivers were fat. Given that these are the highest rates of obesity among all occupational groups, it is noteworthy (Caban *et al.,* 2005).As a result, a large number of drivers are obese. Being overweight and/or obese is associated with a wide range of morbidities, according to epidemiological and biomedical research (Järvholm& Silverman, 2003). It is well known that being overweight and/or obese increases the risk of diabetes, hypertension, stroke, cardiovascular disease, and other conditions (Ostbye *et al.,* 2007). Furthermore, obesity raises the risk of a motor vehicle collision (MVC); Anderson *et al.* (2012) found that among heavy truck drivers with a BMI of over 30, there was a 1.55 relative risk of an MVC compared to non-obese heavy truck drivers in their sample.

The results of this study on the relationship between BMI and lipid profile showed that there is a positive correlation which connotes that an increase in BMI will result in an increase in lipid profile. This finding is consistent with a study by Hirata *et al.* (2012) that found a significant proportion of prediabetic patients and high rates of hypertriglyceridemia (34.4%) and hypercholesterolemia (35.7%) linked to overweight/obesity. One of the five recognized standards for determining a person's personal risk of cardiovascular disease and type 2 diabetes is a triglyceride level of 150 mg/dL (Grundy *et al.,* 2005; Airhomwanbor *et al.,* 2023). Similar results were found in earlier research (Cavagioni *et al.,* 2008) for drivers transporting goods, with prevalence rates of 33% and 38% for hypercholesterolemia and hypertriglyceridemia, respectively, and 34.0% and 69.4%, respectively, for drivers transporting passengers (Wang & Lin, 2001).

The levels of total cholesterol and HDL were significantly higher in commercial bus drivers as compared to the control. The Triglyceride, LDL and VLDL levels were not significantly different in commercial bus drivers as compared to the control. This matches the findings of Marqueze *et al.* (2013), who also noted a noteworthy variance in the lipid profile among truck drivers (Omolumen *et al.,* 2024). The results found are inconsistent with patterns documented in local research conducted on seemingly healthy Nigerians, where low HDL-c levels were the major dyslipidemia (Odenigbo *et al.,* 2008). Furthermore, it has been demonstrated that professional drivers in Iran primarily suffer from hypertriglyceridemia and central obesity, which can be linked to their demanding work environments (Mohebbi *et al.,* 2012). In addition, a number of studies have discovered alterations in drivers' lipid profiles. Atkinson *et al.* (2008), however, assert that the non-specific lipid concentrations that are changed in these studies are not totally consistent. Shift drivers also have greater cholesterol than day shift drivers, according to research by Ha & Park (2005) and Biggi *et al.* (2008), but Ghiasvand *et al.* (2006) reported higher LDL-cholesterol levels. According to Ha and Park (2005), drivers who work irregular shifts are more likely to acquire cardiovascular illnesses. The timing of meals, which are usually taken at night and in the early morning, may be related to the higher sera lipid contents observed in drivers who work irregular shifts. Elevated levels of LDL cholesterol may also be explained by higher consumption of carbohydrates at night (Ghiasvand *et al.,* 2006).A shift in meal timing may also lead to changes in the enzyme activity of several plasma hormones that influence stomach emptying (Iyamu *et al.,* 2023), such as glucagon and insulin, as well as in the activity of various metabolites, including triglycerides, cholesterol, and ketone bodies (Moreno *et al.,* 2001). In addition, drivers with irregular work schedules may not be fully acclimated to the imposed social timing, which may result in a higher risk of cardiovascular illnesses. According to Atkinson *et al.* (2008), metabolic reactions to insufficient nocturnal meals may be the mediating factor in cardiovascular illnesses.

Additionally, the study's findings showed that, when smoking and alcohol consumption were taken into account, the serum lipid profiles of commercial bus drivers changed. Similar to this, some research has linked smoking with driving schedules (Biggi *et al.,* 2008; Nabe-Nielsen *et al.,* 2008; Omolumen *et al.,* 2024), however other research has disproved this theory (Ha & Park, 2005). While Siedlecka (2006) noted that certain research considered smoking to be a risk factor for cardiovascular illnesses, However, smoking should be considered a confounding factor as well as a mediator of drivers' work shifts and cardiovascular diseases, according to a study by Nabe-Nielsen *et al.* (2008). Also, the result of this study revealed that BMI and Lipid parameters varied among commercial drivers as it relates to their years of driving experience. BMI, total cholesterol, triglyceride, HDL, LDL and VLDL were higher as the years of driving (experience) increases. This is consistent with the findings of the study conducted by Oyeniyi and Ajayi (2016) and Obodo *et al.,* (2020). Because of their line of work, professional drivers are frequently sedentary and engage in unhealthy eating habits, which can result in obesity. Additionally, they claimed that a higher BMI and a longer history of years spent driving professionally were strongly associated with a higher risk of hypertension, and that obesity was a predictor of both. This correlation makes sense because long-term drivers often experience unintended weight gain from inactivity and careless eating habits.

Conclusion

In conclusion, as a result of the nature and organization of their jobs, commercial drivers may be particularly vulnerable to cardiovascular risks, according to the study's findings. However, due to their sedentary lifestyle, the study found that commercial bus drivers had substantial changes in their BMI, total cholesterol, triglycerides, HDL, LDL, and VLDL. Therefore, among commercial bus drivers in the research area, there should be a stronger focus on preventing obesity and hypertension. Furthermore, this occupational category may benefit from preventive and educational initiatives focused on dietary and physical activity modifications; nevertheless, these claims will need to be confirmed by prospective research.

Conflict of Interest

The authors declare no conflicts of interest. The authors alone are responsible for the content and the writing of the paper.

Ethical Permission

Ethical approval was obtained from the University Ethics Committee and also informed consent was sought from the subjects before collection of blood samples.

Funding

This research did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The authors would like to acknowledge the management of Ambrose Alli University (AAU), Ekpoma, Edo State, Nigeria for creating the enabling environment for this study. Thanks to all the Laboratory and technical staff of St Kenny Research Consult, Ekpoma, Edo State, Nigeria for their excellent assistance and for providing medical writing support/editorial support in accordance with Good Publication Practice (GPP3) guidelines.

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