Stress, Cardiovascular Health, and Accident Risks for Commercial Drivers in Abuja, Nigeria: Causes and Correlations

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ABSTRACT

Background: *Chronic stress can contribute to poor health (including cardiovascular health), and vice versa. Both can impact job performance, which in the case of CMVDs impacts public safety.*

Objective: *This study examines causal and correlative relationships between self-reported stress level, cardiovascular health, and safety for commercial motor vehicle drivers (CMVDs) in Abuja, Nigeria.*

Methods: *A cross sectional study was conducted among 509 CMVDs in Abuja, Nigeria. Various lifestyle habits, working conditions and demographic factors were considered. Treatment rates among hypertensives were also measured. Multivariate models (logistic multivariate regression) and univariate relative risks were computed.*

Results: *Higher self-reported stress was associated with tobacco use, high alcohol consumption, and lower weight. Prevalence of mid- to high-stress was 28% (140/509). Increased hypertension risk was associated with elevated pulse rate, higher pulse rate, higher alcohol consumption (for CMVDs over 40) and higher weight (for drivers under 40). Overall prevalence of hypertension was 39% (198/507), with 26% (63/246) for drivers under 40 and 47% (124/261) for drivers over 40. Screening tests for hypertension are common (234/260 or 90% for drivers over 40), but less than half (46%, or 74/158) of previously-tested hypertensive drivers had tested positive. Out of all drivers who had previously tested positive, 65% (68/104) were receiving treatment. No significant factor correlations with accident frequency were discovered.*

Conclusions: *High hypertension rate, stress, and alcohol use (especially among younger drivers) indicate that improvements in hypertension testing, stress management, and health education would significantly improve health outcomes for CMVDs.*

Key words: *Commercial vehicle drivers, stress, health, road safety, Nigeria, Abuja*

INTRODUCTION

Impact of Stress on Health

Literature indicates that stress has a significant impact on individual health, safety, and well-being.[1,2,3] Stress is identified as the psychological and physiological response to change from the mind and/or body's homeostatic (resting) state.[4]

Two forms of stress may be differentiated: acute and chronic. Acute stress (the most common form) is generally short-term in duration, from a couple of minutes up to a few weeks. Chronic stress, on the other hand, is connected to what is perceived as a perpetual situation from which one may be unable to experience feelings of relief. Examples of chronic stress may include unhappiness in a long-term relationship, persistent financial troubles, health concerns, and feelings of displeasure with one's job.[1]

Regardless of the type of stress, when the mind recognizes an event as stressful the body engages in a self-protective physiological response that includes the release of hormones, including cortisol.[5] Increased levels of cortisol in the bloodstream result in feelings of depleted energy, which may result in craving for foods high in sugar, fat, salt, and carbohydrates, which are identified as high-energy foods.[3] Prolonged cortisol secretion disrupts the body's circadian rhythm and can lead to metabolic dysregulation as well as disruptions in sleep patterns and ability to focus.[6,7]

In addition to the aforementioned effects, under chronic stress the feelings of energy depletion undermine the stressed individual's motivation to be active and mitigate weight gain.[8,] Unhealthy weight management, especially for persons considered overweight (BMI=25.0-29.9) or obese (BMI $\geq$ 30.0), has been linked to several poor health outcomes including heart disease, Type 2 diabetes, stroke, and sleeping problems, which can limit an individual's ability to concentrate and, thereby, make one more prone to accidents.[3,8] Further, exposure to stress also activates the body's release of chemicals that increase heart rate and blood pressure, also known as hypertension (defined by the World Health Organization as systolic blood pressure over 140 or diastolic blood pressure over 90), which, at prolonged levels, can result in stroke, heart attack, or kidney disease.[10,11] Previous studies have shown that commercial motor vehicle drivers exhibit elevated risk of hypertension compared to the population at large.[12,13]

Commercial Motor Vehicle Drivers (CMVDs) in Nigeria: Health, and Road Safety

The Nigerian Federal Road Safety Corps (FRSC) annual report for 2013 refers to road traffic injuries as an "epidemic on wheels" (FRSC, 2013, p. 10).[14] In 2013, among all Nigerian states, the Federal Capital Territory of Abuja had the highest number of reported road crashes, with 1766 cases resulting in 446 deaths and 3948 injuries.[14] Commercial motor vehicles were involved in 55.8% of reported crashes nationwide. Evidently any efforts to reduce accidents should involve understanding the risk factors that affect CMVDs.

While some studies of CMVDs in Nigeria have focused on vision as a correlate of safety,[15,16] others suggest the importance of also investigating socio-economic indicators

related to CMVDs and safety.[17,18] Previous research suggests that stress plays a critical role in overall health, well-being, and safety, especially for those within occupation-induced stress positions such as commercial truck driving.[1,2,19] Occupation-induced stress affects both those employed in the occupation and those who interact with them. Normally, such stress-induced risks can be partially mitigated by regulations that include a strict emphasis on safety. However, these measures do not always address the root of the problem. In the case of commercial motor vehicles drivers (CMVDs), because of their enormous impact on public safety, a comprehensive approach towards reducing occupational risk is called for.

Like many other countries, Nigeria requires commercial driver's license applicants to undergo a medical examination. However, the medical disqualifying conditions are not clearly specified, unlike many other countries.[20] In the United States, for instance, conditions that may disqualify CMVDs from re-certification include having a blood pressure above 180/110, insulin-dependent or uncontrolled diabetes mellitus, epilepsy, unstable mental conditions and/or psychosis, and alcoholism.[21] As highlighted above, such health issues have been found to correlate with chronic stress and have the potential of impacting an individual's ability to focus while on the job. Hence, studies that examine health issues impacting CMVD's in Nigeria may provide insights leading to improvements in safety and well-being of the drivers as well as the general population. The current study complements previous studies of health and health-related lifestyle habits of Nigerian CMVD's[12,15,16,18] with a particular emphasis on stress, cardiovascular health, and lifestyle factors which may influence these two main factors.

Study Purpose and Scope

Our study of CMVDs in Abuja has the following main objectives: (1) To investigate correlations among three key variables: self-reported stress, hypertension, and accident rate; (2) To investigate correlations between these three key variables and a number of lifestyle habits, working conditions, and demographic factors; (3) To formulate (if possible) multivariate causal models for the three key variables. The term "correlation" in the above objectives refers to a positive or negative linear association, as quantified by the Pearson correlation coefficient. With reference to causal models, the different lifestyle, working condition, and demographic variables are treated as either causes or effects of the three key variables depending on findings in the previous scientific literature: these relationships are explained in more detail below in the "Analysis plan" paragraph in the "Statistical methodology" section.

METHODOLOGY

The study was based on a population survey of CMVDs in Abuja, which served as the research instrument. The design, implementation, and ethical safeguards of the survey are described in the following subsections.

Survey Design

The survey included non-sensitive questions concerning the individual's demographics, working conditions, lifestyle habits, self-reported stress, driving history and simple physiological measurements such as height, weight, blood pressure, and pulse. For

comparative purposes, we chose demographic characteristics and lifestyle habits that were similar to those included in a 2015 survey conducted by Erhiano et al. among CMVDs in Sokoto State, Nigeria.[12] Some of the categories used have particular significance in the Nigerian context, as explained below:

- In the survey five levels of education were specified; none; Qur'anic, primary school, secondary school, and college/university. Nigerian law since 1976 has mandated six years of universal primary education, and in 2004 this was increased to 9 years. But inadequacies in school financing and staffing, parents' poverty, an undersupply of jobs which require education, and cultural skepticism (particularly among Muslim parents) have meant that many children never completed their primary schooling.[22] In Qu'ranic schools in Nigeria, students typically learn Arabic letters, memorization of the Quran, and Islamic law under very basic learning conditions.[23,24] Those subjects who attended both Quranic and primary or secondary school were listed as primary/secondary according to their attendance.
- Religion was included as a demographic factor because of its strong influence on lifestyle choices (such as alcohol consumption), as well as cultural and social attitudes within Nigerian society.
- Three categories of vehicle ownership were specified as part of working conditions: company, hire purchase, and owner. Company drivers are the most likely to drive on a schedule set by the company, and thus have less incentive to engage in risky behavior such as driving at high speeds or for an excessive number of hours per day. Drivers in the "hire purchase" category are obligated to make regular payments to the car's owner, in order to eventually gain ownership of the vehicle once the payments are completed. Vehicle owners bear full responsibility for their own vehicle.
- Long versus short distance categories were included. Long-distance is more monotonous, and requires driving at higher speeds. Armed robberies also occur (albeit infrequently) on some highways.[25] Short distance drivers typically face more traffic, and have more incentive to work longer hours because of prospects of additional income.

Survey administration

The survey was a cross sectional study, conducted among CMVDs in Abuja, Nigeria who consented to participate in the study. Interviewers collected data from November 2015 to January 2016 at 20 motor parks (a motor park in Nigeria is a location where long-distance buses from various companies pick up and discharge passengers.) Prior to each data collection session, permission was sought from the head of the driver's union at the motor park visited. The union head then convened a meeting for drivers, where the data collection team explained their purpose to the drivers. The drivers were informed that weight and blood pressure measurements were being offered free of charge, and that all questionnaire responses would be held in confidence. The actual administration of the questionnaire and

taking of measurements took place outdoors: a station was set up with a table and awning to shade participants from the sun. The data collection team consisted of three persons: one to administer the survey, one to take health measurements, and one to supervise. Weight measurements were obtained using a Tanita digital scale, and blood pressure measurements were taken with an Omron sphygmomanometer. Data collection sessions averaged about 4 hours in duration. 500 total responses were sought, which is sufficient to estimate prevalences within 5% with 95% confidence. 509 responses were actually obtained.

Survey ethics

The questionnaire was designed by OREEP Nig. Ltd. personnel according to guidelines set by the U. S. National Institute of Health [NIH] Office of Extramural Research.[26] The questionnaire was also submitted to the Nigerian National Health Research Ethics Committee. A consent section embedded in the questionnaire allowed participants to accept or decline participation in the study, and acceptance was indicated by signature of respondent.

Statistical methodology

Data cleaning: Before performing statistical analysis, we cleaned the dataset as follows. First, we corrected stray values, and removed evident outliers from the numerical data. Next, we combined categories with a size less than 25 (5% of the survey size) into adjacent categories. This combination was done because it is well-known that small categories may potentially skew the data analysis. In particular, the following categories were combined:

- *Age:* Under 20 (4 responses) was combined with 20-29, and 60 and over (8 responses) was combined with 50-59.
- *Fatty food:* "Never" (7 responses) was combined with "Less than once a week".
- *Religion*: "Traditional" and "None" categories were not included in the data analysis (3 responses in each).
- *Sleep*: "7 or more hours" (21 responses) was combined with "6-7 hours".
- *Education*: "None" (16 responses) was combined with "Quranic" (18 responses).

***Levels*:** Blood pressure data was categorized using the WHO definition of "hypertensive" as a systolic blood pressure of at least 140 or diastolic blood pressure of at least 90. "Pre-hypertensive" was defined as systolic from 120-139 and/or diastolic from 80-89. "Tachycardia" refers to a pulse of over 100 beats per minute.

Analysis plan: Summary statistics were computed to quantify the population demographics. Bivariate correlations between all factors were computed to identify significant interdependencies as well as any confounding factors. Those factors that showed statistically significant correlations with the three key variables (stress, hypertension, and accident rate) were used to construct multivariate models based on stepwise regression. For stress, demographic and working condition factors were treated as causes (independent variables), while lifestyle habits such as drinking, smoking, fatty food consumption, and sleeping habits were treated as effects (dependent variables). For hypertension, all demographic, working condition, and lifestyle habit variables were treated as

causes; and the same was true for accident rate. Relative risks (with confidence intervals) for stress and hypertension were computed for certain factors found to be especially impactful. All calculations were performed using the R statistics programming language, with the RStudio user interface: R packages used were 'Hmisc', 'psych', 'lmtest', and 'epitools'.

RESULTS

Summary of descriptive statistics

Survey respondent frequencies are summarized in and . gives percentages for binary categories, while summarizes the proportion of responses for survey questions with multiple categories.

Table 1: Subject proportions in important demographic, health and safety categories.

Frequency (%)							
Married	Muslim	Long distance	Use Tobacco	Pre-hypertense	Hyper-tense	Tachy-cardia	5-yr accident
406(84)	202(41)	268(53)	111(22)	133(26)	198(39)	13(3)	51(10)

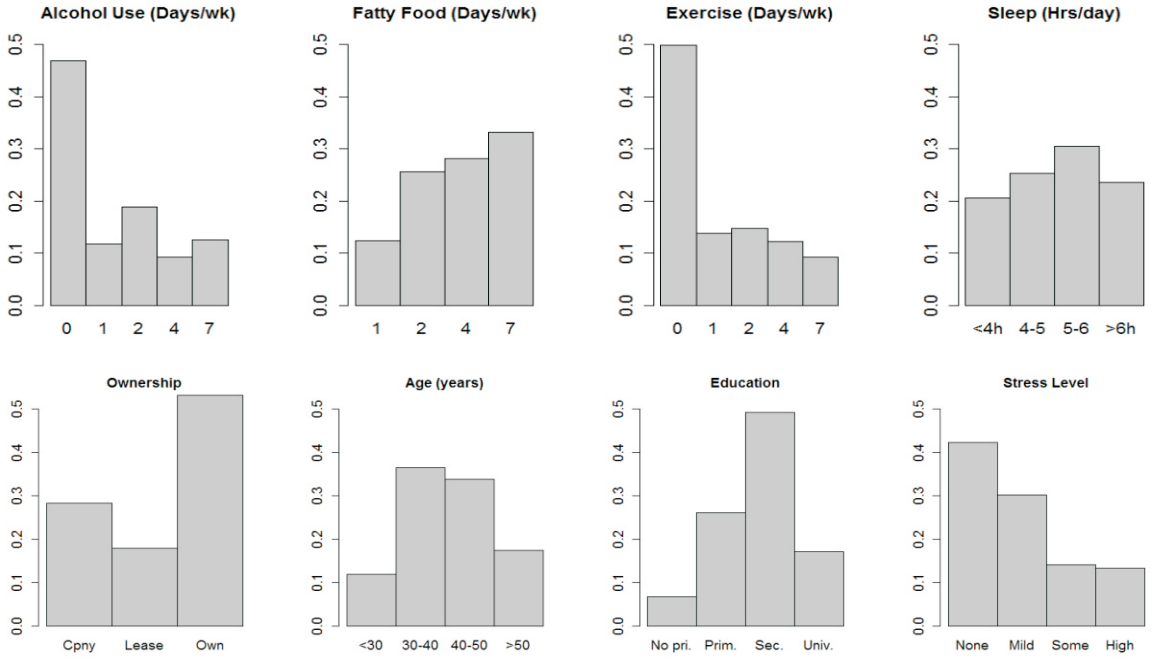

Figure 1: Sample proportions for lifestyle habits, working condition, demographic, and stress factors with multiple categories.

Table 2: gives mean health indicators by age group, with standard deviations. Weight and blood pressures increase steadily with age, while pulse shows no change with age. Note that for the over 50 age group the mean systolic and diastolic (142.1 and over 90.3 respectively) are in the hypertensive range, reflecting the very high rate of hypertension in this age group.

Table 2: Health indicators by age group.

Mean (standard deviation)				
Age group	**Weight (kg)**	**Pulse**	**Systolic**	**Diastolic**
Under 30	66.5(10.1)	80.4(11.0)	126.9(16.5)	80.9(12.1)
30-39	74.7(14.3)	79.2(9.9)	128.4(16.6)	82.0(13.5)
40-49	78.8(13.8)	81.4(12.2)	139.0(23.8)	88.3(17.0)
50 and over	80.8(15.0)	80.9(12.0)	142.1(22.3)	90.3(16.2)

Data correlations

Key variable cross-correlations

No significant correlations were found among the three key variables of self-reported stress, hypertension, and accident rate.

Key variable correlations with health indicators

As far as correlations with health indicators, stress level was negatively correlated with weight and (slightly) positively correlated with pulse rate, while hypertension was positively correlated with both weight and pulse, as shown in Table 3. Correlations with accident rate were insignificant, as were correlations between weight and pulse.

Table 3: Statistically significant correlations of key variables with health indicators.

	Correlation (*p*-value)	
	Weight	**Pulse**
Stress level	***-0.121(.006)****	*0.107(.015)+*
Hypertension	***0.206(.000)****	***0.265(.000)****

+ Significant at the 0.05 level (2-tailed) ****Significant at the 0.01 level (2-tailed)***.

Key variable and health indicator correlations with demographic, working condition, and lifestyle factors

Table 4 shows correlations between key variables and health indicators with demographic factors, working conditions, and lifestyle habits. Variables with no statistically significant correlations (such as accident rate, exercise, and sleep) are not shown. Stress showed statistically significant positive correlations with three lifestyle factors: alcohol, tobacco, and fatty food intake. Hypertension increased significantly with age and alcohol intake. As far as health indicators, pulse was positively related to the lifestyle factors of tobacco and alcohol, while weight related to demographic factors (age, married, and religion) as well as working conditions (ownership and distance).

Table 4: Statistically significant correlations between stress and health indicators and demographic factors, lifestyle habits, and working conditions

	Correlation coefficient (*p*-value)								
	Age	**Educ.**	**Marry**	**Relig.**	**Alcohol**	**Tobac.**	**Fatty**	**Owner**	**Dist.**
Stress	0.004 (.927)	-0.001 (.979)	-0.06 (.188)	0.01 (.817)	***0.117**** ***(.009)***	***0.14**** ***(.002)***	***0.121**** ***(.006)***	-0.04 (.368)	-0.039 (.384)
Hyper-tension	***0.235**** ***(.000)***	*-0.089+ (.045)*	0.068 (.136)	-0.015 (.730)	***0.127**** ***(.004)***	0.071 (.110)	-0.052 (.240)	0.006 (.889)	-0.02 (.647)
Pulse	0.049 (.268)	-0.021 (.268)	-0.01 (.833)	0.051 (.253)	***0.172**** ***(.000)***	***0.204**** ***(.000)***	0.033 (.457)	0.005 (.913)	0.009 (.835)
Weight	***0.278**** ***(.000)***	0.063 (.160)	***0.197**** ***(.000)***	***-0.125**** ***(.005)***	0.032 (.475)	*-0.103+ (.021)*	-0.01 (.816)	***0.158**** ***(.000)***	***-0.177**** ***(.000)***

+ Significant at the 0.05 level (2-tailed) ****Significant at the 0.01 level (2-tailed)***.

Demographic, lifestyle, and working condition factor cross-correlations

Table 5 shows correlations between demographic, lifestyle and working condition factors. In order to reduce the size of the table, only rows and columns with significant correlations are displayed. The table shows that age is strongly correlated with several lifestyle factors, including education, alcohol and tobacco consumption, and exercise. Tobacco and alcohol use are significantly correlated.

Table 5: Statistically significant correlations between demographic factors, lifestyle habits, and working conditions.

Correlation coefficient (*p*-value)									
	Educ.	**Marry**	**Alc.**	**Tobac.**	**Exerc.**	**Fatty**	**Owner**	**Dist.**	**Relig.**
Age (4 categories)	***-0.237**** ***(.000)***	***0.366**** ***(.000)***	***-0.122**** ***(.006)***	***-0.124**** ***(.005)***	***-0.137**** ***(.002)***	*-0.088+ (.050)*	***0.14**** ***(.002)***	***-0.198**** ***(.000)***	0 (.996)
Education (4 levels)	1	-0.077 (.095)	-0.038 (.399)	***-0.132**** ***(.005)***	***0.122**** ***(.006)***	0.075 (.095)	0.029 (.524)	*0.109+ (.015)*	***-0.122**** ***(.007)***
Married 0=no, 1=yes	-0.077 (.095)	1	-0.078 (.089)	***-0.166**** ***(.000)***	-0.029 (.522)	-0.044 (.337)	***0.128**** ***(.005)***	***-0.221**** ***(.000)***	-0.009 (.841)
Alcohol 1-5,5=most	-0.038 (.399)	-0.078 (.089)	1	***0.29**** ***(.000)***	0.075 (.091)	***0.152**** ***(.001)***	-0.069 (.121)	0.014 (.759)	***-0.29**** ***(.000)***
Tobacco 0=no, 1=yes	***-0.132**** ***(.005)***	***-0.166**** ***(.000)***	***0.29**** ***(.000)***	1	0.068 (.126)	-0.013 (.766)	***-0.117**** ***(.009)***	0.034 (.447)	*0.098+ (.030)*
Sleep 1-4,4=most	0.028 (.526)	0.069 (.128)	-0.045 (.308)	-0.052 (.240)	***-0.151**** ***(.001)***	-0.038 (.397)	-0.06 (.177)	0.019 (.672)	-0.055 (.223)

+ Significant at the 0.05 level (2-tailed) ****Significant at the 0.01 level (2-tailed)***.

Multivariate analysis

Based on the correlations reported in the previous section, no statistically significant causative factors for stress or accident rate were identified (tobacco, alcohol and fatty food consumption were viewed as consequences rather than causes of stress, as explained in the analysis plan in the Methodology section above). Accordingly, only hypertension was subjected to multivariate analysis. A stepwise logistic regression was performed using R statistics software. Model selection was determined using the Akaike information criterion (AIC). Table 6 summarizes the logistic model for non-hypertension versus hypertension produced by the stepwise regression procedure. Predictor variables for hypertension were pulse, age, alcohol use, and (possibly) weight.

Table 6: Best logistic regression model (minimum AIC) for non-hypertension versus hypertension as a function of health indicators, lifestyle factors, and working conditions.

Dependent variable (model significance versus null)	Factor	Model coefficient	Significance
Non-hypertension versus hypertension **(2.3e-11*)**	(Intercept)	-8.04	***5.2e-11****
	Pulse	0.045	***2.6e-5****
	Age (by decade)	0.53	***1.7e-4****
	Alcohol (0-4, 0=least)	0.23	***6.2e-3****
	Weight (kg)	0.02	*0.02+*

+ Significant at the 0.05 level (1-tailed) ****Significant at the 0.01 level (2-tailed)***.

Relative risks

Table 5 identified tobacco use and elevated alcohol and fatty food consumption as significant correlates of stress. Table 7 shows relative risks of high alcohol use (4 or more times per week) and/or tobacco use as a function of stress. Frequencies of high alcohol or fatty food use or tobacco use were 10 percentage points higher for CMVDs who self-reported moderate to high stress. The risk of elevated alcohol plus tobacco use was double for higher-stress CMVDs compared to lower-stress CMVDs.

Table 7: Relative risks for alcohol, fatty food, and tobacco use for no or low-stress respondents compared to moderate or high-stress respondents.

	Frequency (percent)			
Lifestyle characteristic	**Lower-stress incidence**	**Higher-stress incidence**	**Calculated Relative risk**	**95% confidence interval**
High alcohol use	69 (19%)	42 (30%)	1.61	[1.15,2.24]
High fatty food use	215(59%)	97 (69%)	1.18	[1.02,1.35]
Tobacco use	70 (19%)	41 (30%)	1.56	[1.12,2.18]
Tobacco+high alc.	21 (6%)	22 (16%)	2.05	[1.59,4.93]

Table 3 and Table 4 identified pulse, weight, age, and elevated alcohol consumption as positively correlated with hypertension. Table 8 shows the relative risk of hypertension due to these identified factors. Elevated pulse rate and age were the strongest indicators of increased hypertension risk: CMVDs with pulse over 87 or age 40 and over were found to have more than double the risk of hypertension compared to CMVDs with pulse below 73 or age under 40, respectively. Since alcohol use and weight are both correlated with age, we computed relative risks for low versus high alcohol use and for low versus high weight separately for drivers under 40 and drivers 40 and over. Results show no significant association between alcohol use and hypertension for under-40 drivers, but increased risk for hypertension associated with high alcohol use for drivers 40 and over. On the other hand, higher weight showed a greater impact on hypertension risk for drivers below 40 than those 40 and over.

Table 8: Relative risks for hypertension, for different health, demographic, and lifestyle factors.

	Hypertension frequency (percent)	**Calculated relative risk**	**95% confidence interval**
Pulse range			
Below 73	29 (22%)	1	--
73-79	31 (27%)	1.21	[0.79,1.89]
80-87	51 (39%)	1.75	[1.19,2.57]
88 and above	75 (57%)	2.57	[1.80,3.65]
Age range			
Under 30	13 (21%)	1	--
30-39	50 (27%)	1.26	[0.74,2.16]
40-49	76 (44%)	2.07	[1.24,3.45]
50 and above	48 (54%)	2.53	[1.51,4.25]
Alcohol use (age under 40)			
Low usage (< 4x/week)	45 (25%)	1	--
High usage (> 3x/week)	18 (27%)	1.10	[0.69,1.75]
Alcohol use (age 40 and over)			
Low usage (< 4x/week)	92 (43%)	1	--
High usage (> 3x/week)	30 (67%)	1.54	[1.19,2.00]
Weight (age under 40)			
Quartiles 1-3 (< 82 kg)	40 (21%)	1	--
Quartile 4 (> 81 kg)	23 (37%)	1.72	[1.12,2.62]
Weight (age 40 and over)			
Quartiles 1-3(< 89 kg)	89 (45%)	1	--
Quartile 4 (> 88 kg)	35 (56%)	1.26	[0.96,1.64]

Hypertension testing

Questionnaire results showed that most CMVDs have been tested for hypertension: 75 percent of drivers under 40 (184/245) and 90 percent of drivers 40 and over (234/260) had been previously tested. However, this testing was ineffective in curbing hypertension. Out of 158 hypertensive drivers who were previously tested, only 47 (30%) were receiving treatment as a result. More than half of hypertensive drivers (85/158, or 54%) who had been previously tested were not identified as hypertensive by their previous test; while 65% (68 out of 104) of drivers who had tested positive were receiving treatment.

Table 9: Hypertension test results for previously tested drivers, grouped by drivers' hypertensive status as determined by the current study.

	Frequency (percent)			
Current study finding	**Total previously tested**	**Previous test negative**	**Prev. test positive + no treatment**	**Prev. test positive + treatment**
Not hyper-tensive	250 (61%)	219 (54%)	10 (2%)	21 (5%)
Hypertensive	158 (39%)	85 (21%)	26 (6%)	47 (12%)
Total	408 (100%)	304 (74%)	36 (9%)	68(17%)

DISCUSSION

Findings Related to Stress

Contrary to expectations, this study found no association between stress and hypertension. On the other hand, our finding that stress is significantly linked to increased alcohol consumption and tobacco use are consistent with previous studies that suggest stress may lead to poor health behaviors such as alcohol use and/or dependence[3,18,27,28] and tobacco use.[29] Stress-induced indulgence in fatty food was only weakly confirmed.[30]

These results suggest that stress mitigation could reduce health-harming habits among CMVDs to some degree. Some studies have reported success in reducing stress in CMVDs through stress-reduction programs or changes in working conditions.[31,32] The potential benefits of such interventions for CMVDs in Abuja may be limited, since only 28% of drivers reported mid- to high-level stress.

The observed (and unanticipated) negative correlation between weight and stress among CMVDs is consistent with some previous findings.[33] It is possible that drivers under low stress are less physically active, which leads to weight gain: more research would be required to determine whether this is in fact the case.

Findings Related to Hypertension and Health Habits

Estimates of hypertension prevalence in Nigeria vary widely, depending on population and cutoff values used (some studies use a systolic of 160 and diastolic of 95 as cutoff values). An estimate of 22.5% was obtained by pooling several studies from 2000-2011.[34] The observed overall hypertension prevalence among Abuja CMVDs was 39%, higher than the 35% figure obtained in a recent comparable study of CMVDs in Sokoto State, Nigeria.[12] Drivers in Abuja were younger (50% under 40 vs. 22%) which should lessen hypertension risk, but

alcohol consumption was higher (48% vs. 6%), It should also be noted that Abuja is more varied in ethnic composition and more urbanized than Sokoto.

Our results raise some concerns about the health impacts of alcohol and tobacco use among this population of CMVDs. Compared with percentages reported for the Nigerian male general population, recent alcohol use among CMVDs was much higher (52% vs. 33%), as was recent tobacco use (22% vs. 6%)[35]. On the other hand, the alcohol usage rate was somewhat lower than that those reported in recent studies for CMVDs in Ife-Ife and Calabar (52% vs. 67% and 84%, respectively). [27,18,] The difference may be largely due to differences in religion (since Muslims are far less likely to drink than non-Muslims).

The observation that younger CMVDs are heavier users of tobacco and alcohol than older CMVDs is consistent with other studies of Nigerian young adults.[28,36,37] This may be due to changing attitudes towards alcohol consumption. [36,37] If so, this could mean further increases in hypertension in the future, because our findings indicate that alcohol only appears as a significant risk factor for older drivers.

Under-40 drivers in the top weight quartile had higher hypertension risk than other under-40 drivers: this suggests that younger drivers should be educated on the adverse health effects of poor weight control.
Our study confirmed the well-known correlation between hypertension, as well as the correlation between hypertension and pulse rate.[38,39] CMVDs with pulse rate of 88 and above and/or age over 40 had a greater than 50% chance of hypertension.

Testing for hypertension, though common, is not efficient in identifying hypertension. This may be due to infrequent or inaccurate testing. More than one third of previously-identified hypertensives were not being treated. Informal discussions with CMVDs during the data-taking process indicate that many of them employ herbal products as alternatives to orthodox medicine. This may be due to habit, traditional beliefs, cultural practices, or lack of education. More research is needed in the area with regard to the unique culture and community of CMVDs in Nigeria and the implications of this knowledge on individual and societal health.

Findings Related to Driver Safety

No significant correlations were observed between accident rate and any other measured factors. Thus, our findings do not support the use of stress and health interventions as an effective solution to the road safety problem. At least, such interventions should be accompanied by other measures.

Conclusion

Comparatively high rates of hypertension were found among this population of CMVDs, confirming previous studies on other populations of CMVDs. Alcohol use is higher than the general population; and elevated rates of alcohol consumption, which in older drivers was found to be associated with hypertension, were partially attributable to stress, implying that stress management interventions may produce some health improvements. Younger CMVDs had a greater tendency towards unhealthy behaviors such as smoking and drinking, indicating that adverse health conditions related to these behaviors may be expected to increase if current trends continue. Improvements in

hypertension testing practices (e.g. more frequent and more reliable testing) could lead to considerably higher treatment rates, as could education of hypertensive drivers on the benefits of treatment. No evidence was found that stress and health interventions could be effective in reducing accident rates.

It is worth mentioning some limitations of the current study. An established self-report measure of stress such as the Perceived Stress Scale (PSS)[40] was not used. The economic condition and family situation of drivers, which are common sources of stress, were not recorded. The questions about working conditions did not address working hours. No reliable height measurements were taken, so that BMI could not be estimated. The fact that no correlates to driver safety were found may have been due in part to the inadequacy of accident history as an indicator of safety. These deficiencies may be amended in future studies.

Conflict of Interests: The authors declare no potential conflict of interest

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REFERENCES

1. Miller LH, Smith AD, Rothstein L. The stress solution: An action plan to manage the stress in your life. New York: Pocket Books, 1994 Mar 1.
2. Block JP, He Y, Zaslavsky AM, Ding L, Ayanian JZ. Psychosocial stress and change in weight among US adults. American Journal of Epidemiology. 2009 May 22;170(2):181-92.
3. University of Maryland Medical Center. Stress [Internet]. Baltimore: University of Maryland Medical Center, 2013 Jan 30 [cited 2017 Sep 28]. Available from: http://umm.edu/health/medical/reports/articles/stress.
4. The American Institute of Stress. What is stress? [Internet]. Fort Worth: American Institute of Stress, 2017 [cited 2017 Sep 28]. Available from: http://www.stress.org/what-is-stress/
5. Bergland, C. Cortisol: Why "The Stress Hormone" is Public Enemy No. 1 [Internet]. Psychology Today; 2013 Jan 22 [cited 28 Sep 2017]. Available from: https://www.psychologytoday.com/blog/the-athletes-way/201301/cortisol-why-the-stress-hormone-is-public-enemy-no-1.
6. National Institute of General Medical Sciences. Circadian rhythms fact sheet [Internet]. National Institutes of Health, 2017 Aug [cited 28 Sep 2017] Available from: https://www.nigms.nih.gov/Education/Pages/Factsheet_CircadianRhythms.aspx
7. Rydstedt LW, Cropley M, Devereux JJ, Michalianou G. The effects of gender, long-term need for recovery and trait inhibition-rumination on morning and evening saliva cortisol secretion. Anxiety, Stress, & Coping. 2009 Jul 1;22(4):465-74.
8. Cox TL, Krukowski R, Love SJ, Eddings K, DiCarlo M, Chang JY, Prewitt TE, West DS. Stress management–augmented

behavioral weight loss intervention for African American women: a pilot, randomized controlled trial. Health Education & Behavior. 2013 Feb;40(1):78-87.

9. Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion. Adult obesity causes & consequences [Internet]. Atlanta: Center for Disease Control; 2017 Aug 29 [cited 28 Sep 2017]. Available from: http://www.cdc.gov/obesity/adult/causes.html.
10. Sandmaier, M. Your Guide to a Healthy Heart [Internet]. National Institutes of Health; 2005 Dec [cited 2017 Sep 28]. Available from: naldc.nal.usda.gov/download/1759370/PDF.
11. World Heart Federation. Hypertension [Internet]. Geneva: World Heart Federation, May 29 [cited 2017 Sep 28]. Available from: http://www.world-heart-federation.org/cardiovascular-health/cardiovascular-disease-risk-factors/hypertension/.
12. 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.
13. Siu SC, Wong KW, Lee KF, Lo YY, Wong CK, Chan AK, Fong DY, Lam CL. Prevalence of undiagnosed diabetes mellitus and cardiovascular risk factors in Hong Kong professional drivers. Diabetes research and clinical practice 2012; 96(1):60-7.
14. Federal Road Safety Corps. 2013 annual report [Internet]. Nigeria: Federal Road Safety Corps, 2013. [cited 28 Sep 2017]. Available from: http://frsc.gov.ng/2013%20FRSC%20Annual%20Report.pdf
15. Oladehinde MK, Adeoye AO, Adegbehingbe BO, Onakoya AO. Visual functions of commercial drivers in relation to road accidents in Nigeria. Indian journal of occupational and environmental medicine 2007;11(2):71.
16. Isawumi MA, Adeoti CO, Ubah JN, Oluwatimilehin IO, Raji RA. Ocular status of commercial drivers in Osun State, Nigeria. African Journal of Medicine and Medical Sciences 2011;40(4):405-11.
17. Aworemi JR, Abdul-Azeez IA, Oyedokun AJ, Adewoye JO. Efficacy of drivers' fatigue on road accident in selected southwestern states of Nigeria. International Business Research 2010;3(3):225-232.
18. Bello S, Fatiregun A, Ndifon WO, Oyo-Ita A, Ikpeme B. Social determinants of alcohol use among drivers in Calabar. Nigerian Medical Journal: Journal of the Nigeria Medical Association 2011;52(4):244.
19. Orris P, Hartman DE, Strauss P, Anderson RJ, Collins J, Knopp C, Xu Y, Melius J. Stress among package truck drivers. American journal of industrial medicine. 1997 Feb 1;31(2):202-10. Blumenthal R, Braunstein J, Connolly H, Epstein A, Gersh BJ, Wittels EH.
20. Immigration and Refugee Board of Canada: Nigeria: Federal driver's licence authority; requirements and procedures to obtain and renew a federal driver's licence in the old and new licence systems; differences in

obtaining and renewing a driver's licence between 2007 and January 2012; appearance of the driver's licence; Lagos state procedures to obtain a driver's licence (2007-January 2012) [NGA103954.E] [Internet] 02 March 2012 [cited 28 Sep 2017]. Available from: http://www.ecoi.net/local_link/233216/341900_en.html

21. Thiese MS, Moffitt G, Hanowski RJ, Kales SN, Porter RJ, Hegmann KT. Commercial driver medical examinations: prevalence of obesity, comorbidities, and certification outcomes. Journal of Occupational and Environmental Medicine 2015;57(6):659.
22. Csapo M. Universal primary education in Nigeria: Its problems and implications. African Studies Review 1983;26(1):91-106.
23. UNICEF. Evaluation report 1999 Nigeria: Baseline Survey of Qur'anic Schools in Katsina, Kebbi, Sokoto and Zamfara States [Internet]. UNICEF: 1999 [cited 2017 April 8]. Available from https://unicef.org/evaldatabase/index_14164.html
24. Antoninis M. Tackling the largest global education challenge? Secular and religious education in northern Nigeria. World Development 2014; 59:82-92.
25. Otu SE, Elechi OO. Pathways and trajectories to life-course persistent armed robbery offending behavior in contemporary Nigeria: Examining the predictors and the risks factors. International Journal of Criminal Justice Sciences 2015;10(1):10.
26. National Institute of Health Office of Extramural Research. Protecting Human Research Participants [Internet]. National Institutes of Health [cited 28 Sep 2017] Available from https://phrp.nihtraining.com/users/login.php.
27. Abiona TC, Aloba OO, Fatoye FO. Pattern of alcohol consumption among commercial road transport workers in a semi-urban community in south western Nigeria. East African medical journal 2006; 83(9).
28. Dumbili EW. Patterns and determinants of alcohol use among Nigerian university students: an overview of recent developments. African Journal of Drug and Alcohol Studies 2013;12(1).
29. Lawless MH, Harrison KA, Grandits GA, Eberly LE, Allen SS. Perceived stress and smoking-related behaviors and symptomatology in male and female smokers. Addictive Behaviors 2015; 51:80-3.
30. Roberts CJ, Campbell IC, Troop N. Increases in weight during chronic stress are partially associated with a switch in food choice towards increased carbohydrate and saturated fat intake. European Eating Disorders Review 2014; 22(1):77-82.
31. Aust B, Peter R, Siegrist J. Stress management in bus drivers: A pilot study based on the model of effort–reward imbalance. International Journal of Stress Management 1997; 4(4):297-305.
32. Kompier MA, Di Martino V. Review of bus drivers' occupational stress and stress prevention. Stress and Health 1995;11(1):253-62.

33. Emdad R, Belkic K, Theorell T, Cizinsky S. What prevents professional drivers from following physicians' cardiologic advice? Psychotherapy and psychosomatics 1998;67(4-5):226-40.
34. Ogah OS, Okpechi I, Chukwuonye II, Akinyemi JO, Onwubere BJ, Falase AO, Stewart S, Sliwa K. Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: A review. World Journal of Cardiology 2012;4(12):327.
35. Gureje O, Degenhardt L, Olley B, Uwakwe R, Udofia O, Wakil A, Adeyemi O, Bohnert KM, Anthony JC. A descriptive epidemiology of substance use and substance use disorders in Nigeria during the early 21st century. Drug and Alcohol Dependence 2007; 91(1):1-9.
36. Chikere EI, Mayowa MO. Prevalence and perceived health effect of alcohol use among male undergraduate students in Owerri, South-East Nigeria: a descriptive cross-sectional study. BMC Public health 2011;11(1):118.
37. Odejide OA, Ohaeri JU, Adelekan ML, Ikuesan BA. Drinking behaviour and social change among youths in Nigeria—a study of two cities. Drug and alcohol dependence. 1987; 20(3):227-33.
38. Fan LB, Blumenthal JA, Hinderliter AL, Sherwood A. The effect of job strain on nighttime blood pressure dipping among men and women with high blood pressure. Scandinavian Journal of Work, Environment & Health;39(1):112.
39. Reule S, Drawz PE. Heart rate and blood pressure: any possible implications for management of hypertension? Current hypertension reports 2012;14(6):478-84.
40. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. Journal of Health and Social Behavior 1983:385-96.