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Relationship between dietary habits and cardiovascular disease risk factors among commercial drivers in northeast Nigeria

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ABSTRACT

Background: Unhealthy dietary practices are prevalent among commercial drivers, and poor diet quality is well known to predispose individuals to cardiovascular diseases (CVDs).
Aims: This study investigated the relationship between dietary habits and cardiovascular disease risk factors among commercial drivers in northeast Nigeria.
Subjects and Methods: This descriptive cross-sectional study was conducted in northeast Nigeria, involving 924 commercial drivers selected using a multistage sampling technique. Dietary habits were assessed using a pretested structured Food Frequency Questionnaire adapted from the WHO STEPS survey. Statistical analysis was performed using SPSS software.
Results: Only 16.3% and 8.1% of participants consumed fruits and vegetables daily, with over half failing to meet the recommended daily servings. The majority (82.1%) ate meals during trips, and 56.4% consumed breakfast outside the home. Consumption of carbonated drinks and snacks was reported by 15.2% of drivers. A significant positive correlation ($p < 0.05$) was observed between the frequency of meals consumed during trips (r = 0.067) and body mass index. A significant negative correlation ($p < 0.01$) existed between eating during trips (r = -0.134) and blood pressure. Additionally, a significant positive correlation ($p < 0.05$) was found between the consumption of carbonated drinks and snacks (r = 0.183) and low-density lipoprotein (LDL), as well as between vegetable servings (r = 0.149) and triglyceride levels.
Conclusions: The low intake of fruits and vegetables and the high reliance on food consumed outside the home among commercial drivers may increase their risk of cardiovascular diseases. Targeted nutrition education is necessary to promote healthier dietary habits among this population.

Keywords: Dietary habits, association, commercial drivers, hypertension, diabetes mellitus, lipid profile, cardiovascular disease risk factors.

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1 Introduction

Cardiovascular disease (CVD) is widely recognized as the leading cause of mortality in both developed and developing countries (Gaziano *et al.*, 2010; Mittal and Singh, 2010). The majority of CVD-related deaths—over 60% globally—are attributable to behavioral risk factors (Cappuccio and Miller, 2016). Numerous studies have established strong associations between CVDs and lifestyle factors, including unhealthy dietary patterns, alcohol consumption, physical inactivity, smoking, and excessive stress (Onyemelukwe *et al.*, 2017; Oguoma *et al.*, 2018). An unhealthy diet, in particular, is a well-documented contributor to the development of CVDs (Nnate *et al.*, 2022). This trend is largely driven by globalization and industrialization, which have led to significant lifestyle changes, such as the consumption of highly refined, energy-dense foods rich in fats and sugars, alongside reduced physical activity and increased stress exposure (Go *et al.*, 2014). As urbanization progresses and incomes rise, traditional dietary habits are increasingly supplanted by the consumption of sugar-sweetened beverages, Western-style fast foods, energy drinks, and higher quantities of meat. In addition, there has been a noticeable shift from home-prepared meals to foods purchased from outside, particularly fast-food outlets. This dietary transition has been linked to the emergence of noncommunicable diseases (NCDs), including hypertension, diabetes mellitus, cancers, and other related conditions. Promoting healthy behaviors such as regular exercise and balanced dietary practices among individuals at risk for CVD has been demonstrated to significantly improve cardiovascular health and mitigate disease risk (WHO, 2016).

Unhealthy lifestyle practices, such as physical inactivity and poor dietary choices, are particularly prevalent among commercial drivers (Okorie *et al.*, 2019). These individuals often exhibit irregular eating habits, frequently consuming meals from fast-food establishments, which are typically high in lipids, calories, and sodium. Additionally, their intake of caffeinated beverages and alcohol is often excessive (Castellani *et al.*, 2022). The habitual consumption of high-calorie, low-nutrient foods contribute significantly to overweight and obesity (Mabry *et al.*, 2022). Excess caloric intake constitutes a major determinant of obesity, also exacerbates risks associated with poor diet, including lipid and glucose dysregulation, elevated blood pressure, reduced plaque stability, and systemic inflammation (Romieu *et al.*, 2017; Torres *et al.*, 2015). Furthermore, evidence indicates that increasing BMI is consistently associated with elevated rates of CVD, cancer, diabetes mellitus, osteoarthritis, and chronic kidney disease (Azadnajafabad *et al.*, 2021).

The World Health Organization's report on global targets for 2025 emphasizes the urgent need for countries to scale up the implementation of evidence-based preventive measures to reduce the prevalence of unhealthy behaviors that contributes to NCDs. Despite this recommendation, Nigeria currently lacks a comprehensive health policy, strategy, or actionable plan to address unhealthy dietary habits or promote healthier eating behaviors (WHO, 2014). Understanding the relationship between dietary habits and CVD risk factors among commercial drivers in northeast Nigeria could provide crucial insights for developing targeted interventions and policies. Such information would also serve as a foundation for strategies aimed at preventing CVD and promoting overall health within this occupational group. Although several studies have examined the relationship between dietary habits and CVD risk factors among commercial drivers in other regions of Nigeria, there is a significant lack of data specific to northeast Nigeria. This gap underscores the need for focused research to better understand the unique dietary behaviors and associated health risks in this population. Therefore, this study aims at assessing the relationship between dietary habits and CVDs risk factors among commercial drivers in northeast Nigeria, contributing to evidence-based initiatives for improved health outcomes in this region.

2 Subjects and Methods

2.1 Study settings

The study was conducted in northeast Nigeria. Northeast Nigeria was one of the economically promising regions of the country from the 1960s to the late 1970s. Prior to the discovery of crude oil in Nigeria, the region's cash crops significantly contributed to the economic viability. Among these crops were groundnuts (peanuts), cotton, and coffee, which engaged millions of small-scale farmers in productive agriculture, providing decent income across several states. For decades, the region's abundant natural resources – including agricultural produce and fisheries – supported investment and industrial growth. During this period, the northeast experienced relative prosperity, religious, cultural, and ethnic harmony, as well as peace. However, over time, these fortunes declined, giving rise to challenges such as environmental degradation, idleness, and radicalization through violent extremism.

2.2 Study design

A descriptive cross-sectional design was employed for this study.

2.3 Study population

The study population consisted of commercial drivers aged 18 years and above.

2.4 Sampling and sampling technique

The sample size was determined based on the 76% prevalence of CVD risk factors among commercial drivers, as reported by Showande & Odukoya (2020). Using Cochran's formula, the calculated sample size was 280. An additional 10% was added to account for attrition and potentials dropout, yielding a final sample size of 308 commercial drivers per state. This resulted in a total of 924 respondents across three states in northeast Nigeria. A multistage sampling technique was applied to select the participants. Initially, simple random sampling was utilized to select major motor parks in the three states. Subsequently, respondents were randomly selected from each motor park, ensuring a representative sample of commercial drivers in the region.

2.5 Inclusion criteria

The study included commercial truck drivers, bus drivers, and taxi drivers aged 18 years and above who were registered at the motor parks where the study was conducted.

2.6 Exclusion criteria

The study excluded all non-commercial drivers, unregistered and unwilling commercial drivers as well as commercial drivers below the age of 18 years.

Ethical Approval

Before embarking on this study, Ethical approval was obtained from the Ministry of Health in the three states where the study was conducted (ADHREC 16/10/2023/086, MOH/ADM/621/V.1/488, and TRSHREC/2023/030) and permission was obtained from the management of the respective motor parks before the commencement of Data collection.

Consent

All authors declare that "written informed consent" was obtained from the respondents by asking them to sign after introducing and explaining the study and its objectives before data collection. Respondents whose consent cannot be ascertained were excluded from the study.

2.7 Data collection

Dietary assessment was measured by pretested and structured Food Frequency Questionnaire (FFQ) adapted from the World Health Organization (WHO) STEPS WHO survey for chronic diseases (WHO, 2005). The questionnaire was designed following the WHO protocol for chronic diseases surveillance.

Anthropometric measurements included height and body weight, which were measured using a constructed wooden meter rule and a bathroom scale respectively, and subsequently used to calculate body mass index (BMI). Waist and hip circumferences were measured with a non-stretchable measuring tape, and these measurements were used to calculate the waist-to-hip ratio (WHR).

Blood pressure was measured using an Omron digital blood pressure monitor. Fasting blood glucose (FBG) levels and fasting lipid profiles were determined using the fingertip prick method with an Accu-Chek Active glucometer, lipid pro kits, and test strips following an overnight fast. Low-density lipoprotein cholesterol (LDL) was calculated using the modified Friedewald equation (NCEP, 2002).

2.8 Data analysis

Data collected were sorted, cleaned, and coded using SPSS software version 21.0 (SPSS, Inc., Chicago, IL, USA). Low fruits and vegetables consumption was defined as consuming fewer than five serving/portions per day during a typical week.

2.9 Statistical analysis

Statistical analysis was performed using SPSS software, version 21.0. Both descriptive and inferential analysis were performed. Dietary habits were summarized as percentages and frequencies. The relationship between dietary habits and CVD risk factors was evaluated using Pearson's product-moment correlation coefficient (r). A p-value of less than 0.05 was considered statistically significant.

3 Results

3.1 Dietary Habits of the Drivers

Table 1 highlights the low consumption of fruit and vegetables among the commercial drivers. Only 16.3% and 8.1% consumed fruits and vegetables daily, respectively. Over half of the drivers did not meet the recommended daily servings,

Table 1. Dietary habits of commercial drivers

Variables	Frequency	Percentage (%)
Weekly fruit consumption		
2 days	213	23.1
3 days	218	23.6
4 days	144	15.6
5 days	89	9.6
6 days	33	3.6
Everyday	151	16.3
Once	76	8.2
Total	**924**	**100.0**
How many servings of fruit do you consume on one of those days?		
< 5 serving/portions of fruit daily	615	66.6
5 serving/portions of fruit daily	247	26.7
> 5 serving/portions of fruit daily	62	6.7
Total	**924**	**100.0**
Weekly vegetable consumption		
2 days	305	33.0
3 days	251	27.2
4 days	119	12.9
5 days	33	3.6
6 days	29	3.1
Everyday	75	8.1
Once	112	12.1
Total	**924**	**100.0**
How many servings of vegetable do you eat on one of those days?		
< 5 serving/portions of vegetable daily	680	73.6
5 serving/portions of vegetable daily	176	19.0
> 5 serving/portions of vegetable daily	68	7.4
Total	**924**	**100.0**
Type of fat and oil mainly consumed		
Vegetable oil	430	46.5
Palm oil	434	47.0
Butter	49	5.3
Margarine	11	1.2
Total	**924**	**100.0**
Meals not prepared at home		
Breakfast	521	56.4
Lunch	351	38.0
Dinner	52	5.6
Total	**924**	**100.0**
Do you eat on your trips?		
Yes	759	82.1
No	165	17.9
Total	**924**	**100.0**
Number of meals consumed daily when on trips		
1-2 meals	408	53.8
3-4 meals	330	43.5
More than 4 meals	21	2.8
Total	**759**	**100.0**
Consumption of carbonated drinks and snacks		
Never	203	22.0
Rarely	137	14.8
Sometimes	444	48.1
Every day	140	15.2
Total	**924**	**100.0**

with 66.6% and 73.6% consuming fewer than five servings of fruits and vegetables per day, respectively. The primary types of oils and fats consumed were palm oil (47.0%) and butter (5.3%). Most drivers (82.1%) reported eating during trips, with 53.8% consuming 1 – 2 meals on their journeys, and over half (56.4%) eating breakfast outside their homes. A smaller proportion (15.2%) consumed carbonated drinks and snacks daily, while 22.0% did not consume these items at all. The most frequently consumed snacks were biscuits (39.3%) and bread (14.8%).

3.2 Correlation between dietary habits and BMI

Table 2 outlines the correlation between dietary habits and BMI among the drivers. A significant positive correlation was observed between the frequency of meals consumed on trips (r = 0.067; $p < 0.05$) and BMI. Conversely, a negative correlation was identified between BMI and servings of vegetables consumed (r = -0.026; $p < 0.05$), as well as the consumption of fat and oil (r = -0.007; $p < 0.05$).

Table 2. Correlation between dietary habits and Body Mass Index of commercial drivers

	SFC	SFVC	CFO	CCDS	ET	FMCT	BMI
SFC	1	.144**	-.120**	-.023	.068*	.003	.028
		.000	.000	.476	.038	.926	.397
SFVC		1	.009	-.023	-.115**	-.139**	-.026
			.787	.483	.000	.000	.426
CFO			1	.124**	-.188**	-.130**	-.007
				.000	.000	.000	.843
CCDS				1	-.347**	-.263**	.056
					.000	.000	.088
ET					1	.887**	.041
						.000	.210
FMCT						1	.067*
							.042
BMI							1

Note. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). SFC= Servings of fruit consumed, SFVC= Servings of vegetable consumed, CFO = Consumption of fat and oil, CCDS = Consumption of carbonated drinks and snacks, ET = Eating on trips, FMCT = Frequency of meals consumed on trips, BMI= Body Mass Index.

3.3 Correlation between dietary habits and WHR

The correlation between dietary habits and WHR is presented in Table 3. A significant positive correlation was observed between WHR and servings of fruits consumed (r = 0.207; $p < 0.05$), eating on trips (r = 0.303; $p < 0.05$), and the frequency of meals consumed on trips (r = 0.158; $p < 0.05$). Additionally, servings of vegetables consumed were positively correlated with WHR (r = 0.073; $p < 0.05$). In contrast, significant negative correlations were noted between WHR and the consumption of fat and oils (r = -0.205; $p < 0.05$), as well as the consumption of carbonated drinks and snacks (r = -0.336; $p < 0.05$).

Table 3. Correlation between dietary habits and WHR of commercial drivers

	SFC	SFVC	CFO	CCDS	ET	FMCT	WHR
SFC	1	.144**	-.120**	-.023	.068*	.003	.207**
		.000	.000	.476	.038	.926	.000
SFVC		1	.009	-.023	-.115**	-.139**	.073*
			.787	.483	.000	.000	.026
CFO			1	.124**	-.188**	-.130**	-.205**
				.000	.000	.000	.000
CCDS				1	-.347**	-.263**	-.336**
					.000	.000	.000
ET					1	.887**	.303**
						.000	.000
FMCT						1	.158**
							.000
WHR							1

Note. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). SFC= Servings of fruit consumed, SFVC= Servings of vegetable consumed, CFO = Consumption of fat and oil, CCDS = Consumption of carbonated drinks and snacks, ET = Eating on trips, FMCT = Frequency of meals consumed on trips, WHR= Waist-hip-ratio.

3.4 Correlation between dietary habits and BP

Table 4 summarizes the relationship between dietary habits and BP. Negative correlations were observed between BP and servings of fruits consumed (r = -0.061; $p < 0.01$), servings of vegetables consumed (r = -0.024; $p < 0.01$), and the frequency of meals consumed on trips (r = -0.056; $p < 0.01$). Additionally, a significant negative correlation was found between eating on trips (r = -0.134; $p < 0.01$) and BP.

Table 4. Correlation between dietary habits and blood pressure of commercial drivers

	SFC	SFVC	CFO	CCDS	ET	FMCT	BP
SFC	1	.144**	-.120**	-.023	.068*	.003	-.061
		.000	.000	.476	.038	.926	.066
SFVC			.009	-.023	-.115**	-.139**	-.024
			.787	.483	.000	.000	.460
CFO			1	.124**	-.188**	-.130**	.024
				.000	.000	.000	.474
CCDS				1	-.347**	-.263**	.053
					.000	.000	.107
ET					1	.887**	-.134**
						.000	.000
FMCT						1	-.056
							.091
BP							1

Note. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). SFC = Servings of fruit consumed, SFVC= Servings of vegetable consumed, CFO = Consumption of fat and oil, CCDS = Consumption of carbonated drinks and snacks, ET = Eating on trips, FMCT = Frequency of meals consumed on trips, BP = Blood pressure

3.5 Correlation between dietary habits and blood glucose (BG)

The correlation between the dietary habits and blood glucose among the drivers is summarized in Table 5. A significant negative correlation was observed between servings of vegetables consumed (r = -0.109; $p < 0.05$) and BG. Additionally, negative non-significant correlations were identified between BG levels and consumption of fats and oil (r = -0.091; $p > 0.05$), carbonated drinks and snacks (r = -0.013; $p > 0.05$), eating during trips (r = -0.015; $p > 0.05$), and the frequency of meals consumed on trips (r = -0.016; $p > 0.05$).

Table 5. Correlation between dietary habits and BG levels

	SFC	SFVC	CFO	CCDS	ET	FMCT	PG
SFC	1	.144**	-.120**	-.023	.068*	.003	.045
		.000	.000	.476	.038	.926	.404
SFVC		1	.009	-.023	-.115**	-.139**	-.109*
			.787	.483	.000	.000	.041
CFO			1	.124**	-.188**	-.130**	-.091
				.000	.000	.000	.087
CCDS				1	-.347**	-.263**	-.013
					.000	.000	.812
ET					1	.887**	-.015
						.000	.779
FMCT						1	-.016
							.765
PG							1

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). SFC= Servings of fruit consumed, SFVC= Servings of vegetable consumed, CFO = Consumption of fat and oil, CCDS = Consumption of carbonated drinks and snacks, ET = Eating on trips, FMCT = Frequency of meals consumed on trips, PG = Plasma glucose.

3.6 Correlation between dietary habits and lipid profile (LP)

The correlation between dietary habits and the LP of the drivers is presented in Table 6. A negative, non-significant correlation ($p > 0.05$) was observed between total cholesterol and most dietary habit variables. However, a significant negative correlation ($p < 0.05$) was found with servings of fruits consumed (r = -0.161).

Similarly, a negative non-significant correlation ($p > 0.01$) was noticed between high density lipoprotein (HDL) and servings of fruits consumed (r = -0.128), servings of vegetables consumed (r = -0.086), and consumption of carbonated drinks and snacks (r = -0.010). For low-density lipoprotein, a significant positive correlation ($p < 0.05$) was recorded with the consumption of carbonated drinks and snacks (r = 0.183). Conversely, negative significant correlations ($p < 0.05$) were found between LDL levels and servings of fruits consumed (r = -0.161), as well as the frequency of meals consumed during trips (r = -0.147). Additionally, a significant negative correlation ($p < 0.01$) existed between eating during trips (r = -0.202) and LDL levels. A significant positive correlation ($p < 0.05$) was also noticed between servings of vegetables consumed (r = 0.149) and triglyceride levels.

Table 6. Correlation between dietary habits and lipid profile of commercial drivers

	TC	HDL	LDL	TG	SFC	SVC	CFO	CCDS	ET	FMCT
TC	1	.321**	.485**	.092	-.161*	-.073	-.034	-.007	-.029	-.023
		.000	.000	.213	.028	.325	.646	.927	.699	.752
HDL		1	.148*	.051	-.128	-.086	.002	-.010	.101	.079
			.045	.494	.083	.242	.982	.898	.173	.283
LDL			1	.151*	-.161*	-.009	.036	.183*	-.202**	-.147*
				.040	.028	.908	.624	.013	.006	.046
TG				1	-.054	.149*	.018	.101	-.113	-.085
					.463	.042	.813	.173	.125	.251
SFC					1	.144**	-.120**	-.023	.068*	.003
						.000	.000	.476	.038	.926
SVC						1	.009	-.023	-.115**	-.139**
							.787	.483	.000	.000
CFO							1	.124**	-.188**	-.130**
								.000	.000	.000
CCDS								1	-.347**	-.263**
									.000	.000
ET									1	.887**
										.000
FMCT										1

Note. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). SFC= Servings of fruit consumed, SFVC= Servings of vegetable consumed, CFO = Consumption of fat and oil, CCDS = Consumption of carbonated drinks and snacks, ET = Eating on trips, FMCT = Frequency of meals consumed on trips, TC = Total cholesterol, HDL=High density lipoprotein, LDL=Low density lipoprotein, TG=Triglycerides.

4 Discussion

The findings of the present study revealed low consumption of fruits and vegetables among commercial drivers, with the majority not meeting the recommended daily servings. Similar trends have been reported in previous studies (Appiah *et al.*, 2020; Castellani *et al.*, 2022; López-González *et al.*, 2021). However, the proportion of drivers failing to meet the recommended intake in this study exceeds the levels reported by Mohsen and Hakim (2019). This inadequate intake may be attributed to factors such as unavailability of produce, low-income status, and a lack of nutritional education or awareness regarding the importance of fruit and vegetable consumption. Increasing the availability of sliced and packaged fruits and vegetables at motor parks and along travel routes could encourage higher consumption rates among drivers.

Low fruit and vegetable intake has significant health implications, as it may contribute to the development of obesity, diabetes mellitus, hyperlipidaemia, and hypertension—all of which are risk factors for CVDs. Fruits and vegetables are beneficial for weight management due to their low glycemic index, low fat content, and low energy density, as well as their ability to slow eating speed (Dreher and Ford, 2020). A systematic review and meta-analysis by Nishi *et al.* 2023, confirmed that adequate fruit and vegetable intake is associated with a reduced risk of CVD. The protective effect of fruits and vegetables against CVD is largely due to their rich antioxidant content, which mitigates oxidative stress and inflammation (Miller *et al.*, 2017; Wang *et al.*, 2014).

In sub-Saharan Africa, the consumption of fruits and vegetables remains particularly low (Mensah *et al.,* 2021). Adequate fruits and vegetable intake plays a critical role in preventing all forms of malnutrition—undernutrition, micronutrient deficiencies, overweight, and obesity—and in reducing the risk of NCDs (GBD, 2019). According to the Global Burden of Disease Study, low fruit intake is among the top three leading dietary risk factors for global mortality (GBD, 2019).

Palm oil emerged as the most commonly consumed type of oil among the drivers, likely due to its widespread availability and affordability. These factors make it a preferred choice for food vendors aiming to maximize profit. According to Kadandale, Marten and Smith, (2019), palm oil is one of the widely used vegetable oils globally. Butter was also a primary fat source, largely consumed through snacks like biscuits and bread, in which butter serves as a key ingredient or spread.

While palm oil is affordable and accessible, it contains a high proportion of saturated fats compared to other vegetable oils (Kadandale *et al.*, 2019; Sun *et al.*, 2015). Studies have associated palm oil consumption to increased body weight, elevated hepatic triglyceride levels (An *et al.*, 2022; de Wit *et al.*, 2012), higher low-density lipoprotein (LDL) cholesterol, and greater risk of ischemic heart disease and CVD (Chen *et al.*, 2011; Kadandale *et al.*, 2019; Sun *et al.*, 2015). However, Odia, Ofori and Maduka (2015) argue that when consumed as part of a balanced diet, palm oil does not necessarily increase the risk for CVD. Nonetheless, the consumption of oil and fat in some populations, as reported by Castellani *et al.* (2022), significantly exceeds recommended levels, underscoring the need for targeted interventions.

Eating during trips was a common practice among the drivers in this study, as nearly all participants reported consuming meals while on their routes. This behavior is likely due to the nature of their work, which often requires long hours, leaving them unable to return home or returning very late at night. This pattern has been observed in other studies. For instance, Ramukumba & Mathikhi (2016), reported that 81.16% of taxi drivers in their study consumed meals from taxi vendors or fast-food outlets. Similarly, Adeyanju *et al.* (2024) noted that 85% of drivers in their study ate at least one meal outside their homes daily. Eating out frequently has been associated with increased risks of overweight, obesity, diabetes mellitus, and high blood pressure. Research indicates that individuals who primarily eat at home or consume meals outside the home less frequently (fewer than six meals per week) exhibit a lower risk of CVD (An *et al.*, 2022). This could be attributed to the high calorie and low nutritional quality of foods commonly served at fast-food outlets and roadside vendors (Sendall *et al.*, 2019). Such foods are typically low in fruits and vegetables (Vardavas *et al.*, 2010; Appiah *et al.*, 2020) and high in saturated fats and salt (Fouda *et al.*, 2012).

In the current study, more than half of the drivers ate breakfast outside their homes, a finding consistent with that of Appiah *et al.* (2020), where 81% of drivers consumed breakfast outside their residences. This practice may stem from the early start and late end of their workdays. Previous research concluded that individuals who ate breakfast at home had better overall diet quality compared to those who consumed breakfast elsewhere (Grimes *et al.*, 2018).

The daily consumption of carbonated drinks and snacks among the drivers in this study was relatively low compared to findings by Adeyanju *et al.* (2024), where most drivers consumed soft drinks at least once weekly. The most commonly consumed snacks were biscuits and bread, likely due to their availability at motor parks and along the drivers' routes. Carbonated drinks are typically high in calories and saturated fat, contributing to overweight and obesity, both of which are risk factors for CVD. The moderate consumption of snacks and carbonated drinks observed in this study may be advantageous, as high intake of such items has been linked to excessive energy consumption. Research has shown that high consumption of sugar-sweetened beverages may contribute to weight gain and obesity by increasing overall calorie intake (Malik *et al.*, 2006). Furthermore, a positive association exists between sugar-sweetened beverages consumption and adiposity (Zipes *et al.*, 2019). Even consuming soft drinks as infrequently as once a week has been identified as a predictor of cardiovascular risk (Brandão *et al.*, 2022).

The observed correlation between the frequency of meals consumed during trips and obesity among the drivers in this study can be attributed to the energy-dense nature of meals consumed during trips, which are typically high in calories and, therefore, contribute to increase the risk of obesity. Elevated caloric intake is a well-established factor for the development of overweight and obesity (Passeri, 2014). Obesity is often associated with poor diet quality—characterized by high consumption of saturated fats, sugar, ultra-processed foods, and insufficient intake of fresh fruit and vegetables—as well as reduced physical activity and sedentary behaviors, all of which independently increase CVD risk (Bray *et al.*, 2017; Bann *et al.*, 2018; Patel *et al.*, 2020).

The significant correlation observed in this study between the servings of fruits and vegetables consumed, eating on trips, frequency of meals consumed during trips and WHR among drivers is consistent with the drivers' insufficient consumption of the recommended daily servings of fruits and vegetables. Additionally, their tendency to consume 1 – 2 calorie-dense meals during trips likely contributed to the high rates of abdominal obesity observed. The increased caloric density of foods has been identified as a key driver of the global rise in body weight and obesity (Rodgers *et al.*, 2018). These findings underscore the relationship between diet quality—characterized by increased consumption of fruits and vegetables and reduced intake of calorie-dense foods—and body composition (as indicated by WHR). A lower WHR generally reflects a healthier body composition and a reduced risk of certain chronic diseases.

The significant negative correlation between eating during trips and BP observed in this study contrasts with findings from prior studies. Research has typically reported a positive association between eating away from home and elevated BP in middle-aged men (Liu *et al.*, 2022; Wang *et al.*, 2019). Given that most drivers in this study consumed meals during their trips, a positive correlation between eating during trips and BP was anticipated, as foods consumed outside the home are often high in salt—a key risk factor for hypertension. Hypertension is recognized as a significant risk factor for the development of CVD (Fuchs and Whelton, 2020).

The dietary habits of the drivers demonstrated a negative correlation with BG levels. One of the dietary habits that was negatively correlated with BG levels was the consumption of carbonated drinks and snacks. This may be attributed to the low intake of these items among the drivers. Studies indicate that high consumption of sugar-sweetened beverages significantly increases the risk of elevated FBG in men (Seloka *et al.*, 2022). Deshpande *et al.* (2017), reported that sweetened beverages disrupt the hormonal mechanisms involved in energy balance regulation and the satiety center within the limbic system, potentially leading to overeating and results in an increase in positive energy balance in the body. In addition, snacks have been found to heighten hunger, thereby increasing overall food intake during meals (Ohkawara *et al.*, 2013). Sugar-sweetened beverages are also highly addictive, contributing to weight gain, especially in the abdominal region —a known risk factor for diabetes.

A nonsignificant negative correlation was observed between total cholesterol levels and most dietary habit variables, except for servings of fruit consumed, which showed a significant negative correlation. This nonsignificant negative correlation suggests that dietary habits did not have a measurable influence on changes in total cholesterol levels across the studied population. However, the inverse correlation between fruit consumption and total cholesterol indicates that increased fruit intake is associated with lower total cholesterol levels among drivers. Contrarily, a randomized controlled trial found no significant association between increased fruit consumption and healthier blood cholesterol profiles (John *et al.*, 2002; Liu *et al.*, 2021).

Given the low fruit and vegetable consumption recorded in this study, the nonsignificant negative correlation between HDL levels and servings of fruit and vegetables was unexpected. Recent research has shown that the avoidance of fresh fruits is associated with a higher likelihood of abnormal HDL levels (Sekgala *et al.*, 2023). Fruits and vegetables are rich in dietary fiber, which plays a critical role in human health by binding cholesterol and other substances rendering them insoluble and preventing their absorption (Nzeagwu *et al.*, 2022). A nonsignificant negative correlation between HDL levels and the consumption of carbonated drinks and snacks was also detected in the present study. However, Haslam *et al.* (2020), reported that both frequent (>1 serving per day) and infrequent (<1 serving per month) consumption of sugar-sweetened beverages were associated with a notable decrease in HDL cholesterol levels. Consistent with findings from previous studies, this study observed a significant positive correlation between the consumption of carbonated drinks and snacks and LDL levels. Haslam *et al.* (2020), also reported that sugar-sweetened beverage consumption is positively associated with increased LDL cholesterol levels.

A significant negative correlation was observed between the number of fruit servings consumed, the frequency of meals consumed during trips and LDL. The low fruits consumption among the drivers in this study likely accounts for this relationship. An increase in fruits consumption could reduce LDL levels, which may be attributed to the polyphenols present in fruits, such as flavonoids, phenolic acids, and lignans. These compounds exhibit antioxidant properties and have been shown to reduce LDL levels, thus ameliorating cardiovascular complications (Behl *et al.*, 2020). The significant negative correlation between eating on trips and LDL in this study was unexpected, given that foods typically consumed during trips are high in saturated fatty acids, which are known to elevate LDL levels (Chopra, 2024).

In this study, a significant correlation was found between vegetable servings consumed and triglyceride levels. This finding may be attributed to the low vegetable intake among the drivers. Evidence from previous research indicates that plant-based diets rich in vegetables are beneficial and associated with lower triglyceride levels, which in turn reduces the risk of NCDs such as dyslipidemia and obesity (Berrougui *et al.*, 2012; Turner-McGrievy *et al.*, 2017). Furthermore, Takahashi *et al.*, 2010 reported that vegetable consumption exerts a protective effect against hypertriglyceridemia. These findings emphasize the importance of adequate vegetable intake in promoting lipid profile health and reducing the risk of associated metabolic disorders.

5 Conclusions

The findings of this study revealed commendably low consumption of carbonated drinks and snacks among the commercial drivers. However, the insufficient intake of fruits and vegetables and the frequent consumption of meals outside the home constitute areas of significant concern. These dietary patterns highlight the need for targeted interventions to improve the nutritional habits of this population.

To address these issues, it is recommended that comprehensive nutrition education programs be implemented for commercial drivers to encourage healthier dietary behaviors. Additionally, the Ministry of Health should develop policies to promote the advertisement and consumption of fruits and vegetables. Initiatives such as healthy food campaigns and improved access to fresh fruits and vegetables at motor parks and along the drivers' routes should also be prioritized. These measures are essential to fostering a healthier lifestyle and reducing the risk of diet-related health complications among commercial drivers.

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