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Research

Prevalence and predictors of near misses and road traffic crashes among long-distance bus drivers in Ghana

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Abstract

Introduction Despite the critical role of bus drivers in the Ghanaian economy, research on their safety is limited, hindering progress towards reducing road traffic crashes (RTCs) in line with Sustainable Development Goal (SDG) 3.6. This study aimed to investigate the rate of RTCs and near misses among long-distance bus drivers, identifying key predictors.

Method This cross-sectionl survey sampled 7,315 long-distance bus drivers operating from Accra and Tema to other parts of Ghana and sub-region. Descriptive and binary logistic regression analyses were condcuted using Jamovi software version 2.5.3.

Results The study found that 53.7% and 96.9% of bus drivers had at least one RTC and one near-miss two years prior to data collection respectively. Older age, higher education, and extensive driving experience (≥ 21 years) reduced RTC risk, while factors like 6–20 years of experience, individual bus ownership, irregular shifts, long driving hours, sleepiness, job security, low decision authority, and skill discretion increased RTC risk. Near-misses were more likely with public bus ownership, not driving alone, low decision authority, skill discretion, and supervisor support, while high work-family conflict reduced near-miss likelihood.

Conclusion Concerted efforts are needed to implement targeted interventions aimed at regulating working hours, enhancing job security and integrating occupationl health and safety standards in the Ghanaian bus transport industry. By prioritizing evidence-based policies and practices, stakeholders can work towards creating safer roads and healthier work environments for bus drivers.

Keywords Road traffic crash · Near misses · Bus drivers · Road safety · Ghana

1 Introduction

Road traffic crashes (RTCs) refer to incidents involving at least one moving vehicle on a public road that results in injury, death, or property damage [1]. Near misses, in road transport, are incidents where a potential collision is narrowly avoided [2]. The World Health Organisation (WHO) states that RTCs cause over 1.19 million deaths annually and about 50 million non-fatal injuries, often leading to permanent disability, and cost nations around 3% of their GDP [3]. In countries like Ghana, the impact is exacerbated by inadequate road safety infrastructure, enforcement, emergency response, and post-crash care [3, 4].

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Road transport is crucial for Ghana's economy and social interactions, but road safety remains a major issue [5]. The National Road Safety Authority (NRSA) reports that near misses are common, with over 2,000 fatalities and numerous injuries from RTCs each year, significantly affecting productivity and development [6]. In 2023, 2,276 individuals were killed in 14,135 road crashes, with 15,409 people injured and 2,559 pedestrians knocked down. Compared to 2022, fatalities, injuries, and crashes slightly decreased [6].

In Ghana, long-distance drivers are defined as those who commute at least 140 km or spend a minimum of three hours on a single trip [7]. Long-distance bus drivers are responsible for a significant portion of RTCs (25%) and fatalities (36%) in Ghana [8]. Buses account for 53% of RTCs on the Kumasi-Accra highway [9]. These drivers face high crash risks due to long hours, irregular shifts, lone driving, limited rest periods, and pressure to meet tight schedules [10, 11], leading to fatigue and impaired judgment [12]. Despite their critical role, research on drivers' working conditions, particularly on psychosocial work factors such as job demands, job resources, psychosocial safety climate, and work-family conflict, is limited in the Ghanaian context, hindering progress towards reducing RTCs in line with Sustainable Development Goal (SDG) 3.6 and creating safe and healthy workplace in line with SDG 8.5.

This study aims to investigate the rate of RTCs and near misses among long-distance bus drivers, identifying key socio-demographic and working condition predictors. Addressing these issues supports SDG 3.6 by reducing deaths and injuries from RTCs and SDG 8 by promoting safe working conditions. Highlighting these challenges can improve policies and practices, protecting drivers and passengers. Most road safety initiatives in Ghana focus on correcting risky driving behaviors, often ignoring the working conditions of professional drivers [13]. Improving drivers' working conditions may help create a safe, healthy, and decent work environment as advocated by SDG 8 target 5. Near-misses serve as critical indicators of potential hazards and risky driving behavior that could lead to accidents if not addressed. By analyzing near-misses, authors can identify areas for intervention and preventive measures to enhance overall road safety, even before actual crashes occur.

1.1 Theoretical model

The Job Demands-Resources (JD-R) Model [14]offers a framework for understanding the factors influencing RTCs and near misses among long-distance bus drivers in Ghana. The JD-R model posits that when job demands exceed job resources, workers are at risk of experiencing poor health and reduced performance outcomes [15, 16]. Thus, when job demands, such as long driving hours, lone driving, and irregular shifts, increase stress and fatigue, elevating the risk of safety incidents. Conversely, job resources, like adequate rest periods, ongoing training, and a supportive work environment, can mitigate these risks by enhancing drivers' capacity to cope with job demands. The JD-R model is highly applicable to this study as it provides a structured approach to examining how the interplay between job demands and resources affects long-distance bus drivers' safety and health outcomes. In the context of this study, the JD-R model helps to explain how the specific demands placed on drivers, such as extended driving hours, lone driving, and irregular shifts, can lead to increased stress and fatigue, thereby heightening the risk of road traffic collisions and near misses. The model also highlights the protective role of job resources, such as sufficient rest, ongoing training, and a supportive work environment, in mitigating these risks and enhancing drivers' resilience. This model has been applied in explaining working condition of occupational drivers [17–19].

1.2 Prevalence of RTCs and near misses

In ethiopia, Mekonnen et al. [20] found that 16.3% of the sampled bus drivers reported a history of RTCs in the 12 months prior to the study. A similar prevalence of RTCs (15%) has been reported 36 months prior to data collection among Iranian inter-city bus drivers (254) [21]. In Cameroon, Kunsoan et al. [22] reported a relatively higher prevalence of 53% for a 24 months duration prior to data collection among 201 bus drivers. In Ghana, a prevalence of 55.5% has been reported among commercial drivers in the Kintampo Municipality [23]. The reviewed studies suggest that bus drivers are highly prone to RTCs. On near-misses, Miyama et al. [24] report a prevalence of 44.5% among bus drivers in Japan. A relatively lower prevalence of 36.6% of near-mises have been reported among bus drivers in London [25]. Evidence or data on near-mises among professional drivers are rare in Africa, expecially in Ghana.

1.3 Socio-demographic predictors of road safety incidents

Age, education, and experience significantly predict RTCs among drivers [26–28]. Younger drivers face higher RTC risks due to limited experience and risk-taking found significantly higher crash rates among drivers aged 18–29 [29–31]. Higher education correlates with better safety adherence and reduced RTC risk noted this trend among educated drivers [32–34]. More years of driving experience lead to a reduction in risky behaviors and crash rates [20, 35–39]. Mekonnen et al. [20] observed 2.7 times higher RTC likelihood among less experienced drivers. Experienced drivers adeptly handle complex driving and stress, developing coping mechanisms and situational awareness, reducing RTCs [35, 36].

1.4 Working conditions and road traffic incidents

Working conditions significantly affect road traffic incidents among professional drivers [10]. Factors like emotional fatigue, poor sleep quality, and job stress strongly predict RTCs and related injuries [18, 40–43]. Job strain and effort-reward imbalance are also RTC predictors [12, 43, 44]. Lack of social support, low job control, long driving hours, intense schedules, lone driving, irregular job schedules, work-family conflicts, and job insecurity contribute further to RTC likelihood [45–48]. Given the high prevalence of RTCs and near misses among bus drivers, and the influence of socio-demographic factors, exploring these dynamics further, particularly in Ghana, is crucial. Additionally, while working conditions are significant RTC predictors, their impact on RTCs and near misses in Ghana remains under-researched.

2 Methods

2.1 Design and participants

The methods described in this paper has been published elsewhere [49–51]. This cross-sectional survey studied 7,315 (95.9% response rate) long-distance commercial bus drivers in Ghana. The sample size was not determined based on an a priori assumed effect size or statistical power calculations. Instead, the researchers estimated a sample size representing approximately 70% (7,630) of the target population of 10,900 long-distance bus drivers working from Accra and Tema to other regions. This estimated sample size was considered large enough to provide sufficient statistical power to make reliable generalizations to the target population. Babbie [52] has highlighted that sample size for cross-sectional surveys should be sufficiently large to allow for generalization but also warned against unnecessarily large samples that could lead to diminishing returns in terms of added accuracy. These long-distance bus drivers commute at least 140 km or 3 h on a single trip from Accra and Tema to other parts of the country or to other major cities in West Africa. Using a convenient sampling technique, 5,260 (71.9%) minibus drivers and 2,055 (28.1%) long-bus drivers were sampled from 38 bus transport yards and terminals in the Greater Accra region, Ghana. We recruited minibus and long-bus drivers who were readily available at their stations or bus terminals and willing to participate in the study. In this study, a mini-bus is defined as a passenger vehicle with a seating capacity ranging from 12 to 30 seats, while a long-bus is defined as a passenger vehicle with a seating capacity of more than 30 seats.

2.2 Measures

The bus drivers responded to brief sociodemographic items such as age, educational background, and years of working experience. Furthermore, they responded to other items on working conditions such daily working hours, weekly working days, lone driving, irregular shift work, type of bus, and bus ownership type. Additionally, near-misses and RTCs recorded for the two years prior to data collection were obtained from the drivers. Drivers' subjective sleepiness/alertness was rated using the modified Karolinska Sleepiness Scale (KSS) [53]. The KSS ranges from 1 to 9: 1-Extremely alert, 2-very alert, 3-alert, 4-fairly alert, 5-neither alert nor sleepy, 6-signs of sleepiness, 7-sleepy, but no effort to stay awake, 8-sleepy, some effort to stay awake and 9-very sleepy great effort to keep awake, fighting sleep. Higher scores indicate high signs of drowsy driving. Scores between 1 and 4 were rated alertness and a score between 5 and 9 were rated sleepiness.

A 27-item Job Content Questionnaire [54] was used to measure supervisor support (4 items, $\alpha = 0.913$), co-worker support (4 items, $\alpha = 0.857$), skill discretion (6 items, $\alpha = 0.926$), decision authority (4 items, $\alpha = 0.725$), psychological demands (6 items, $\alpha = 0.950$), and job insecurity (3 items, $\alpha = 0.830$). Sample items included, "My job requires hard work all the time" and "People I work with are competent to do their job." The JCQ was scored using a 4-point Likert scale, ranging

from strongly disagree (1) to strongly agree (4), with higher scores indicating higher job demands and job resources. Work–family conflict was measured using the Work–Family Conflict Scale [55], a 5-item scale with a reliability of α = 0.764. An example item is, "My work has a negative impact on my family life." Responses ranged from strongly disagree (1) to strongly agree (4), where a higher score denotes a greater risk of conflict. Mean scores of subscales of the JCQ were used to categroise the psychosocial work variables in low or high perception of these variables.

Psychosocial Safety Climate (PSC) was assessed using the PSC-12, which has a reliability value of α = 0.94[56]. An example item is, "In my workplace, senior management/car owner acts quickly to correct problems/issues that affect employees' psychological health." Responses were given on a scale from strongly disagree (1) to strongly agree (4). A high PSC score indicates that bus drivers are involved in decision-making at their workplaces, and their well-being and safety are prioritized by management, supervisors, or car owners. A core of 36.99 or less, between 37 and 40.99 and 41 and above were rated as low, moderate and high PSC work enviornment.

2.3 Procedures and ethics

Bus drivers were recruited through their "station masters" and bus terminal or yard administrators. Drivers who had just completed a trip or were waiting at their terminals for the next trip were selected through convenient sampling. Only bus drivers that voluntarily agreed and consented to participate were included in this study. The questionnaire was translated into Twi, the most widely spoken local dialect in Ghana, and then back into English to ensure accuracy in translation. Survey interviews, lasting between 15 and 30 min, were conducted by twenty trained field assistants over a two-month period (November 2023 to January 2024). Bus drivers were informed of their right to withdraw from the study at any time and assured of the confidentiality of their information. They provided either written or oral informed consent before participating. The drivers were informed that the survey was solely for research purposes and were not compensated in cash or kind. The study was conducted in relation the guidelines outlined in the Helsinki Declaration and approved by the Institutional Review Board (IRB) of the University of Cape Coast, Ghana (ID: UCCIRB/CES/2022/82). This ethical approval was secured prior to the commencement of data collection. Pretesting was done using 173 long-distance bus drivers in the Takoradi Metropolis. This was done to establish psychometric properties of the survey instruments.

2.4 Analytical procedures

Descriptive statistics using frequency and percentages were presented to show the rate of near misses and RTCs reported by the bus drivers. Missing data for quantitative data were replaced with their serial means whereas the median of nearby points was applied to categorical missing data. Additionally, pairwise deletion was employed in the regression analysis to maximize the use of available data and reduce potential bias. This approach allowed the researchers to retain more data and maintain statistical power while ensuring the reliability of the results. A bivariate analysis using Chi-square test of distribution was conducted to know the independent variables (socio-demographic and working conditions) associated with the dependent variables (near misses and RTCs). Independent variables that were significant at the bivariate phase were moved into the multivariate phase. Near-misses and RTCs were dichotomised (reported no incident of near misses or RTC (0) and reported an incident of near-misses or RTC (1)). Hence, a binary logistic regression was condcuted. Jamovi software version 2.5.3 was used in the statistical analysis.

3 Results

The results indicate that the majority of the bus drivers 3928 (53.7%) have recorded at least 1 RTC two years prior to the data collection. Also, the majority (7086) of the bus drivers representing 96.9% have recorded at least one near-miss two years prior to the data collection. Details are presented in Fig. 1.

3.1 Bivariate results

Age, education status and years of working experience were the socio-demographic variables that had significant association with RTC. All physical working conditions (employment type, bus type, bus ownership, irregular work shift, lone driving, daily and weekly driving hours, and fatigue driving) had significant association with RTC. Job insecurity, skill discretion, decision autonomy, work-family conflict, psychological demands, supervisor support and psychosocial safety

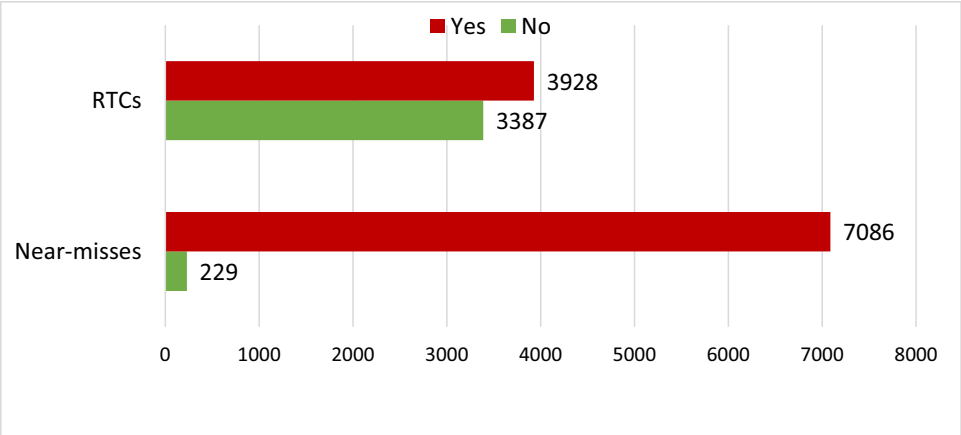

Fig. 1 RCTs and near-misses reported by bus drivers

climate were the psychosocial work factors that had significant association with RTC. All these variables had a significant association with near-misses except years of driving experience which had a statistical non-significant association with near-misses. Besides, co-worker support had a significant relationship with near misses but not RTC. See Table 1 for bivariate results.

3.2 Multivariate results for predictors of RTC

Independent variables entered in the model explained 95.9% (Nagelkerke's R^2 value of 0.959) of variance in RTCs. For RTC, being 41 years or older was associated with significantly lower odds of RTC (AOR = 0.02101, CI 0.00755–0.0584, $p < 0.001$). Education reduced the likelihood of RTC, with basic education (AOR = 0.18117, CI 0.06750–0.4863, $p < 0.001$), vocational training (AOR = 0.14479, CI 0.04693–0.4467, $p < 0.001$), secondary education (AOR = 0.20907, CI 0.06597–0.6626, $p = 0.008$), and tertiary education (AOR = 0.22892, CI 0.06101–0.8589, $p = 0.029$) showing protective effects. Driving experience showed mixed results: 6–10 years (AOR = 3.82017, CI 1.96222–7.4374, $p < 0.001$) and 11–20 years (AOR = 8.78736, CI 3.79640–20.3397, $p < 0.001$) increased odds, while ≥ 21 years decreased odds (AOR = 0.12637, CI 0.06345–0.2517, $p < 0.001$). Casual employment reduced RTC likelihood (AOR = 0.45412, CI 0.25806–0.7991, $p = 0.006$). Individual bus ownership was associated with higher RTC odds (AOR = 2.11103, CI 1.21386–3.6713, $p = 0.008$). Irregular shift work (AOR = 0.05238, CI 0.02373–0.1156, $p < 0.001$) and > 8 daily driving hours (AOR = 2.77468, CI 1.52280–5.0557, $p < 0.001$) increased RTC risk. Weekly driving > 40 h (AOR = 2.72782, CI 1.45036–5.1305, $p = 0.002$) and sleepiness (AOR = 3.91345, CI 2.09661–7.3047, $p < 0.001$) were significant risk factors. Job security increased RTC likelihood (AOR = 26.89006, CI 10.89516–66.3666, $p < 0.001$). Low decision authority (AOR = 30.05471, CI 14.90759–60.5923, $p < 0.001$), low skill discretion (AOR = 44.07493, CI 20.62414–94.1906, $p < 0.001$), and high psychosocial safety climate (AOR = 0.27326, CI 0.11413–0.6543, $p = 0.004$) were significant factors. Low supervisor support greatly increased RTC risk (AOR = 18.20181, CI 8.10444–40.8796, $p < 0.001$).

3.3 Multivariate results for predictors of near misses

The regression analysis revealed that the independent variables in the model explained 31.3% of variance in near misses. The results show that drivers aged ≥ 41 years are more likely to report near-misses, with an Adjusted Odds Ratio (AOR) of 2.08 (95% CI 0.99–4.37, $p = 0.053$). Education status does not significantly impact near-misses; for instance, drivers with basic education have an AOR of 0.90 (95% CI 0.21–3.95, $p = 0.892$) compared to those with no formal education. Employment contract type also does not significantly affect near-misses, with casual employees having an AOR of 1.18 (95% CI 0.84–1.66, $p = 0.330$) compared to permanent employees. Driving a long bus versus a mini-bus is not significantly associated with near-misses (AOR: 0.78, 95% CI 0.53–1.16, $p = 0.227$). Public bus ownership significantly reduces the likelihood of near misses (AOR: 0.43, 95% CI 0.25–0.77, $p = 0.026$) compared to private bus ownership. Not driving alone increases the likelihood of near misses (AOR: 1.95, 95% CI 1.19–3.19, $p = 0.008$). Drivers experiencing high work-family conflict are less likely to report near-misses (AOR: 0.35, 95% CI 0.26–0.47, $p < 0.001$). Low decision authority significantly increases the likelihood of near misses (AOR: 3.51, 95% CI 2.61–4.71, $p < 0.001$). Similarly, low skill discretion increases near-misses

Table 1 Bivariate association between socio-demographic, working conditions and safety incidents (RTCs and near-misses)

Variables	Categories	RTC				Near-misses			
		No	Yes	X^2	p-value	No	Yes	X^2	p-value
		N (%)	N (%)			N (%)	N (%)		
Age	≤ 40 years	288 (3.9%)	3882 (53.1%)	6054	< .001	11 (0.2%)	4159 (56.9%)	263	< .001
	≥ 41 years	3099 (42.4%)	46 (0.6%)			218 (3%)	2927 (40%)		
Sex	Male	3353 (45.8%)	3903 (53.4%)	3.22	0.199	225 (3.1%)	7031 (96%)	3.62	0.163
	Female	31 (0.4%)	22 (0.3%)			4 (0.1%)	49 (0.7%)		
	Others	3 (0.05)	3 (0.05)			–	6 (0.1%)		
Education status	No formal education	32 (0.4%)	920 (12.6%)	1606	< .001	2 (0.03%)	950 (13%)	77.4	< .001
	Basic education	1481 (20.2%)	2166 (29.6%)			93 (1.3%)	3554 (48.6%)		
	Vocational training	653 (8.9%)	612 (8.4%)			78 (1.1%)	1187 (16.2%)		
	Secondary education	1043 (14.3%)	184 (2.5%)			53 (0.7%)	1174 (16%)		
	Tertiary education	178 (2.4%)	46 (0.6%)			3 (0.04%)	221 (3%)		
Driving experience (years)	≤ 5 years	440 (6%)	507 (6.9%)	8.05	< .001	29 (0.4%)	918 (12.5%)	0.748	0.862
	6–10 years	1305 (17.8%)	1513 (20.7%)			93 (1.3%)	2725 (37.3%)		
	11–20 years	1232 (16.8%)	1508 (20.6%)			85 (1.2%)	2655 (36.3%)		
	≥ 21 years	410 (5.6%)	400 (5.5%)			22 (0.3%)	788 (10.8%)		
Employment contract	Permanent	2106 (28.8%)	2511 (34.3%)	8.28	0.016	126 (1.7%)	4491 (61.4%)	8.25	0.016
	Fixed term	436 (6%)	546 (7.5%)			32 (0.4%)	950 (13%)		
	Casual	847 (11.6%)	871 (11.9%)			71 (1%)	1645 (22.5%)		
Bus type	Mini-bus	1354 (18.5%)	3906 (53.4%)	3184	< .001	87 (1.2%)	5173 (70.7%)	135	< .001
	Long bus	2033 (27.8%0	22 (0.3%)			142 (1.9%)	1913 (26.2%)		
Bus ownership	Private bus ownership	1224 (16.7%)	904 (12.4%)	219	< .001	79 (1.1%)	2049 (28%)	6.34	0.042
	Public bus ownership	453 (6.2%)	375 (5.1%)			16 (0.2%)	812 (11.1%)		
	Individual bus ownership	1710 (23.4%)	2649 (36.2%)			134 (1.8%)	4225 (57.8%)		
Irregular shift work	Yes	42 (0.6%)	2912 (39.8%)	4014	< .001	-	2954 (40.4%)	160	< .001
	No	3345 (45.7%)	1016 (13.9%)			229 (3.1%)	4132 (56.5%)		
Lone driving	Yes	913 (12.5%)	3901 (53.3%)	4232	< .001	48 (0.7%)	4766 (65.2%)	211	< .001
	No	2474 (33.8%)	27 (0.4%)			181 (2.5%)	2320 (31.6%)		
Daily driving hours	≤ 8 h	2177 (29.8%)	1332 (18.2%)	672	< .001	141 (1.9%)	3368 (46%)	17.5	< .001
	> 8 h	1210 (16.5%)	2596 (35.5%)			88 (1.2%)	3718 (50.9%)		
Weeking driving hours	≤ 40 h	1800 (24.6%0	847 (11.6%)	786	< .001	116 (1.6%)	2531 (34.6%)	21.4	< .001
	> 40 h	1587 (21.7%)	3081 (42.1%)			113 (1.5%)	4555 (62.3%)		
Driving fatigue	Alertness	3334 (45.6%)	1904 (26%)	2233	< .001	229 (3.1%)	5009 (68.5%)	93.7	< .001
	Sleepiness	53 (0.7%)	2024 (27.7%)			–	2077 (28.4%)		

Table 1 (continued)

Variables	Categories	RTC				Near-misses			
		No	Yes	X^2	p-value	No	Yes	X^2	p-value
		N (%)	N (%)			N (%)	N (%)		
Job insecurity	Insecurity	2208 (30.2%)	51 (0.7%)	3478	< .001	229 (3.1%)	2030 (27.8%)	529	< .001
	Security	1179 (16.1%)	3877 (53%)			–	5056 (69.1%)		
Work-family conflict	Low WFC	1328 (18.2%)	1430 (19.5%)	6.09	0.014	118 (1.6%)	2640 (36.1%)	19.2	< .001
	High WFC	2059 (28.1%)	2498 (34.1%)			111 (1.5%)	4446 (60.8%)		
Decision authority	High decision authority	2556 (34.9%0	1862 (25.5%)	599	< .001	118 (1.6%)	4300 (58.8%)	7.77	< .001
	Low decision authority	831 (11.4%)	2066 (28.2%)			111 (1.5%0	2786 (38.1%)		
Skill discretion	High skill discretion	3027 (41.4%)	74 (1%)	5700	< .001	228 (3.1%)	2873 (39.3%)	316	< .001
	Low skill discretion	360 (4.9%)	3854 (52.7%)			1 (0.01)	4213 (57.6%)		
Psychological demands	Low psychological demands	3006 (41.1%)	987 (13.5%)	2970	< .001	229 (3.1%)	3764 (51.5%)	197	< .001
	High psychological demands	381 (5.2%)	2941 (40.2%)			–	3322 (45.4%)		
Psychosocial safety climate	Low PSC	2164 (29.6%)	3375 (46.1%)	520	< .001	229 (3.1%)	5310 (72.6%)	75.8	< .001
	Moderate PSC	779 (10.6%)	442 (6%)			–	1221 (16.7%)		
	High PSC	444 (6.1%)	111 (1.5%)			–	555 (7.6%)		
Co-worker support	High co-worker support	546 (7.5%)	668 (9.1%)	1.03	0.310	25 (0.3%)	1189 (16.3%)	5.51	0.019
	Low co-worker support	2841 (38.8%)	3260 (44.6%)			204 (2.8%)	5897 (80.6%)		
Supervisor support	Low supervisor support	3022 (41.3%)	3294 (45%)	44.4	< .001	221 (3%)	6095 (83.4%)	20.7	< .001
	High supervisor support	365 (4%)	634 (8.7%)			8 (0.1%)	991 (13.5%)		

(AOR: 0.0046, 95% CI 0.0059–0.035, $p < 0.001$). Lastly, low supervisor support significantly increases near-misses (AOR: 9.46, 95% CI 4.46–20.06, $p < 0.001$). See Table 2 for multivariate results.

4 Discussion

4.1 Summary findings

The study found that 53.7% of bus drivers had at least one RTC and 96.9% had at least one near-miss two years prior to data collection. Older age, higher education, and extensive driving experience reduced RTC risk, while factors like 6–20 years of experience, individual bus ownership, irregular shifts, long driving hours, sleepiness, job security, low decision authority, skill discretion, and supervisor support increased RTC risk. Near-misses were more likely with public bus ownership, not driving alone, low decision authority, skill discretion, and supervisor support, while high work-family conflict reduced near-miss likelihood.

4.2 Rate of RTCs and near-misses

The 53.7% rate of RTCs is relatively higher (more than 3 times higher) than what is reported in previous studies [20, 21]. However, a similar finding of 53% [22] and 55% [23] has been reported in Cameroon and Ghana respectively. The high prevalence of near misses (96.9%) observed in this study is notably higher than the 44.5% reported by Miyama et al. [24] and the 36.6% reported by Miller et al. [25]. These high rates of safety incidents may be due to the demanding work conditions faced by Ghanaian bus drivers [11]. Thus, the precarious nature of their work, characterized by the pressure to meet tight schedules and sales targets, exacerbates these risks[18, 57]. Bus drivers often work under intense stress, with limited job security and inadequate support, leading to chronic fatigue and reduced attention on the road[58, 59].

Contextually, the high RTC and near-miss rates in Ghana can also be attributed to inadequate road infrastructure, poor vehicle maintenance, and a lack of stringent road safety enforcement [26]. Many Ghanaian roads are in poor condition, with potholes, lack of signage, and inadequate lighting, all contributing to higher accident rates[8]. Additionally, the economic pressures faced by drivers, including low wages and the need to maximize trips for higher earnings, lead to risky behaviours such as speeding and ignoring necessary rest breaks. The high incidence of near misses could indicate a chronic issue with driver alertness and decision-making under stress, which are critical factors for road safety [60]. The cumulative effect of these factors creates a hazardous work environment, making bus driving one of the most dangerous occupations in the country.

4.3 Predictors of RTCs and near-misses

The findings of this study reveal that younger drivers and those with less experience are at a higher risk for RTCs, which is consistent with prior studies [29, 31]. This can be attributed to younger drivers' limited driving experience and a greater propensity for risk-taking behaviors. Extensive driving experience of 21 years or more was found to reduce the risk of RTCs, likely due to the accumulation of practical knowledge and skills over time. Drivers with such extensive experience are more familiar with various road conditions, have honed their ability to anticipate potential hazards, and generally exhibit more defensive driving behaviors. They are also more likely to have developed a strong sense of intuition and judgment when navigating challenging situations, which can help prevent accidents [29, 31]. On the other hand, drivers with 6–20 years of experience, while still relatively experienced, may not exhibit the same level of caution or adaptive strategies as those with over two decades of driving experience. This middle range of experience might lead to a level of confidence that, while beneficial, could result in occasional lapses in judgment or overestimation of their driving capabilities, potentially increasing RTC risk.

Additionally, higher education levels correlate with better adherence to safety protocols, as supported by previous studies [32, 33]. This may be because higher education typically improves cognitive skills and knowledge, leading to more cautious and informed driving practices [33]. The study also suggests that drivers with fewer than five years of driving experience report more RTCs just as reported in literature [29–31]. This may be due to their ongoing learning curve and lesser familiarity with handling complex driving situations and work environment. Furthermore, the study found that irregular shifts, long driving hours, sleepiness, job security, low decision authority, skill discretion, and supervisor support increase the risk of RTCs. Irregular shifts and long hours can lead to fatigue, both impairing

Table 2 Multivariate binary logistic regression of predictors of safety incidents (RTCs and Near misses)

Variables	Categories	RTC				Near-misses			
		AOR	95% Confidence Interval		p-value	AOR	95% Confidence Interval		p-value
			Lower	Upper			Lower	Upper	
Age	≤ 40 years	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	≥ 41 years	0.02101	0.00755	0.0584	< .001	2.07910	0.9892	4.3701	0.053
Education status	No formal education	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Basic education	0.18117	0.06750	0.4863	< .001	0.90255	0.2062	3.9499	0.892
	Vocational training	0.14479	0.04693	0.4467	< .001	1.99749	0.4518	8.8321	0.362
	Secondary education	0.20907	0.06597	0.6626	0.008	0.66508	0.1495	2.9591	0.592
	Tertiary education	0.22892	0.06101	0.8589	0.029	0.59735	0.0923	3.8640	0.589
Driving experience (years)	≤ 5 years	Ref	Ref	Ref	Ref	–	–	–	–
	6–10 years	3.82017	1.96222	7.4374	< .001	–	–	–	–
	11–20 years	8.78736	3.79640	20.3397	< .001	–	–	–	–
	≥ 21 years	0.12637	0.06345	0.2517	< .001	–	–	–	–
Employment contract	Permanent	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Fixed term	0.78530	0.40350	1.5284	0.477	1.07474	0.6895	1.6752	0.750
	Casual	0.45412	0.25806	0.7991	0.006	1.18371	0.8429	1.6623	0.330
Bus type	Mini-bus	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Long bus	0.97736	0.22751	4.1987	0.975	0.78247	0.5258	1.1645	0.227
Bus ownership	Private bus ownership	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Public bus ownership	1.19273	0.54059	2.6316	0.662	0.43411	0.2456	0.7673	0.026
	Individual bus ownership	2.11103	1.21386	3.6713	0.008	1.23120	0.9043	1.6763	0.859
Irregular shift work	Yes	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	No	0.05238	0.02373	0.1156	< .001	–	–	–	–
Lone driving	Yes	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	No	0.28316	0.06013	1.3334	0.110	1.94670	1.1862	3.1948	0.008
Daily driving hours	≤ 8 h	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	> 8 h	2.77468	1.52280	5.0557	< .001	1.03640	0.6866	1.5644	0.865
Weeking driving hours	≤ 40 h	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	> 40 h	2.72782	1.45036	5.1305	0.002	1.27316	0.8596	1.8856	0.225
Driving fatigue	Alertness	Ref	Ref	Ref	Ref	–	–	–	–
	Sleepiness	3.91345	2.09661	7.3047	< .001	–	–	–	–
Job insecurity	Insecurity	Ref	Ref	Ref	Ref	–	–	–	–
	Security	26.89006	10.89516	66.3666	< .001	–	–	–	–
Work-family conflict	Low WFC	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	High WFC	1.04536	0.65462	1.6694	0.853	0.35117	0.2607	0.4730	< .001
Decision authority	High decision authority	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Low decision authority	30.05471	14.90759	60.5923	< .001	3.50996	2.6147	4.7117	< .001
Skill discretion	High skill discretion	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Low skill discretion	44.07493	20.62414	94.1906	< .001	0.00455	0.005.91	0.0350	< .001
Psychological demands	Low psychological demands	Ref	Ref	Ref	Ref	–	–	–	–
	High psychological demands	1.47684	0.82725	2.6365	0.187	–	–	–	–
Psychosocial safety climate	Low PSC	Ref	Ref	Ref	Ref	–	–	–	–
	Moderate PSC	1.73082	0.75462	3.9699	0.195	–	–	–	–
	High PSC	0.27326	0.11413	0.6543	0.004	–	–	–	–
Co-worker support	High co-worker support	_	_	–	–	Ref	Ref	Ref	Ref
	Low co-worker support	–	–	–		0.64621	0.3664	1.1397	0.131
Supervisor support	High supervisor support	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
	Low supervisor support	18.20181	8.10444	40.8796	< .001	9.46182	4.4640	20.0551	< .001

judgment and reaction time [18]. Sleepiness and job insecurity contribute to stress and distraction, while low decision authority and skill discretion can diminish drivers' sense of control and engagement, increasing crash risk [61].

Regarding near misses, the study highlights that long driving hours, irregular shifts, and job stress, significantly increase their likelihood. This finding aligns with previous studies [18, 43], which show that fatigue and job strain are strong predictors of Risky driving. Long driving hours and irregular shifts lead to physical and mental exhaustion, impairing drivers' ability to react quickly and effectively in near-miss situations [25, 62]. Furthermore, a lack of social support and low job control, as reported in previous studies [45, 61], exacerbate these risks by contributing to a stressful work environment. Drivers in such conditions may experience feelings of isolation and pressure, which can reduce their overall alertness and decision-making capabilities.

The study also found that factors such as public bus ownership, not driving alone, low decision authority, skill discretion, and supervisor support increase the likelihood of near misses. Public bus ownership in Ghana may involve less personalized maintenance and oversight, contributing to mechanical issues or operational lapses [11]. Driving with others might lead to distractions, while low decision authority and skill discretion reduce drivers' autonomy and engagement, impairing their proactive safety measures [45, 61]. Supervisor support, while generally positive, might also inadvertently pressure drivers to meet performance targets, increasing stress and near-miss occurrences [45, 61].

The finding that work-family conflict reduced near-miss likelihood is surprising because one might expect that the stress and distractions associated with work-family conflict would increase the likelihood of near-misses. However, a practical reason for this could be that drivers experiencing work-family conflict may become more cautious and vigilant while driving, consciously avoiding risks to prevent further complications in their already stressed lives. This heightened awareness and careful driving behavior might inadvertently reduce the likelihood of near misses.

4.4 Implications for policy and practice

Based on the findings, practical and contextually relevant policy and practice recommendations include implementing targeted training programs for younger and less experienced drivers to enhance their situational awareness and driving skills. Strict regulations should be enforced to limit long driving hours and irregular shifts, reducing fatigue and associated risks. Enhancing job security and providing continuous education on safety protocols can improve adherence to safe driving practices. Increasing social support and job control by fostering a supportive work environment and involving drivers in decision-making can mitigate stress and improve alertness. Regular maintenance checks for public buses and minimizing distractions for drivers can further reduce near misses. Lastly, addressing work-family conflicts through flexible scheduling and support services can help drivers manage stress, contributing to safer driving practices. These measures collectively aim to create safer, healthier working conditions for long-distance bus drivers in Ghana, ultimately reducing RTCs and near misses.

Improving transport infrastructure, such as better roads and clear signage, could significantly reduce travel time for long-distance bus drivers, potentially easing their stress and fatigue. While this study primarily focuses on the drivers' working conditions and behaviors, it is important to recognize that safer and more efficient roads may enhance overall road safety. The reduction in travel time could lead to fewer near-misses and RTCs, as drivers would not be subjected to prolonged hours on poorly maintained roads. Thus, policy recommendations should incorporate the need for enhanced transport infrastructure as part of a comprehensive road safety strategy.

5 Limitations and suggestion for future studies

The use of a convenient sampling technique may have introduced selection bias, as the study included only those drivers who were readily available and willing to participate. This may not fully represent the entire population of long-distance bus drivers in Ghana. The reliance on self-reported data for near misses, RTCs, and other variables can lead to recall bias or social desirability bias, potentially affecting the accuracy and reliability of the findings. The cross-sectional nature of the study limits the ability to establish causality between socio-demographic factors, working conditions, and the occurrence of RTCs and near misses. Longitudinal studies would be necessary to better understand these causal relationships.

6 Conclusion

The data for this study suggest that 53.7% of bus drivers had at least one RTC and 96.9% had at least one near-miss two years prior to data collection. The data further suggests that older age, higher education, and extensive driving experience reduced RTC risk, while factors like 6–20 years of experience, individual bus ownership, irregular shifts, long driving hours, sleepiness, job security, low decision authority, skill discretion, and supervisor support increased RTC risk. Also, the findings suggest that near-misses were more likely with public bus ownership, not driving alone, low decision authority, skill discretion, and supervisor support, while high work-family conflict reduced near-miss likelihood. To effectively address this challenge, concerted efforts are needed to implement targeted interventions aimed at improving driver training, regulating working hours, and enhancing job security and support systems. By prioritizing evidence-based policies and practices, stakeholders can work towards creating safer roads and healthier work environments for bus drivers, thus advancing both road safety and sustainable development goals in Ghana.

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Data availability Data that support the study findings can be accessed via the link below: https://doi.org/https://doi.org/10.17605/OSF.IO/CG5ZP Data can only be used with authorisation from Mustapha Amoadu (mustapha.amoadu@ucc.edu.gh).

Declarations

Ethics approval and consent to participate The study was conducted according to the guidelines outlined in the Helsinki and approved by the Institutional Review Board (IRB) of the University of Cape Coast, Ghana (ID: UCCIRB/CES/2022/82). This ethical approval was secured prior to the commencement of data collection. Participation was voluntary and anonymous, and informed consent was obtained from each bus driver who participated. The privacy of the participants was safeguarded, and the parameters for the use of the collected information were clearly established and guaranteed.

Competing interest The authors declare no competing interests.

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