



Prevalence and factors associated with ever had road traffic accidents among drivers in Hargeisa city, Somaliland, 2022

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ABSTRACT

Road traffic accidents (RTAs) are a major cause of morbidity in Somaliland. This study aimed to determine the prevalence and factors associated with traffic-related incidents in Hargeisa city. A cross-sectional study was conducted between January and March 2022, utilizing a mixed approach involving quantitative and qualitative research approaches. Key informant interviews were conducted with 15 government officials, and structured questionnaires were administered to 387 drivers. Cluster sampling and purposive sampling were employed to select drivers and government officials, respectively. Data collection was performed using the Kobo Collect application, followed by cleaning and analysis using IBM SPSS version 25. Descriptive statistics, binary logistic regression, and chi-square tests were utilized for data analysis. The findings revealed an increasing trend of RTAs in Somaliland over the past 11 years (2011–2021). Moreover, the prevalence of RTAs in the past two years alone was determined to be 28.17% (CI: 23.67, 32.63). Factors significantly associated with RTAs in the research area included the type of vehicle, particularly Minibus (AOR = 3.249, CI: 1.022, 10.322) and Vitz (AOR = 2.325, CI: 1.092, 5.494), encountering aggressive behavior from other drivers (AOR = 1.790, CI: 1.013, 3.162), vehicles less than 4 years (AOR = 0.446, CI: 0.258, 0.771), traffic law violations (AOR = 2.726, CI: 1.296, 5.735), and the presence of traffic campaigns (AOR = 0.465, CI: 0.236, 0.917). The study recommends increasing awareness of RTAs among drivers and pedestrians, regular vehicle maintenance checks, enforcement of traffic laws, and increased police presence in road management to reduce fatalities associated with RTAs.

1. Introduction

Road traffic accidents (RTAs) present a global challenge that affects nations worldwide. These accidents result in injuries, disabilities, and fatalities, impacting individuals of all ages, particularly children and the working population. According to a 2018 report by the World Health Organization (WHO), road traffic injuries are the leading cause of death among individuals aged 5–29 years [1]. Annually, RTAs claim the lives of approximately 1.3 million people globally, with an additional 20–50 million individuals suffering

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non-fatal injuries, often leading to disabilities [1]. Shockingly, 93% of these fatalities occur in low- and middle-income countries, despite these nations possessing only 60% of the world’s vehicles [1].

Variations in the utilization of streets and the types of casualties experienced have significant implications for road safety practices and policies [2]. While car drivers are primarily involved in high-motorized nations, motorcyclists play a prominent role in some Asian countries. In low-income nations, RTAs often involve pedestrians, transportation systems, vehicle performance, and exposure to risk factors such as speeding and lack of seatbelt usage [3]. As motorization rates increase, the fatality rate from RTAs worsens. Different nations bear the burden of RTAs to varying extents, with low- and middle-income countries being the most affected. Even with a relatively small number of registered cars, Africa experiences a significant predicted fatality rate from RTAs [2]. Africa’s annual RTA fatality rate stands at approximately 24.1 per 100,000 people, compared to 10.3 per 100,000 people in Europe [4].

While risk factors and causes of RTAs may vary depending on the context, the Government of India identifies driver error as the primary cause, encompassing speeding, alcohol consumption, wrong-side driving, and mobile phone usage while driving [5]. Other significant factors include errors by pedestrians and passengers, mechanical vehicle failures, inadequate road infrastructure, poor lighting conditions, and more. An empirical study in Gambia reveals that high vehicle and pedestrian densities contribute to the risk of RTAs [6]. In the Kibaha district of Tanzania, factors such as sex, age, excessive speeding, aggressive driving behaviour, being a motorcyclist or pedestrian, and other issues like poor management, irresponsibility, corruption, cell phone usage while driving, lack of driver training, failure to obey traffic regulations, vehicle age, poor service condition, and vehicle maintenance contribute to RTAs [7]. Fenta and Workie highlight factors such as failure to give priority as required by law, pedestrian behaviour when crossing roads, and non-use of seat belts as risk factors for RTAs in northwestern Ethiopia [8]. Additionally, Gasu finds that uneven land use allocation, poor road conditions, heavy traffic flow, lack of road infrastructure, inadequate traffic management, and weak enforcement all contribute to the prevalence of RTAs [9].

The reviewed studies provided valuable insights into the prevalence and associated factors of RTAs in different contexts. A study conducted in Ethiopia highlighted the significance of RTAs as a critical public health problem, emphasizing the need for attention from government authorities and stakeholders [10]. Another study conducted by Bucsuházy and his colleagues emphasized the complex nature of accident causation and the importance of analyzing human behavior and conditions that contribute to accidents [11]. It recommended specific measures such as vehicle maintenance, media utilization, and driver training to prevent accidents. Konlan and Hoyford examined factors associated with motorcycle-related road traffic crashes (RTC) in Africa [12]. The study identified themes related to rider and non-rider factors, prevalence and severity of injuries, and measures to reduce RTC. Behavioral factors such as alcohol use, poor knowledge of traffic regulations, and non-use of protective equipment were linked to RTC. The review emphasized the importance of implementing multi-sectoral measures targeting rider behavior and enforcing road safety regulations to ensure safer road usage. A study, focusing on adolescents and children in Ethiopia, highlighted the high prevalence of RTIs and identified socio-economic factors, parental education, and child supervision practices as associated factors [13]. Finally, Oltaye and his coauthors examined motorcycle accidents in Ethiopia and finds a high prevalence among RTA patients, particularly among males aged 20–29 years [14]. Factors such as age, sex, speed, and road type were identified as significant associations. These studies collectively emphasized the urgent need for comprehensive strategies, including education, enforcement, and infrastructure improvements, to address the significant public health burden of RTAs.

Based on the reviewed literature, the key determinants of RTAs can be summarized in the conceptual framework depicted in Fig. 1.

RTAs occur frequently in Somaliland, resulting in a significant negative impact on the community, thereby making it a serious health problem. The incidence of RTAs is on the rise, with 182 fatalities and an estimated 3372 injuries recorded in 2019 alone [15].

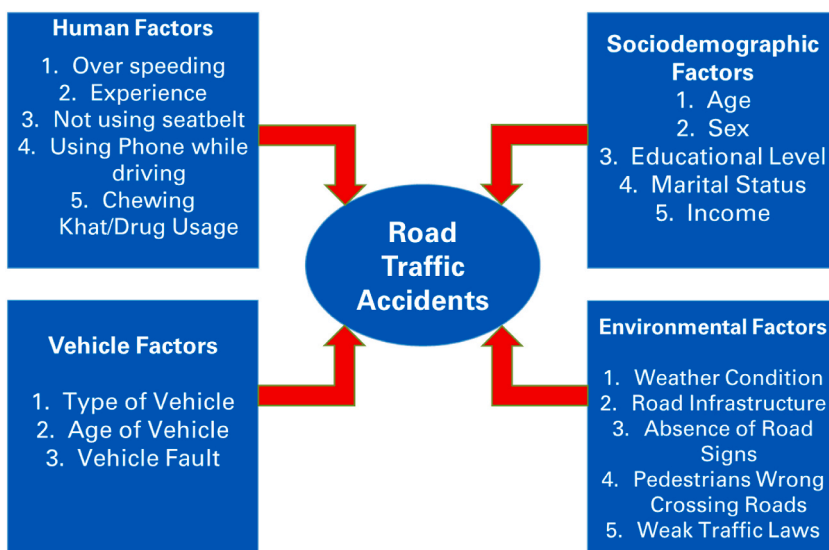


Fig. 1. The conceptual framework for the factors associated with RTA in Hargeisa city.

These figures, when compared to Ethiopia's population of 100 million, are disproportionately high, emphasizing the urgency of addressing the issue of RTAs [15]. However, the specific risk factors contributing to RTAs in Hargeisa, Somaliland, are not well-understood, as there is a scarcity of peer-reviewed and published studies on the subject. Thus, the primary aim of this study is to identify and investigate the factors that contribute to RTAs in Hargeisa, Somaliland. Specific objectives include determining the prevalence and associated risk factors of RTAs, exploring driver perceptions and attitudes, and providing recommendations based on the findings.

This research endeavour seeks to enhance our understanding of the risk factors associated with RTAs, which result in fatalities, injuries, and property damage within the study area. Moreover, it aligns with the Sustainable Development Goals (SDGs), particularly SDG target 3.6, which aims to halve the global number of deaths and injuries caused by RTAs, as well as SDG target 11.2, which aims to provide safe, affordable, accessible, and sustainable transport systems for all. According to Auert and Khayesi, improving road safety worldwide is crucial for saving lives and promoting sustainable development [16]. It is recognized that RTAs and fatalities have profound social, economic, and environmental implications, affecting countries at various stages of development [17]. By prioritizing road safety, societies can create safer and more inclusive communities, reduce the burden on healthcare systems, and work towards the overall well-being and sustainability of populations [17]. Ultimately, the findings of this study will provide valuable scientific information to policymakers, including officials from the Ministry of Transport and Roads Development, and other stakeholders, facilitating the formulation of effective policies to address the risks posed by RTAs in the country.

2. Materials and methods

2.1. Study area

Hargeisa is the capital city of Somaliland, an unrecognized country located in the Horn of Africa. Situated between Gebiley and Berbera in the west and east respectively, Hargeisa is positioned at geographical coordinates of 9° 33' 0" North and 44° 4' 3" East. Somaliland shares its borders with Djibouti to the northwest, Ethiopia to the south, and the Puntland region of Somalia to the east. In 2017, the population of Hargeisa was estimated to be approximately 1,500,000 residents [18]. The city spans a total area of 33 km² and comprises eight districts, each with its own set of sub-villages [18]. These districts are Mohamoud Haybe, Mohamed Moge, Ibrahim Kodbur, 31 May, Ahmed Dhagah, 26 June, Ga'an Libah, and Mo'alim Harun.

Hargeisa experiences a semi-arid climate, characterized by warm and hot temperatures during the winter and summer seasons, respectively. The average annual rainfall in the city is slightly below 400 mm, and the monthly temperature ranges from approximately 18 °C (64 °F) in December and January to 24 °C (75 °F) in June [18].

Livestock rearing, remittances, and small businesses constitute the primary sources of income for the residents of Hargeisa City. In 2012, the estimated GDP per capita for Somaliland was \$347, reflecting a low level of investment in the country [19]. The employment rate is relatively low, with only 28% of males and 17% of females engaged in employment [19].

2.2. Study design and settings

A cross-sectional study was conducted in the eight districts of Hargeisa city from January to March 2022. The cross-sectional design involves sampling various segments of the population at a single point in time [20]. To achieve the study objectives, a mixed-methods approach combining qualitative and quantitative research methodologies was utilized. This approach allows for a comprehensive understanding of the situation and provides opportunities for participants to express themselves and share their experiences regarding the issue [21].

Both primary and secondary data were collected for this study. Primary data was obtained from the target population, which consisted of drivers and government officials. A validated interviewer-administered questionnaire and Key Informant Interview (KII) tools were used to collect primary data. The questionnaire and KII tools were initially written in English, translated into Somali (the local language), and then translated back into English to ensure consistency. The questionnaire and KII tools incorporated relevant variables identified through a comprehensive review of the literature (e.g. Refs. [8,22]) on the topic of RTAs. Secondary data on RTA cases, deaths, and injuries over the past 11 years were collected from the Traffic Police Department of the government of Somaliland.

By employing this mixed-methods approach and utilizing both primary and secondary data sources, the study aimed to gather comprehensive information and insights regarding RTAs in Hargeisa city.

2.3. Sampling procedure and sample size determination

The selection of respondents for this study involved a combination of probability and non-probability sampling techniques. To gather data from drivers who participated in the survey questionnaire, cluster sampling was employed. In this approach, the study area was divided into grid sections, and a random sample of grids was selected. This method, known as the area frame, allowed us to capture a representative sample of drivers.

To identify key informants from the study area, purposive sampling was utilized. This technique involved a deliberate selection of individuals who possessed relevant knowledge and expertise related to the research topic.

The determination of the sample size was based on Cochran's formula [23], which considers a 95% confidence interval and a 5% margin of error: $n = \frac{z^2 p(1-p)}{d^2}$. The formula calculates the minimum required sample size (n) using the following parameters: the critical

value of the normal distribution at $\alpha/2$ (z), the proportion of drivers encountering RTAs (p), and the margin of error (d). Since no previous studies were conducted in the study area or nearby regions, we conservatively assumed $p = 0.5$. Thus, the formula becomes $n = 1.96^2 \times (0.5)(0.5)/(0.05^2)$, resulting in a minimum sample size of 384.

Considering a non-response rate of 5% observed in the pilot study questionnaire, we accounted for this potential non-response by adding it to the minimum sample size. Therefore, the final sample size considered for this study was 404.

Ultimately, the study received responses from 387 drivers and 15 key informants, exceeding the required sample size.

2.4. Data processing and analysis

The primary data for this study was collected using Kobo Toolbox and subsequently imported into SPSS version 25 for data analysis. Prior to conducting the analyses, thorough checks were performed to ensure the data's completeness and accuracy.

Both descriptive and inferential analyses were employed in this study to gain insights from the collected data. Descriptive analyses involved the use of frequency tables, bar charts, and pie charts to summarize and present the data. Additionally, measures of central tendency (mean) and dispersion (standard deviation) were utilized in certain analyses to understand the distribution and variability of the data.

Inferential analyses, on the other hand, aimed to identify the key factors contributing to RTAs in Hargeisa, Somaliland. These analyses included chi-square tests, as well as bivariate and multivariate logistic regression analyses. Through these statistical techniques, we assessed the relationships and associations between various factors and the occurrence of RTAs. The results of these analyses were reported with a 95% confidence interval, providing a range within which we can be confident that the true values lie. Furthermore, both Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) were calculated to determine the strength of the associations. The significance of the identified risk factors was evaluated using a threshold of P-value < 0.05 and Cohen's d effect sizes, indicating statistical significance and magnitude of the effect.

Overall, these data processing and analysis methods were employed to comprehensively explore and understand the factors influencing RTAs in Hargeisa, Somaliland.

2.5. Data quality management

The data quality assurance process involved regular communication between the investigators and enumerators, ensuring the integrity of the collected data. The investigators monitored the soft data received from the enumerators, reviewing the GPS location and submission timestamps of the interviews. This monitoring mechanism helped maintain data quality standards. Supervisors also played a crucial role in conducting regular checks to further enhance data quality.

The programming of data was determined by the nature of the variables being analyzed. Each variable was appropriately programmed to ensure accurate data entry and analysis.

To assess the reliability of the data, a pretest of the questionnaire was conducted using a 5% sample size. In this pretest, 20 eligible drivers participated and provided feedback. The results of the pretest were thoroughly discussed among the supervisors and lead investigators. Based on the feedback received, necessary adjustments were made to the questionnaire to improve its effectiveness and relevance for the final data collection phase.

The development of the questionnaire for this study involved rigorous measures to ensure its validity and reliability. Validity refers to the extent to which the questionnaire measures what it intends to measure, while reliability refers to the consistency and stability of the questionnaire's results. To establish the validity of the questionnaire, a thorough literature review was conducted to identify relevant constructs and items. Existing validated questionnaires were examined, and items were adapted or modified to suit the specific research objectives. This process helped ensure that the questionnaire items effectively captured the intended concepts and variables of interest. Content validity, which assesses the relevance and comprehensiveness of the questionnaire items, was ensured through expert reviews. A panel of experts, including researchers and subject matter specialists, critically evaluated the questionnaire for clarity, coherence, and appropriateness. Their valuable feedback and expertise were incorporated to refine and enhance the questionnaire items. Regarding reliability, the internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient. The Cronbach's alpha value of 0.86 was obtained, which indicates a high level of internal consistency among the questionnaire items. This value suggests that the items within each construct of the questionnaire are strongly correlated with each other, consistently measuring the intended concept.

This rigorous data quality assurance process, which included regular monitoring, supervisor checks, and a comprehensive pretest, aimed to enhance the accuracy and reliability of the collected data. By implementing these measures, we took necessary steps to ensure the validity and quality of the data for subsequent analysis.

2.6. Ethical considerations

This study adhered to ethical considerations essential for research conduct. Ethical approval, obtained from the University of Hargeisa Research Ethics Review Committee with the reference number UOH-RERC/035/2022, ensured compliance with ethical guidelines. Additionally, a formal letter was written to the Ministry of Transport and Roads Development to seek their authorization. Informed consent was obtained from all participants prior to conducting interviews and administering questionnaires. The respondents willingly participated in the study and collaborated with the data collectors. To maintain confidentiality, drivers and informants were treated as anonymous participants throughout the study.

3. Results

3.1. Analysis of trend of RTAs in Somaliland

In this section, we have examined the trend of RTAs in Somaliland. Fig. 2 illustrates the 11-year trend based on the available data on RTAs in the region. The data clearly indicates a consistent increase in the number of RTAs, as well as a rise in the number of injuries and fatalities. This upward trend can be attributed to the simultaneous increase in the number of vehicles and population over the years. Consequently, there has been a corresponding rise in the number of individuals injured in RTAs, and this trend has persisted annually.

Utilizing a simple linear time series model with the number of cases as the dependent variable and time (in years) as the independent variable, we observed a significant upward trend in both the number of accident cases and injuries. However, the trend in deaths resulting from RTAs showed an insignificant upward pattern. On average, each year witnesses an increase of approximately 322 accident cases, 213 injuries, and 3 deaths.

3.2. Analysis of the impact of sociodemographic factors on RTAs

All relevant socio-demographic information concerning the surveyed drivers is presented in Table 1. Of the 387 driver respondents, approximately 91.73% were male, while 8.27% were female. Notably, only 8.53% of the drivers were aged 46 and above, with the majority falling between the age range of 18–35. It is worth mentioning that there was a disproportionately higher number of young drivers among the respondents. Regarding marital status, 54.52% were single, and 45.48% were married. The educational background of the respondents was distributed as follows: 23.78% had primary education or below, 25.06% had completed secondary school, 4.39% held diplomas, and 46.77% had obtained bachelor's degrees or higher. Thus, it is evident that the majority of participants possessed a higher level of education, which suggests their potential to comprehend and benefit significantly from traffic awareness programs. In terms of monthly income, the majority of respondents (75.97%) earned less than 400 USD, while the remaining 24.03% earned more than 400 USD. Among the respondents, 76.23% were self-employed, while 19.38% and 4.39% worked in the private and public sectors, respectively. Regarding residential areas, a significant portion of the respondents resided in Ibrahim Kodbur district (23.26%), followed by Ga'an Libah district (22.48%) and Ahmed Dhagah district (16.28%). The remaining participants (drivers), comprising 14.73%, 8.53%, 5.94%, 5.68%, and 3.10%, resided in 26 June, Mohamud Haibe, 31 May, Mo'alim Harun, and Mohamed Moge districts, respectively. Moreover, 19.12% of the respondents had over seven years of driving experience, while 21.96%, 38.24%, and 20.67% had been driving for less than one year, 1–3 years, and 4–6 years, respectively. On the other hand, over 40% of the respondents had received less than one month of driving skills training, 35.66% had received training for 1–4 months, 11.11% had received training for 5–8 months, 4.65% had received training for 9–12 months, and 7.75% had more than one year of driving skills training.

The prevalence of individuals who have ever been involved in RTAs in the past two years is 28.17% (95% CI: 23.67–32.63). Men (27.13%) were more frequently involved in RTAs compared to women (1.03%). Among different age groups, the 18–25 age group had the highest rate of RTAs (11.89%), followed by the 26–35 age group (2.7%). The age group of 46 years and above had the lowest involvement in RTAs (2.07%). Additionally, there was little variation in the percentage of respondents involved in an RTA who reported being married or single (12.14% vs. 16.02%). In terms of educational level, 13.7% of respondents who encountered RTAs had a bachelor's degree or above. For drivers with a diploma, secondary education, and primary education or below, the corresponding percentages were 1.03%, 6.46%, and 6.98%, respectively. Among respondents, those with a monthly income level of less than \$300 (15.25%) had a higher involvement in RTAs compared to those with an income level of more than \$300 (12.92%). The self-employed category of respondents accounted for 20.41% of the RTAs, while the public sector and private sector categories contributed 1.55% and 6.20% of the RTAs, respectively. Regarding residential areas, the majority of respondents who encountered RTAs were from Ga'an

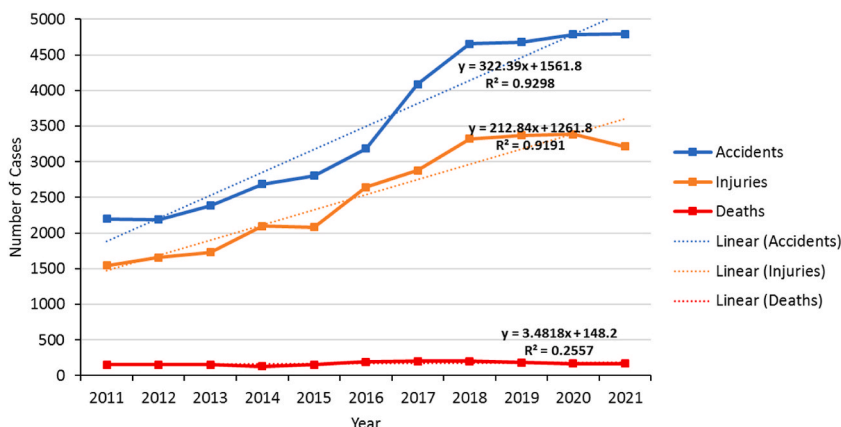


Fig. 2. The trend of RTAs occurred for the last 11 years in Somaliland.

Table 1
Association of RTAs with different sociodemographic factors.

Variable	Categories	Have you had any road traffic accidents in the last two years?		Total (%)	Chi-square Statistic	P-value
		Yes	No			
Gender	Male	105 (27.13%)	250 (64.59%)	355 (91.73%)	4.23	0.04
	Female	4 (1.03%)	28 (7.24%)	32 (8.27%)		
Marital Status	Single	62 (16.02%)	149 (38.50%)	211 (54.52%)	0.34	0.56
	Married	47 (12.14%)	129 (33.33%)	176 (45.48%)		
Age	18–25	46 (11.89%)	114 (29.48%)	160 (41.34%)	1.90	0.59
	26–35	43 (11.11%)	96 (24.81%)	139 (35.92%)		
	36–45	12 (3.10%)	43 (11.11%)	55 (14.21%)		
	46 +	8 (2.07%)	25 (6.46%)	33 (8.53%)		
Educational Level	Primary and Below	27 (6.98%)	65 (16.80%)	92 (23.78%)	0.63	0.89
	Secondary	25 (6.46%)	72 (18.60%)	97 (25.06%)		
	Diploma	4 (1.03%)	13 (3.36%)	17 (4.39%)		
	University	53 (13.70%)	128 (33.07%)	181 (46.77%)		
Average Monthly income	≤\$100	14 (3.62%)	23 (5.94%)	37 (9.56%)	11.07	0.05
	\$101–\$200	30 (7.75%)	52 (13.44%)	82 (21.19%)		
	\$201–\$300	15 (3.88%)	71 (18.34%)	86 (22.22%)		
	\$301–\$400	22 (5.68%)	67 (17.32%)	89 (23.00%)		
	\$401–\$500	15 (3.88%)	28 (7.24%)	43 (11.11%)		
	>\$500	13 (3.36%)	37 (9.56%)	50 (12.91%)		
Employment Status	Self-employed	79 (20.41%)	216 (55.81%)	295 (76.23%)	1.25	0.54
	Public Sector	6 (1.55%)	11 (2.84%)	17 (4.39%)		
	Private Sector	24 (6.20%)	51 (13.18%)	75 (19.38%)		
District	Ibrahim Kodbur	25 (6.46%)	65 (16.80%)	90 (23.26%)	4.62	0.71
	Ahmed Dhagah	20 (5.17%)	43 (11.11%)	63 (16.28%)		
	Ga'an Libah	28 (7.24%)	59 (15.25%)	87 (22.48%)		
	Mo'alim Harun	6 (1.55%)	16 (4.13%)	22 (5.68%)		
	Mohamud Haibe	9 (2.33%)	24 (6.20%)	33 (8.53%)		
	Mohamed Moge	2 (0.52%)	10 (2.58%)	12 (3.10%)		
	26 June	11 (2.84%)	46 (11.89%)	57 (14.73%)		
	31 May	8 (2.07%)	15 (3.88%)	23 (5.94%)		
	Experience	Less than 1 year	21 (5.43%)	64 (16.54%)		
1–3 years	43 (11.11%)	105 (27.13%)	148 (38.24%)			
4–6 years	26 (6.72%)	54 (13.95%)	80 (20.67%)			
7+ years	19 (4.91%)	55 (14.21%)	74 (19.12%)			
Driving Skills Training	Less than one month	46 (11.89%)	112 (28.9%)	158 (40.83%)	4.36	0.36
	1–4 months	35 (9.04%)	103 (26.61%)	138 (35.66%)		
	5–8 months	14 (3.62%)	29 (7.49%)	43 (11.11%)		
	9–12 months	8 (2.07%)	10 (2.58%)	18 (4.65%)		
	More than 1 year	6 (1.55%)	24 (6.20%)	30 (7.75%)		

Libah (7.24%), Ibrahim Kodbur (6.46%), and Ahmed Dhagah (5.17%), while the least number of respondents were from 26 June (2.84%), Mohamud Haibe (2.33%), 31 May (2.07%), Mo'alim Harun (1.55%), and Mohamed Moge (0.52%). Drivers with less than 3 years of driving experience were more likely to be involved in RTAs (approximately 16.54%) compared to drivers with more than 3 years of experience (approximately 11.63%). Furthermore, those who had received driving skills training for less than 4 months were

Table 2
Causes of RTAs - total 282 incidents.

Causes of Road Traffic Accidents	Responses	
	N	Percent
Over speeding	47	16.7%
Poor road infrastructure	45	16.0%
Lack of experience	38	13.5%
Lack of driving skills	25	8.9%
Absence of road signs	23	8.2%
Vehicle fault	22	7.8%
Traffic violation	16	5.7%
Using phones while driving	16	5.7%
Chewing Khat/Drug Usage	11	3.9%
Crossing road either pedestrian or animal	11	3.9%
Weather condition	8	2.8%
Overloading	8	2.8%
Aggressive behavior	7	2.5%
Other	5	1.8%

more likely to encounter RTAs (20.93%) than those who had received training for more than 4 months (7.24%).

The association between the occurrence of RTAs and sociodemographic variables was examined using the Chi-square test. The null hypothesis (H_0) states that there is no association between the occurrence of RTAs and sociodemographic variables, while the alternative hypothesis (H_a) suggests the presence of an association. Based on the obtained p-values, gender (0.04) and average monthly income (0.05) were found to be the only significant sociodemographic factors associated with RTAs. Conversely, marital status (0.56), age (0.59), educational level (0.89), employment status (0.54), district (0.71), experience (0.68), and driving skills training (0.36) were deemed insignificant factors in relation to RTAs.

3.3. Analysis of RTAs encountered by drivers

Table 2 presents an overview of the causes of RTAs reported by respondents in Hargeisa City, Somaliland. According to the respondents' accounts, the most commonly mentioned causes of RTAs were over-speeding (16.7%), poor road infrastructure (16.0%), lack of experience (13.5%), lack of driving skills (8.9%), absence of road signs (8.2%), vehicle faults (7.8%), traffic law violations (5.7%), while the least reported causes were overloading (2.8%) and aggressive behavior (2.5%).

Fig. 3 illustrates the types of vehicles driven by the respondents at the time of the accidents. The majority of drivers (26.27%) were operating a Vitz vehicle, while 20.34%, 11.86%, and 11.02% were driving a Luxury car, City Bus, and Probox, respectively. The remaining portion (30.51%) comprised drivers operating Water trucks, Mini-buses, Cargo Vehicles, and other vehicle types.

The respondents who had experienced an accident in the last two years were asked about the frequency of accidents they had encountered. The results showed that over 50% of the drivers reported being involved in one accident. Additionally, 27.52% of the drivers encountered two accidents, 13.76% experienced three accidents, and 8.26% were involved in more than three accidents. These findings provide insights into the distribution of accident frequencies among the respondents.

3.4. Analysis of drivers' opinions and perception regarding RTAs and associated causes

In this study, drivers were asked various questions regarding their perspectives, perceptions, and experiences related to RTAs. Fig. 4 illustrates the drivers' views on the importance of the RTA problem. The majority of drivers (66.93%) consider the RTA issue to be highly important and in need of appropriate attention. Only a small percentage (6.46%) perceive the RTA problem as somewhat important, while a significant portion (26.61%) do not consider it important at all. These findings highlight a concerning lack of awareness among a substantial number of drivers regarding the public health implications associated with RTAs.

The respondents were asked to express their level of agreement with a series of statements, and their responses were categorized as strongly disagreed (SD), disagreed (D), not sure (NS), agreed (A), and strongly agreed (SA). A summary of the responses obtained from the study is presented in Table 3. The findings reveal that 72.6% of the respondents agreed that the occurrence of RTAs in Somaliland is increasing, while only 11.1% disagreed that RTAs are a cause for concern in the region. The majority of drivers acknowledged that factors such as younger age, aggressive behavior, older vehicles, lack of education, absence of traffic lights, and a lack of driver responsibility contribute to the occurrence of RTAs.

The mean column in Table 3 indicates that respondents generally agreed with all the statements. Moreover, the standard deviation (SD) column highlights that the responses for statement 1 exhibited the highest variation, with an SD of 1.54, while statement 11 had the least variation with an SD of 0.99. Overall, these results suggest that most drivers possess a positive attitude and perception regarding the occurrence of RTAs in Somaliland. They demonstrate an understanding of the increasing trend of RTAs and recognize

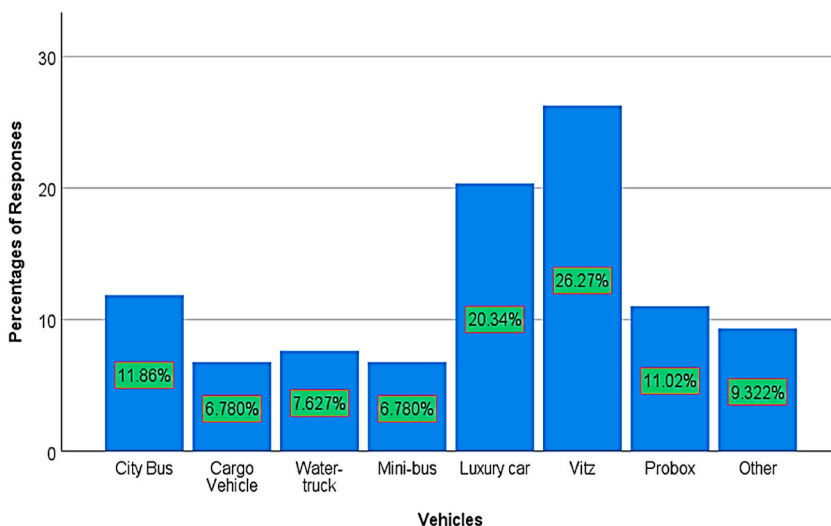


Fig. 3. The type of vehicle at the time of the accident.

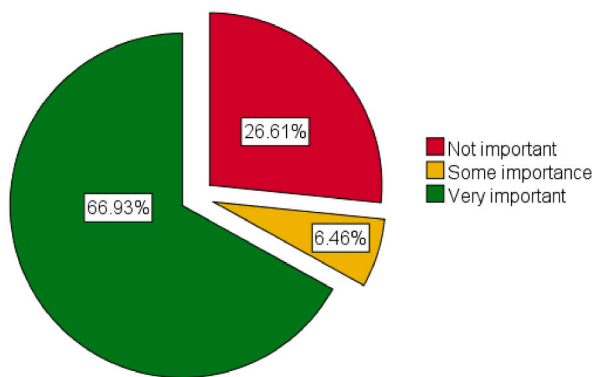


Fig. 4. How important is the RTA problem to you?.

Table 3
The level of agreement on the risk and awareness of RTAs.

No.	Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	SD
1	Road traffic accidents in Somaliland are increasing	63 (16.3%)	25 (6.5%)	18 (4.7%)	52 (13.4%)	229 (59.2%)	3.92	1.54
2	I am worried about road traffic accidents in Somaliland.	27 (7.0%)	16 (4.1%)	30 (7.8%)	98 (25.3%)	216 (55.8%)	4.18	1.18
3	Young drivers are more vulnerable to road accidents than elder drivers.	29 (7.5%)	28 (7.2%)	47 (12.1%)	81 (20.9%)	202 (52.2%)	4.03	1.27
4	Driver behavior such as aggressiveness, tiredness, and sleeplessness is one of the major factors in road accidents.	14 (3.6%)	18 (4.7%)	40 (10.3%)	104 (26.9%)	211 (54.5%)	4.24	1.05
5	Older vehicles are more vulnerable to road accidents than new vehicles.	32 (8.3%)	68 (17.6%)	56 (14.5%)	69 (17.8%)	162 (41.9%)	3.67	1.38
6	Not having a warranty fitness is a risk factor for road accidents	50 (12.9%)	74 (19.1%)	58 (15%)	62 (16%)	143 (37%)	3.45	1.47
7	Those who have a high level of education are less risky in having road traffic accidents than those who have a low level of education.	39 (10.1%)	65 (16.8%)	49 (12.7%)	64 (16.5%)	170 (43.9%)	3.67	1.43
8	As a driver, I am sometimes very angry with other drivers	22 (5.7%)	46 (11.9%)	63 (16.3%)	106 (27.4%)	150 (38.8%)	3.82	1.23
9	Lack of traffic lights is a determinant of road traffic accidents.	16 (4.1%)	20 (5.2%)	28 (7.2%)	88 (22.7%)	235 (60.7%)	4.31	1.08
10	Vehicle breaking traffic law is a significant contributor to road traffic accidents.	14 (3.6%)	14 (3.6%)	33 (8.5%)	88 (22.7%)	238 (61.5%)	4.35	1.03
11	Driver's care while driving minimizes road traffic accidents.	11 (2.8%)	17 (4.4%)	26 (6.7%)	78 (20.2%)	255 (65.9%)	4.42	0.99
12	Many road traffic accidents are mainly traced to the drivers	11 (2.8%)	39 (10.1%)	32 (8.3%)	114 (29.5%)	191 (49.4%)	4.12	1.11

Table 4
In your opinion, what are the major causes of RTAs in Hargeisa City?

Opinion of the Causes of Road Traffic Accidents	Responses	
	N	Percent
Lack of experience	283	13.4%
Poor road infrastructure	256	12.1%
Over speeding	246	11.7%
Lack of driving skills	235	11.1%
Using a phone while driving	193	9.2%
Absence of road signs	182	8.6%
Weak traffic law enforcement	160	7.6%
Chewing Khat/Drug Usage	153	7.3%
Crossing road either pedestrian or animal	139	6.6%
Driver's behavior	132	6.3%
Overloading	109	5.2%
Vehicle Fault	20	0.9%

various risk factors associated with them.

Drivers were asked to provide their opinions on the major causes of RTAs in Hargeisa city. The drivers' responses are summarized in Table 4. According to the drivers, the most commonly believed causes of RTAs were lack of experience (13.4%), poor road infrastructure (12.1%), over-speeding (11.7%), lack of driving skills (11.1%), using a phone while driving (9.2%), absence of road signs (8.6%), weak traffic law enforcement (7.6%). On the other hand, the least cited causes were overloading (5.2%) and vehicle fault (0.9%).

Fig. 5 illustrates the types of vehicles that respondents perceive to be involved in road traffic accidents (RTAs). According to the respondents, the majority of drivers (30.46%) believe that water trucks are commonly involved in RTAs. Additionally, 22.34% of respondents think that Vitz cars, 13.43% believe city buses are involved, and 9.52% perceive cargo vehicles to be associated with RTAs. The remaining respondents (24.25%) believe that luxury cars, Probox cars, mini-buses, and other vehicle types are involved in RTAs. Furthermore, 165 respondents (approximately 42.6%) believe that RTAs primarily occur at night, while 103 respondents (approximately 26.6%) think that RTAs mainly happen at noon. Additionally, 55 respondents (about 14.2%), 35 respondents (approximately 9.0%), and 29 respondents (about 7.5%) believe that RTAs mostly occur in the morning, evening, and afternoon, respectively. These insights provide valuable information about the drivers' perceptions of the types of vehicles involved in RTAs as well as their beliefs regarding the timing of such accidents.

3.5. Drivers' perception regarding RTAs and law enforcement

In this section of the study, we inquired drivers about their perception of RTAs and law enforcement. Fig. 6 presents the responses obtained. Out of the study's participants, 159 individuals (approximately 41.1%) rated the commitment of traffic police to their duties and responsibilities as good. On the other hand, 123 participants (about 31.8%) perceived the commitment of traffic police as poor. Additionally, only 105 respondents (approximately 27.1%) rated the duties and responsibilities of traffic police as moderate.

Further information obtained from the survey reveals that out of the respondents, 191 individuals (approximately 49.4%) received a traffic fine ticket while driving in Somaliland, while the remaining 196 individuals (about 50.6%) did not receive any traffic fine ticket. When asked about the cost of fines for traffic violations, the majority of respondents (51.9%) believed that the fines were not expensive. In contrast, 32% of participants considered the fines to be expensive, while 16% had no knowledge of the cost of fines for traffic violations. Furthermore, among those who received a traffic ticket, 159 respondents (about 83.2%) reported that they changed their driving behavior as a result, while the remaining 16.8% did not alter their usual driving behavior. A significant portion of the study participants (approximately 72.9%) expressed that the level of police enforcement of traffic laws on the road was insufficient, whereas the remaining 27.1% considered it to be adequate.

Regarding driving licenses, approximately 85.0% of the respondents possessed a valid driving license, indicating a substantial proportion of licensed drivers. However, 15.0% of the respondents did not possess a driving license, which can be a risk factor contributing to the increased occurrence of RTAs. Among those with a driving license, 93.66% obtained it through the formal process, while the remaining 6.34% acquired it through a car agency or other means.

Furthermore, when asked about their interaction with traffic police in the past year, 25.84% of the respondents reported not being stopped by traffic police, while 29.97%, 19.64%, and 24.55% reported being stopped 1 to 2 times, 3 to 5 times, and more than 5 times, respectively. Fig. 7 illustrates the reasons for being stopped by traffic police. Improper road usage accounted for 28.57% of the stops, followed by over-speeding (23%), and violations related to not having a driving license (14.98%), not paying tax (12.20%), using a phone while driving (8.71%), vehicle registration plate issues (7.32%), and overall vehicle inspection (5.23%).

Among the study's participants, 54.01% stated that they had never heard of traffic campaigns, while 22.74%, 10.59%, and 12.66%

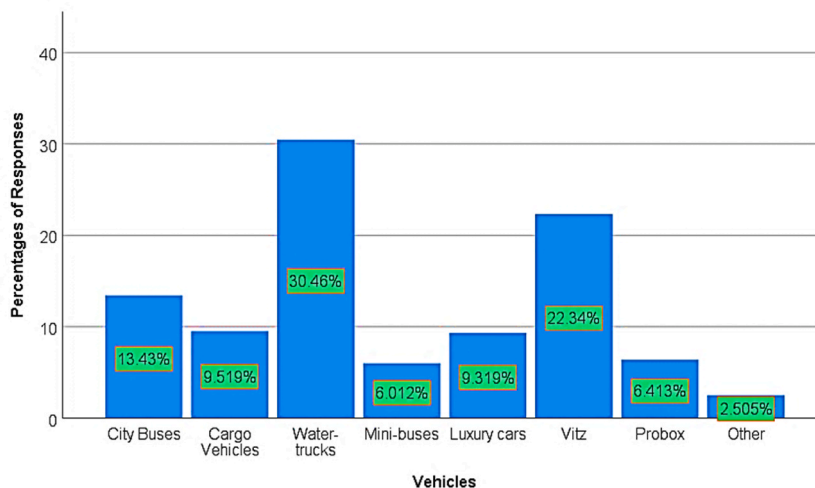


Fig. 5. In your opinion, which vehicles are more involved in RTAs?.

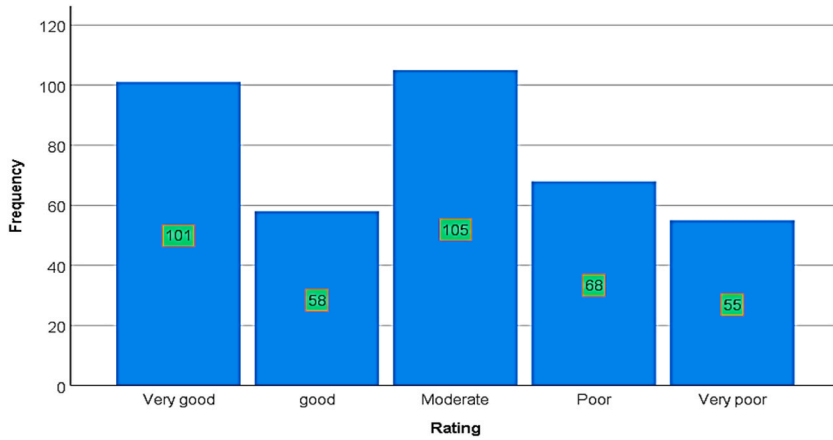


Fig. 6. How do you rate the traffic police’s commitment to their duties and responsibilities?.

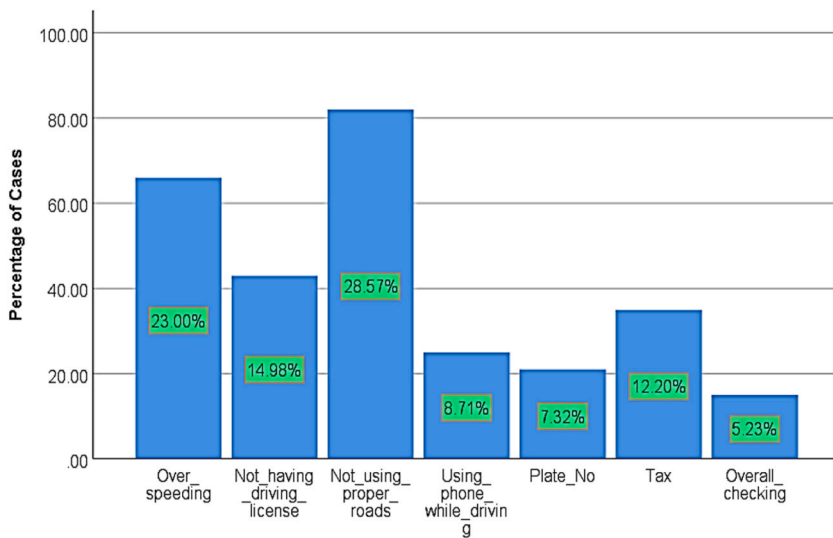


Fig. 7. Reasons for stopping drivers by traffic police over the last year.

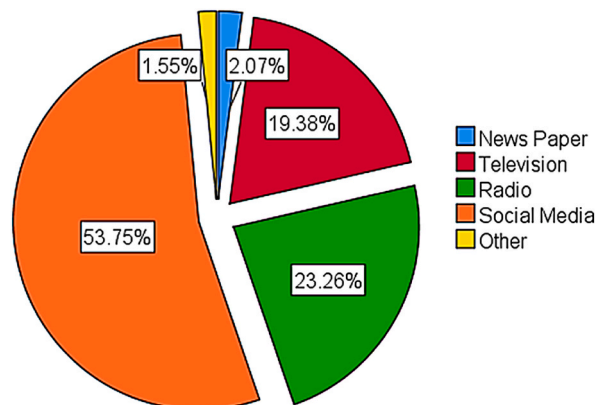


Fig. 8. The main sources of traffic campaigns that drivers are interested in.

indicated that they had heard of traffic campaigns less than 2 months ago, 2–6 months ago, and more than 6 months ago, respectively. The lack of sufficient traffic campaigns can contribute to the problem of RTAs.

Fig. 8 displays the main sources of traffic campaigns that drivers find interesting. The majority of participants (approximately 53.75%) expressed their interest in social media, while 23.26% were interested in radio campaigns. Additionally, 19.28% primarily relied on television for traffic campaign information, and the remaining 3.62% preferred other sources such as newspapers.

Participants were asked about their likelihood of reporting a vehicle breaking the traffic law to the police. Their responses were as follows: 38.76% stated that they would always report, 34.37% indicated that they would never report, and 26.87% mentioned that they would sometimes report to the traffic police. These findings highlight the significant number of individuals who are unwilling to report vehicles breaking traffic laws to the authorities, which can further complicate the issue of RTAs.

3.6. Analysis of RTAs and safety

This section presents the analysis of RTAs and safety. To begin with, 50.13% of the study's participants reported that they use a mobile phone while driving. Among the respondents, 26.61% indicated that they stop the vehicle before using mobile phones, while 23.26% stated that they never use a mobile phone while driving.

The drivers were asked about their seatbelt usage frequency while driving. The findings revealed that 33.33% of drivers do not use seatbelts, 46.25% sometimes use seatbelts, and the remaining always use seatbelts. The non-use of seatbelts among drivers in Somaliland poses a risk factor and increases the likelihood of injuries.

Participants were also asked to observe how pedestrians cross the road. According to the drivers' observations, 78.04% indicated that most pedestrians they observed did not cross the road properly, 20.16% reported that some pedestrians crossed the road incorrectly, and 1.81% believed that none of the pedestrians crossed the road incorrectly. These findings support the WHO report [1] highlighting that pedestrians crossing the road incorrectly contribute to the occurrence of RTAs. Furthermore, 72.87% of the respondents stated that they always give priority to pedestrians when crossing the road, while 23.77% sometimes give priority, and 3.36% never give priority.

Regarding vehicle age, 23% of the respondents had vehicles less than 1 year old, while 48.58%, 16.54%, and 11.89% had vehicles aged 1–4 years, 5–8 years, and more than 8 years, respectively. Older vehicles may contribute to the occurrence of RTAs.

Aggressive behavior from other drivers was reported by 53.7% of the respondents, while 46.3% had not experienced such behavior. Numerous studies have highlighted that aggressive driving behavior is a significant risk factor for RTAs.

In terms of vehicle safety, more than half of the respondents stated that they regularly check the safety of their vehicles. Approximately 38.24% indicated that they sometimes check the safety of their vehicles but not always. Only 8.01% of the drivers reported that they do not check the safety of their vehicles. Introducing safety intervention programs may increase awareness and contribute to the reduction of RTAs.

Fig. 9 presents the average driving speed reported by the respondents while driving within Hargeisa city. About one-third of the drivers (34.88%) stated that they drove at an average speed of less than 30 km/h, while 29.72% reported an average speed between 30 km/h and 35 km/h. Additionally, 23.26% and 12.14% reported average speeds between 36 km/h and 45 km/h, and above 45 km/h, respectively. Numerous studies have indicated that overspeeding increases the occurrence of RTAs, emphasizing the importance of speed control as a preventive measure.

3.7. Logistic regression analysis

In the bivariate logistic regression model, several factors were found to be associated with RTAs, including the driver's gender, health status, type of vehicle (particularly water trucks, cargo vehicles, minibusses, and Vitz cars), possession of a driving license, history of receiving traffic fine tickets, aggressive behavior from other drivers, phone usage while driving, chewing Khat while driving, age of the vehicle, seat belt usage, vehicle safety checks, traffic violations, and lack of exposure to traffic campaigns.

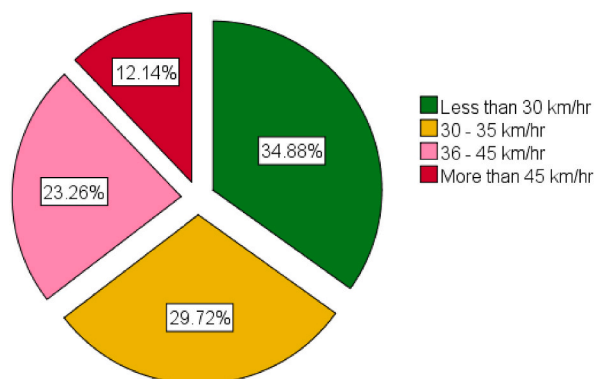


Fig. 9. What is your approximate driving speed while you are driving inside the city?.

In the multivariate analysis, minibus and Vitz cars, aggressive behavior from other drivers, older cars, traffic violations, and lack of traffic campaigns emerged as independent predictors of RTAs. Minibus cars were found to have a 3.2 times higher likelihood (AOR = 3.249, CI: 1.022, 10.332) of being involved in RTAs compared to other vehicle types. The predictor variable “Minibus” has a moderate effect size (Cohen’s *d* = 0.650). This indicates a substantial increase in the risk of RTAs associated with minibus cars. Similarly, Vitz cars showed a 2.3 times higher likelihood (AOR = 2.325, CI: 1.092, 5.494) of being associated with RTAs compared to other vehicles. The predictor variable “Vitz” has a small effect size (Cohen’s *d* = 0.465). Although the effect size is small, it still suggests a meaningful increase in the risk of RTAs related to Vitz cars. Encountering aggressive behavior from other drivers increased the risk of RTAs by 1.8 times (AOR = 1.790, CI: 1.013, 3.162) compared to drivers who did not experience such behavior. The predictor variable “Aggressive Behavior” has a small effect size (Cohen’s *d* = 0.321). While the effect size is small, it indicates a noticeable impact of aggressive behavior on the likelihood of RTAs. Furthermore, cars less than 4 years old were 55% less likely (AOR = 0.446, CI = 0.258, 0.771) to be

Table 5
Logistic regression analyses of factors associated with RTAs in Hargeisa, Somaliland.

Variables	COR	95% CI	P-value	Cohen’s <i>d</i>	AOR	95% CI	P-value	Cohen’s <i>d</i>
Gender								
Male	2.940	(1.006, 8.590)	.049**	0.595	2.708	(.770, 9.527)	.121	0.549
Female (Reference Category)								
Average Monthly Income								
≤\$100	1.732	(.693, 4.334)	.240	0.303	1.677	(.556, 5.058)	.359	0.285
\$101–\$200	1.642	(.756, 3.566)	.210	0.273	1.509	(.599, 3.803)	.383	0.227
\$201–\$300	.601	(.259, 1.396)	.237	−0.281	.477	(.177, 1.284)	.143	−0.408
\$301–\$400	.935	(.422, 2.069)	.867	−0.037	1.032	(.411, 2.593)	.946	0.017
\$401–\$500	1.525	(.626, 3.714)	.353	0.233	1.369	(.487, 3.850)	.552	0.173
>\$500 (Reference Category)								
Health Status								
Healthy	.414	(.195, .881)	.022**	−0.486	.525	(.195, 1.412)	.202	−0.355
Not Healthy (Reference Category)								
Type of vehicle								
City Bus	1.100	(.383, 3.162)	.860	0.053	.776	(.225, 2.671)	.687	−0.140
Cargo Vehicle	3.771	(1.107, 12.853)	.034**	0.732	3.296	(.792, 13.71)	.101	0.658
Water Truck	5.867	(1.771, 19.435)	.004***	0.975	3.856	(.953, 15.60)	.058*	0.744
Minibus	3.457	(1.313, 9.106)	.012**	0.684	3.249	(1.022, 10.332)	.046**	0.650
Luxury Car	1.393	(.650, 2.985)	.394	0.183	1.416	(.576, 3.483)	.449	0.192
Vitz	2.200	(1.097, 4.411)	.026**	0.435	2.325	(1.092, 5.494)	.030**	0.465
Probox	1.333	(.541, 3.288)	.532	0.158	1.718	(.660, 5.197)	.242	0.298
Other (Reference Category)								
License of Driving								
Yes	.539	(.301, .961)	.037**	−0.341	.518	(.254, 1.056)	.070*	−0.363
No (Reference Category)								
Traffic Fine Ticket								
Yes	2.090	(1.327, 3.291)	.001***	0.406	1.566	(.890, 2.755)	.120	0.247
No (Reference Category)								
Aggressive behavior from other drivers								
Yes	2.272	(1.426, 3.620)	.001***	0.452	1.790	(1.013, 3.162)	.045**	0.321
No (Reference Category)								
Using a Phone While Driving								
Yes	2.030	(1.289, 3.196)	.002***	0.390	1.616	(.947, 2.757)	.078*	0.265
No (Reference Category)								
Chewing Khat While Driving								
Yes	2.136	(1.204, 3.787)	.009***	0.418	1.273	(.602, 2.692)	.528	0.133
No (Reference Category)								
Average Speed								
≤30 km/h	.784	(.496, 1.239)	.297	−0.134	.905	(.516, 1.585)	.726	−0.055
>30 km/h (Reference Category)								
Age of the Vehicle								
≤4 years	.420	(.264, .668)	.000***	−0.478	.446	(.258, .771)	.004***	−0.445
>4 years (Reference Category)								
Wearing Seat Belt								
Yes	.552	(.349, .873)	.011**	−0.328	.597	(.338, 1.054)	.075*	−0.284
No (Reference Category)								
Checking Vehicle Safety								
Yes	0.442	(.210, .931)	.032**	−0.450	0.497	(.201, 1.232)	.131	−0.385
No (Reference Category)								
Traffic violation								
Yes	3.364	(1.787, 6.330)	.000***	0.669	2.726	(1.296, 5.735)	.008***	0.553
No (Reference Category)								
Traffic Campaign								
I have heard	.539	(.301, .965)	.038**	−0.341	.465	(.236, .917)	.027**	−0.422
I have never heard (Reference Category)								

involved in RTAs compared to cars older than 4 years. The predictor variable "Age of the Vehicle" has a small effect size (Cohen's $d = -0.445$). Despite the negative effect size, indicating a protective effect of newer cars, the effect size itself is small. Drivers who violated traffic laws had a 2.7 times higher likelihood (AOR = 2.726, CI = 1.296, 5.735) of being involved in RTAs compared to drivers who did not commit violations. The predictor variable "Traffic Violation" has a moderate effect size (Cohen's $d = 0.553$). The effect size, although moderate, suggests a meaningful increase in the risk of RTAs associated with traffic violations. Lastly, the presence of traffic campaigns was found to be a protective factor against RTAs. Drivers who were exposed to traffic campaigns had a 53% lower likelihood (AOR = 0.465, CI: 0.236, 0.917) of experiencing RTAs compared to drivers who were not exposed to such campaigns. The predictor variable "Traffic Campaign" has a small effect size (Cohen's $d = -0.422$). Although the effect size is small, it still signifies a notable reduction in the likelihood of RTAs associated with traffic campaigns. The details are given in [Table 5](#).

3.8. Qualitative analysis

Thematic analysis was conducted on the data collected from key informant interviews with 15 traffic police and ministry of transport and roads development officials in Hargeisa city. The analysis aimed to explore in-depth the causes and challenges of RTAs in Somaliland, as well as proposed recommendations to address them. The analysis revealed several themes, providing a detailed understanding of the issues surrounding RTAs and potential solutions.

3.8.1. Theme 1: causes of RTAs

Under this theme, several factors contributing to RTAs in Somaliland were identified. Poor road infrastructure emerged as a significant cause, with narrow roads and inadequate conditions increasing the risk of accidents, particularly in congested downtown areas. Lack of driving skills and experience among drivers was also highlighted as a key factor, leading to reckless driving behaviors and an elevated likelihood of accidents. Negligence on the part of drivers, including a lack of care and attention while driving, was identified as a contributing factor as well.

Vehicle-related factors played a role in RTAs, with vehicle faults and insufficient safety checks leading to accidents. Additionally, the absence of adequate road signs and traffic lights posed risks to drivers, contributing to accidents. Limited enforcement of traffic laws due to a small number of traffic police officers resulted in increased violations such as speeding, improper lane changing, and overtaking without caution. Aggressive driving behaviors, including tailgating and phone use while driving, were also recognized as common causes of accidents.

3.8.2. Theme 2: vehicle types involved in RTAs

The second theme focused on specific vehicle types associated with higher rates of accidents. Key informants identified vehicles such as Vitz, water-trucks, buses, cargo vehicles, and those driven by khat drivers as being more prone to RTAs. These vehicles were associated with specific risks and driving patterns that contributed to accidents.

3.8.3. Theme 3: challenges faced by traffic police officers

This theme explored the challenges encountered by traffic police officers in their efforts to manage and enforce road safety. Aggressive behavior from some drivers towards traffic police officers emerged as a major challenge, hindering the enforcement of traffic laws. Bribery was identified as another significant issue, driven by the low salaries of traffic police officers, which compromised the effectiveness of law enforcement.

Limited enforcement resources, including a small number of traffic checkpoints, posed challenges to effective monitoring and control of traffic violations. Insufficient equipment, such as vehicles, safety measuring instruments, and online vehicle checking services, further hindered the capabilities of traffic police officers. Additionally, the lack of skill and capacity building opportunities for officers impacted their ability to effectively manage traffic flow and enforce regulations.

3.8.4. Theme 4: recommendations

Based on the thematic analysis, several recommendations were proposed to address the challenges and reduce RTAs in Hargeisa city, Somaliland. The recommendations included:

- 1) Improve road infrastructure by constructing and widening roads, ensuring adequate road signs and traffic lights, and enhancing safety measures such as pedestrian lanes.
- 2) Strengthen the enforcement of traffic laws by increasing the number of traffic police officers and their checkpoints, particularly in accident-prone areas. This should be accompanied by equipping officers with necessary resources such as vehicles, safety measuring instruments, and online vehicle checking services.
- 3) Enhance driver education and awareness programs to improve driving skills and knowledge of traffic regulations. This should include mandatory training for obtaining a driving license and continuous capacity building for traffic police officers.
- 4) Implement measures to address aggressive driving behaviors, including awareness campaigns and stricter penalties for traffic violations.
- 5) Improve the overall quality of driving schools by implementing standardized curricula and ensuring adherence to proper teaching methods.
- 6) Address the specific risks associated with certain vehicle types by imposing regulations, conducting vehicle inspections, and enforcing safety standards.

- 7) Increase public awareness through comprehensive traffic campaigns, emphasizing safe driving practices and the importance of following traffic laws.
- 8) Enhance medical checkups for license applicants, including examination of mental disorders and drug addiction, to ensure fitness for driving.
- 9) Strengthen coordination between the traffic police and relevant government agencies to develop comprehensive strategies and policies for road safety.
- 10) Encourage community involvement and participation in promoting road safety, such as forming local committees and engaging with drivers' associations.

By addressing the identified causes of RTAs and implementing these recommendations, it is anticipated that the number of accidents in Hargeisa city, Somaliland, can be significantly reduced, ensuring safer roads for all residents and visitors.

4. Discussion

The results of this study indicate that RTAs are a significant public health problem in the study area. The study specifically focused on both public and private car drivers, revealing an RTA prevalence of 0.2817 (CI: 0.2367, 0.3263) in Hargeisa. This finding is consistent with a study conducted in Jigjiga city, Somali region of Ethiopia [2], which reported a prevalence of 32.8% (CI: 29.0, 34.8) among taxi drivers. It is also similar to a study conducted in Vietnam [24], which reported an RTA prevalence of 22.7% among taxi drivers. These results suggest that the prevalence of RTAs in Hargeisa is higher than that reported in studies conducted in Western Iran (prevalence = 16.4%) [25], Lahore, Pakistan (prevalence = 12.4%) [26], and Ibadan, Nigeria (prevalence = 15.9%) [27]. However, it shows a lower rate of RTAs compared to earlier studies (52.61% and 31%, respectively) conducted in India [28,29]. This discrepancy may be due to variations in the study populations, study periods, types of vehicles used, and study designs.

The current study identified excessive speeding as the leading cause of RTAs (16.7%). However, a study conducted in Jigjiga revealed that poor road conditions were the leading cause of RTAs (27.4%) [2]. This difference might be attributed to the insufficient presence of vehicle speed governors in Hargeisa city. Inadequate road infrastructure, characterized by poor road quality with uneven surfaces prone to flooding, absence of "zebra" markers for pedestrian crossings, lack of traffic lights and signs, absence of dedicated pedestrian paths, and limited number of lanes, has been identified as the second leading cause of RTAs in Hargeisa city.

The findings of this research also suggest that both social media and mass media campaigns could effectively target drivers in Hargeisa city and improve their safe driving practices in Somaliland. However, several additional factors contribute to an increased risk of RTAs among drivers. This research established a connection between the type of vehicle and RTAs. Consistent with this study, vehicle type was associated with RTAs in the Philippines [30], Iraq [31], and Sri Lanka [32]. This association may be due to the fact that drivers of vehicles such as Vitz, buses, and water trucks often drive at high speeds without exercising adequate caution.

One of the major contributing factors to the rising number of RTAs is driver behavior, which exemplifies the vulnerability resulting from human factors [33]. According to this study, participants who reported experiencing aggressive behavior from other drivers were more likely to be involved in RTAs compared to those who did not encounter such behavior. Thus, the study establishes an association between aggressive driving behavior and RTAs, which aligns with a study conducted in Austria [34].

Another factor found to be associated with RTAs is the age of the vehicle. This finding is consistent with previous studies. For example, NHTSA [35] reported in a research study in the USA that the likelihood of a driver sustaining a fatal injury increased with increasing vehicle age and for cars from earlier model years, even after considering other crash risk variables. Blows found, after adjusting for relevant confounders, that vehicles built before 1984 had a significantly higher likelihood of being involved in an injury crash compared to those built after 1994 (OR = 2.88, 95% CI: 1.20–6.91) [36]. There was also a trend towards an increased collision risk with each additional year of vehicle age (OR = 1.05, 95% CI: 0.99–1.11; p-value = 0.09).

Consistent with previous studies, this research establishes a significant association between traffic law violations and RTAs. For instance, Jiang and his colleagues found a strong association between the overall number of traffic crashes and traffic violations [37]. Tarlochan, Ibrahim and Gaben revealed a clear link between traffic law violations and RTAs [38]. Their study implies a direct connection between reckless driving, which leads to traffic violations, and accidents. Al-Reesi, who investigated young Omani drivers, arrived at similar conclusions [39].

In the Key Informant Interviews, most government officials perceived an increasing trend of RTAs in Hargeisa city, Somaliland. The main causes of RTAs identified by officials included poor road conditions, mechanical errors, lack of traffic lights and adequate road signs, traffic law violations, aggressive driving behavior, overloading, and phone usage while driving. The strategies proposed to address the issue of RTAs included improving road infrastructure by implementing sufficient traffic lights and road signs, raising community awareness of RTAs, enforcing traffic laws by imposing fines on violators, reducing the load carried by cargo vehicles, and increasing the number of police officers.

The study primarily focused on interviewing drivers and government officials. Therefore, the prevalence of RTAs was estimated based on currently employed drivers. The non-participation of some drivers and government officials presented a challenge to data collectors and introduced potential selection bias. Although the selected drivers were believed to be representative of the overall population of drivers in Hargeisa city, and the sample size was large, the voluntary participation of drivers introduced inherent selection bias that could not be eliminated. One limitation of this study is the challenge of ensuring a representative sample of drivers due to their mobility and movement between different locations. It was difficult to guarantee that there was no redundancy or duplicate respondents in the sample. As a result, the sampling method used in this study may resemble convenience sampling rather than probability sampling. Confirming the reported accidents of drivers with official police records was not possible to maintain

confidentiality and driver anonymity. Furthermore, the context of Hargeisa city may not be entirely representative of other cities in Somaliland. Another limitation was the lack of reliable secondary data on the causes of RTAs, so caution should be exercised when interpreting the identified factors as the true causes of RTAs. Additionally, the cross-sectional study design limited the ability to establish causality between RTAs and the identified variables. To thoroughly examine the occurrence and characteristics of RTAs, a prospective study tracking a cohort of drivers would be necessary.

5. Conclusions and recommendations

RTAs pose a significant public health concern in Somaliland, resulting in substantial human and economic losses. The findings of this study, based on both qualitative and quantitative data, indicate a concerning upward trend in RTAs within the region. While a majority of drivers in Hargeisa city exhibited awareness of the risks associated with RTAs, a notable proportion remained unaware. The study revealed that 28.17% (CI: 23.67, 32.63) of public and private car drivers in Hargeisa reported involvement in an RTA within the previous two years. The multivariate analysis identified several independent predictors of RTAs, including vehicle type (particularly Minibus and Vitz), aggressive behavior among drivers, older vehicles over 4 years of age, traffic law violations, and a lack of traffic campaigns. Key informant interviews provided valuable insights into the specific causes of RTAs in Hargeisa city. Poor road conditions, inadequate vehicle maintenance, insufficient road signs and traffic lights, unsafe driving behaviors (such as over-speeding, tailgating, improper passing, and changing lanes without signaling), failure to wear seat belts, and distracted driving (e.g., using mobile phones) were identified as significant contributors to RTAs. Additionally, certain vehicle types, including khat, water trucks, buses, Vitz, and cargo vehicles, were found to be more commonly involved in accidents.

Based on these findings, it is imperative for the Ministry of Transport and Roads Development and the Traffic Police Department to prioritize raising awareness among drivers and the general community regarding RTAs through comprehensive campaigns and educational programs on traffic safety. Regular vehicle fitness checks should be conducted, and the number of traffic police officers on the streets should be increased, along with the establishment of checkpoints throughout the country. Equipping traffic police officers with modern surveillance technology, speedometers, dedicated vehicles, motorcycles, and body cameras would enhance their effectiveness. Strengthening traffic law enforcement should also be a priority. The government should prioritize the maintenance and improvement of road infrastructure, including the installation of zebra crossings and sidewalks (pavements), as well as the provision of complete road signs, traffic lights, and cameras. Furthermore, there is a need to implement policies that limit the speed of vehicles, particularly those identified as being more prone to RTAs, such as khat, water trucks, buses, Vitz, and cargo vehicles. Additionally, measures should be put in place to ensure regular vehicle inspections to maintain their roadworthiness.

Implementation of these recommendations will play a crucial role in reducing the occurrence and mitigating the impacts of RTAs in Hargeisa city, Somaliland. By addressing the identified causes, raising awareness, enforcing traffic laws, and improving road infrastructure and vehicle safety, a safer road environment can be achieved, protecting the lives and well-being of the residents and visitors in the region.

Author contribution statement

Jama Mohamed: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Ahmed Ismail Mohamed: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Dahir Abdi Ali: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Tewelde Tesfaye Gebremariam: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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