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Prehospital factors associated with mortality among road traffic injury patients: analysis of Cameroon trauma registry data

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Abstract

Background Cameroon is amongst the worst affected countries by road traffic injuries with an estimated 1443 disability-adjusted life years per 100,000 population. There have been very limited reports on the crucial prehospital response to road traffic injuries in Cameroon. This study aimed to identify prehospital factors associated with RTI mortality in Cameroon.

Methods We included patients enrolled between June 2022 and March 2023 in the Cameroon Trauma Registry. Information about prehospital factors and demographic data was obtained from patients or their proxies. We examined the association of prehospital care factors like care at the crash scene and type of transportation during crash with final patient outcome. We used Chi-squared test to investigate the association between selected independent variables and mortality. A multivariable logistic regression model was built to identify independent predictors of dying from an RTI.

Results RTIs constituted 69.5% ($n=3203$) of all injuries in the Cameroon Trauma Registry. Only 20.7% ($n=102$) of 4 + wheel vehicle occupants had seatbelts on and just 2.7% ($n=53$) of motorcycle riders were wearing helmets during the collision. Only 4.9% ($n=156$) of patients received any form of scene care. In-hospital mortality was 4.3% ($n=139$) and was associated with male sex (AOR = 1.7, 95%CI = 1.08–2.80), crashing on a motorcycle (AOR = 2.08, 95%CI = 1.1–3.67) and scene care (AOR = 0.25, 95%CI = 0.04–0.80).

Conclusions Receiving any type of care at the scene such as bleeding control or being placed in the recovery position by bystanders is associated with improved survival. Improving on existing informal prehospital care responses should be a priority in Cameroon.

Keywords RTI, Prehospital care, Emergency response, Trauma, Disposition

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Introduction

Road traffic injuries (RTIs) are a significant globalhealth and development challenge, contributing to 1.35 million deaths annually, with 90% percent of these deaths occurring in low-and-middle income countries [1]. In Cameroon, a lower-middle income country in Central Africa, the situation is particularly dire. The country experiences over 16,500 road crashes each year that result in approximately 6000 deaths [2] making it one of the most severely affected countries worldwide. Cameroon's RTI burden is reflected in the estimated 1443 disability-adjusted life years (DALYs) per 100,000 population lost to road crashes [3].

On the Douala-Yaoundé highway, one of Cameroon's busiest roads, the fatality rate is 35 times higher per 100,000 km driven compared to similar roads in Europe and the United States [4]. In addition to the human toll, RTIs impose significant economic losses, exceeding 100 billion Central African CFA francs (approximately $165 million US dollars) per year. Given these staggering figures, under-reporting is believed to mask the true scale of the problem, indicating a potentially worse scenario than currently reported [5].

Despite the high burden, data on RTIs in Cameroon remain sparse, coming largely from single-hospital studies or incomplete police reports. Comprehensive RTI data are needed to guide targeted interventions. However, the few existing studies have already highlighted several challenges within the country's road safety and trauma care infrastructure, including the absence of formal prehospital care systems and low use of protective gear like seat belts, helmets, and protective jackets for motorcycle riders [6, 7]. Prehospital factors, such as injury prevention interventions have proven crucial in reducing injury-related mortality in other similar LMIC settings [8]. To properly plan these types of injury prevention efforts in Cameroon, there is need for a more comprehensive understanding of the various factors related to road safety, such as preventive practices and availability of prehospital care, and their association with injury outcomes. The Cameroon Trauma Registry (CTR), which prospectively collects trauma data from ten hospitals across the country, provides a unique opportunity to fill this gap.

This study seeks to address the identified knowledge gap by leveraging CTR data to assess prehospital factors associated with RTI mortality in Cameroon. The primary objective of this analysis is to identify actionable targets for injury prevention and prehospital care interventions to reduce the RTI burden and improve survival outcomes. By doing so, we aim to inform policymakers and public health authorities on strategic areas for intervention that could have a tangible impact on reducing RTI-related mortality in the country.

Methods

Study setting and data source

Cameroon is a lower middle-income country in Central Africa known for its complex road infrastructure and varying traffic regulations [9]. The country has been experiencing rapid urbanization and motorization, with the risks associated with RTIs exacerbating the existing public health challenges [9]. The data used for this study were extracted from the CTR, a prospective, multisite trauma registry that collects data from 10 hospitals in seven out of 10 regions in Cameroon. "The CTR began in 2015 as a collaboration between the University of California (San Francisco, then Los Angeles) and the Ministry of Public Health, Cameroon at four sites and was scaled up to its present strength of 10 hospitals in June 2022 in partnership with University of Buea. CTR hospitals were selected strategically based on perceived high trauma volume, location along national roads with frequent road traffic crashes and the importance of capturing potentially underserved populations in rural areas. The CTR includes nine public hospitals, and one private catholic hospital designated from smaller district hospitals to larger regional and tertiary referral hospitals equipped with resources for trauma care. For this study, data for RTI patients enrolled in the 10 hospital CTR between June 2022 and March 2023 (study period) were analyzed.

Data collection

CTR data is prospectively collected from participants using a structured questionnaire administered by trained CTR research assistants in the emergency department (ED) at study sites. The questionnaire is an adapted trauma registry tool whose scope includes but goes beyond the variables reported in this study. The questionnaire is attached as a supplement to this article. The CTR collects data from all patients presenting with an acute injury (presented within 2 weeks of occurrence) who are recommended for hospital admission or die in the ED. Admitted patients include those sent to the intensive care unit (ICU), sent to the surgical ward or kept at the emergency ward for observation across hospitals. Unconscious patients without next of kin to consent or patients who refused to consent to enrollment in the CTR were excluded. Eligible patients were followed until final disposition from the hospital. Data is then entered into Research Electronic Data Capture (REDCap), a HIPAA-compliant, secure web application [10]. Patients suffering from a RTI mechanism of injury within the larger CTR cohort were selected for our analysis.

Ethical approval

Ethical approval for the CTR was obtained from the Institutional Review Boards (IRBs) at universities in the United States (#19–000086) and Cameroon (2021/1506-

07/UB/SG/IRB/FHS), and from the Cameroon National Ethics Committee (No. 2022/04/1444/CE/CNERSH/SP).

Study variables

We extracted CTR data on demographic variables (e.g., age, sex, education, occupation, rural/urban residence, and region of residence), time and date of injury, injury mechanism, use of protective gear (i.e., seatbelts, helmets and car seats), overloading (i.e., boarding more than the designated number of passengers for your vehicle), scene care type(any first aid or life support measure administered on injured person before arriving the ED), scene care provider, transportation means to hospital, and disposition at the end of their ED course (e.g., left against medical advice, admission to the hospital, admission to the intensive care unit, admission to the operating theatre, or death). Professionally, we classified people as employed (i.e., with a permanent job), manual labourer (i.e., no permanent job or specialized skill), farmer, or unemployed (educated or skilled with no job)/child.

Data analysis

Descriptive statistics were used to compute frequencies for demographic and other study variables. All variables were categorically measured and were reported as percentages. We used Chi-squared or Fisher's exact test (when at least an expected count in a cell was less than 5) to investigate the association between selected independent variable and patient outcome. For this analysis, patient outcome was dichotomized (e.g., died and survived) while commercial four or more-wheel vehicle transportation was set as a reference for transportation means because it was the category with lowest mortality. All variables with $P<0.2$ were included in a multivariable logistic regression model to identify independent predictors of dying from an RTI. Variables with p-values less than 0.05 was significant. Data were missing for 3.0% ($n=96$) of cases in eight variables. Missing data were imputed using multiple imputation [11]. Data analysis was done using R software version 2022.12.0+353 [12].

Results

Among the 4611 trauma patients enrolled in the CTR during the study period, 3203 (69.5%) experienced RTIs. Of the 3203 RTI patients, males were 77.2% ($n=2472$) (Table 1). The age group 20–29 years had the highest number of patients, 981 (30.6%), followed by the age group 30–39 years with 23.6% ($n=755$), respectively. Professionally, people who identified as employed were the highest category of injured patients with 37.1% ($n=1189$). The most common educational level among the patients was the secondary school level with 62.7% ($n=2007$) of

Table 1 Demographic characteristics of participants ($n=3203$)

Variable	Categories	Frequency (%)
Age (years)	0–9	110 (3.43)
	10–19	324 (10.12)
	20–29	981 (30.63)
	30–39	755 (23.57)
	40–49	517 (16.14)
	50–59	262 (8.18)
	60–69	158 (4.93)
	> 70	96 (3.0)
Sex	Male	2472 (77.18)
	Female	731 (22.82)
Education level	No formal education	199 (6.21)
	Primary education	618 (19.29)
	Secondary education	2009 (62.73)
	University education	377 (11.77)
Occupation	Employed	1189 (37.12)
	Manual laborer	999 (31.19)
	Unemployed/child	790 (24.66)
	Farmer	225 (7.02)
Urban vs. rural residence	Urban	2598 (80.11)
	Rural	605 (18.89)
Transportation during crash	Motorcycle	2102 (65.63)
	Pedestrian	585 (18.26)
	Private 4 or more-wheel vehicle	211 (6.59)
	Commercial 4 or more-wheel vehicle	208 (6.49)
	Truck	74 (2.31)
	Others	23 (0.72)

participants. Among all RTIs, 65.6% (n=2102) of RTIs occurred with people on a motorcycle.

Of the 493 patients that were in a four or more-wheel vehicle during a crash, 20.7% (n=102) reported using their seatbelts while 11.0% (n=54) of patients reported deployment of a vehicle airbag. Of the 10 children below 10 years who crashed in four or more-wheel vehicles, none was reported to have been in a car or booster seat during the crash. For motorcycle crashes, only 2.7% (n=53) of victims reported having a helmet on at the time of the crash. Overall, for all crashes involving motorcycles or four or more-wheel vehicles, 13.18% (342) of patients reported overloading of passengers (more than 2 occupants on a motorcycle or more than specified number of occupants for four or more-wheel vehicles) (Table 2).

Only 156 (4.87%) patients in total received care at crash scene, 76.3% (n=119) of these received it from layperson responders. For all RTI patients, the most utilized means of transportation to the hospital was a taxi, used by 23.4% (n=749) of patients. Only 3.9% (n=126) of patients were transported to hospital by an ambulance (Table 2). The majority (55.5%, n=1778) of patients were admitted to the ward (Table 3) while 15.7% (n=505) left the hospital against medical advice.

Overall, the mortality among all RTI patients was 4.3% (n=139). In bivariate analysis, dying from RTI was significantly associated with male sex (P=0.048) and not receiving care at crash scene (P=0.03). In the multivariable model, male sex was significantly associated with increased mortality (adjusted odds ratio [AOR]=1.7, 95%CI=1.08–2.80, P=0.03) after controlling for urban/rural residence, means of transportation during crash, and availability of care at crash scene. Also compared to commercial four or more-wheel vehicles, having a crash while on a motorcycle was significantly associated with mortality (AOR=2.08, 95%CI=1.1–3.67, P=0.02). Any type of care at crash scene was significantly associated with decreased odds of mortality (AOR=0.25, 95%CI=0.04–0.80, P=0.048).

Table 2 Distribution of prehospital care factors, preventive practices and outcome among participants

Variable	Category	Frequency (%)
Type of care at crash (n=3203)	None given	3047 (95.13)
	Fracture Immobilization	22 (0.69)
	Recovery Position	4 (0.12)
	Tourniquet Placed	17 (0.53)
	Control Bleeding	112 (3.50)
	Other	13 (0.41)
Care provider (n=156)	Person involved in the injury	5 (3.20)
	Bystander	119 (76.28)
	Relative	10 (6.41)
	Police/Firefighter	11 (7.05)
	Medic	11 (7.05)
Transportation to hospital (n=3203)	Ambulance	126 (3.93)
	Private car	659 (20.57)
	Taxi	749 (23.38)
	Motorcycle/Moto taxi	674 (21.04)
	Police/firefighter	147 (4.59)
	Other public transport	110 (3.43)
	Other	20 (0.62)
	Unknown	718 (21.82)
Outcome (n=3203)	Emergency ward observation	335 (10.55)
	Admitted to ward	1778 (55.51)
	Admitted to ICU	199 (6.21)
	Directly to OR	69 (2.15)
	Died	139 (4.34)
	Left AMA against medical advice	505 (15.67)
	Transferred	158 (4.93)
Seatbelt used (n=493)	Yes	102 (20.7)
Carseat used (n=10)	Yes	0 (0)
Airbag deployed (n=493)	Yes	54 (11)
Helmet used (n=2102)	Yes	53(2.7)
Overload (n=2595)	Yes	342 (13.18)

Table 3 Results of multivariable analysis of factors associated with mortality among RTI patients ($n=3203$)

Variable	Frequency (%) $N=3203$	Died(%)	Survived (%)	*P* value	AOR (95%CI)	*P* value
Age (Years)				0.76		
0–9	110 (3.43)	6 (4.32)	104 (3.39)			
10–19	324 (10.12)	14 (10.07)	310 (10.12)			
20–29	981 (30.63)	37 (26.62)	944 (30.81)			
30–39	755 (23.57)	30 (21.58)	725 (23.66)			
40–49	517 (16.14)	21 (15.11)	496 (16.19)			
50–59	262 (8.18)	12 (8.63)	250 (8.16)			
60–69	158 (4.93)	9 (6.47)	149 (4.86)			
> 70	96 (3.00)	9 (6.47)	87 (2.84)			
Male	2472 (77.18)	117 (84.17)	2355 (76.86)	0.048	1.7 (1.08–2.80)	0.03
Urban	2598 (80.11)	119 (85.61)	2479 (80.91)	0.18	1.40 (0.88–2.33)	0.97
Transportation during crash				0.18		
Commercial 4 or more-wheel vehicle	208 (6.49)	89 (64.03)	2013 (65.70)		Ref	
Private 4 or more-wheel vehicle	211 (6.59)	8 (5.76)	203 (6.63)		0.99 (0.43–1.95)	0.97
Motorcycle	2102 (65.63)	14 (10.07)	194 (6.33)		2.08 (1.1–3.67)	0.02
Pedestrian	585 (18.26)	26 (18.71)	559 (18.24)		1.11 (0.70–1.73)	0.63
Truck	74 (2.31)	0 (00)	74 (2.42)		5.63 (0.00-15.11)	0.97
Others	23 (0.72)	2 (1.44)	21 (0.69)		2.09 (0.33–7.29)	0.33
Care at crash scene	174 (5.43)	2 (1.44)	172 (5.61)	0.03	0.25 (0.04–0.80)	0.048

Discussion

This study aimed to identify the factors associated with hospital mortality among road traffic injury (RTI) victims using data from the Cameroon Trauma Registry (CTR). The study reveals a high in-hospital mortality rate, with over 4% of RTI victims dying after arrival at the ED. While this figure likely underestimates total RTI mortality, since it excludes those who died at the crash site, it is still higher than reported by similar studies in other African countries, such as Malawi [13] and Uganda [14]. This highlights the urgent need for improved trauma care and interventions to reduce mortality among hospitalized RTI victims in Cameroon.

Our analysis revealed that in-hospital mortality was significantly higher among males and motorcycle riders, consistent with previous studies suggesting that these groups may engage in riskier behaviours, such as over speeding and driving under the influence [15, 16]. These behaviours likely contribute to the increased severity of injuries and higher mortality rates. Interventions targeting male drivers and motorcycle riders, particularly with education campaigns focused on road safety and alcohol use, are crucial for reducing these deaths.

Furthermore, any form of care provided at the scene, even by layperson bystanders, was associated with increased survival in our study. This finding suggests that community training in basic life-saving skills could have an immediate positive impact on survival rates, even in the absence of formal emergency medical services (EMS). Similar findings have prior been reported in Cameroon [17]. This finding gives more importance to the serious gaps in prehospital care for RTI victims also revealed in our study. Only 5.25% of RTI patients in our study received any form of care at the crash scene and a mere 3.9% were transported to hospital by ambulance. Although these findings point to a severe deficiency in prehospital care as reported in other African settings [13, 18], the emphasis here is on how these prehospital gaps contribute to higher mortality rates in hospitals. Patients who do not receive appropriate care before arriving at a healthcare facility may present with more severe injuries, reducing their chances of survival. Our team is currently conducting a community analysis to identify high-risk populations, such as residents along major highways and commercial vehicle drivers, who could be trained in critical lifesaving first-responder skills. In other countries, lay bystanders and taxi drivers have been trained to support weak prehospital care systems and improve injury outcomes [19].

Remarkably, 69.5% of all trauma cases were RTI-related, a much higher proportion than reported by other trauma registries in sub-Saharan Africa such as in Uganda, Malawi and Kenya [20–22] and from an earlier iteration of the CTR [23]. This underscores the significant burden of RTIs in Cameroon, as also highlighted by the Global Burden of Disease Study (2019) [24] and emphasizes the need to properly address the avoidable deaths due to poor prehospital response to RTI. Among this population of RTI victims, nearly four out of five were male, and this could be due to the societal context in Cameroon as in many other African populations, where males are typically the primary breadwinners and often travel for work to support their families.

In addition to the high RTI burden observed, poor adherence to preventive practices such as seatbelt and helmet use was evident among RTI victims. Only 20.7% of vehicle passengers reported using seatbelts, and fewer than 3% of motorcycle riders were wearing helmets at the time of the crash. While laws mandating seatbelt and helmet use exist in Cameroon [25], enforcement appears to be weak, as suggested by both our findings and those of similar studies in other African countries [13, 26]. To address this, public health campaigns and stricter law enforcement are needed to promote compliance and reduce the incidence and severity of RTIs.

Limitations

The study relies on patient reporting for prehospital data and utilization of preventative measures, which may be inaccurately reported especially in critically ill patients. Also, our data don't speak to the specific factors contributing to people not wearing protective gear (seatbelts weren't available vs. not worn, etc.). The CTR does not indicate whether passengers in four or more-wheel vehicles were front seat or back seat occupants and does not indicate if motorcycle occupants were drivers or passengers. Following our analysis, the latter has been included in the CTR tool. Cameroon law only mandates seatbelts for front seat occupants. Also, our reported mortality may be an underestimate of mortality due to RTI because of the exclusion of prehospital mortality and due to the exclusion of some unconscious patients who had no next of kin to consent to the study.

Conclusion

Our study highlights the high in-hospital mortality rate among RTI victims in Cameroon and its association with factors such as gender and motorcycle use. We show that RTIs comprise more than two-thirds of trauma cases requiring hospital admission. We highlight great lapses in prehospital care of RTI patients and the associated mortality. There is a great need for building on local prehospital care systems by providing potentially life-saving training. Key populations that may benefit from such training include commercial vehicle drivers, as well as community members living in villages and towns around major highways. There should be education and enforcement efforts to increase compliance to traffic safety measures to reduce the mortality from RTIs.

Abbreviations

CFA	Central African CFA francs
CTR	Cameroon Trauma Registry
DALYs	Disability Adjusted Life Years
ED	Emergency Department
RTI	Road Traffic Injury
AOR	Adjusted Odds Ratio
CI	Confidence interval
EMS	Emergency medical services

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12873-024-01113-8.

Supplementary Material 1

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Author contributions

SN: Conceptualization, formal analysis, writing - original draft; CJ: Funding acquisition, methodology, writing - review & editing; AC-M: funding acquisition, writing - review & editing; AC: project administration, writing - review & editing; AH: formal analysis, writing - review & editing; SIM: writing - review & editing; RO: project administration, writing - review & editing; FD-D: project administration, writing - review & editing; MY: writing - review & editing; KO: writing - review & editing. NB- Field coordination, DAT – Field coordination, NT - writing - review & editing, GNT - writing - review & editing All authors read and approved the final manuscript.

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Data availability

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

Declarations

Ethics approval and consent to participate

Ethical approval for the CTR was obtained from the Institutional Review Boards (IRBs) at universities in the United States (#19–000086) and Cameroon (2021/1506-07/UB/SG/IRB/FHS), and from the Cameroon National Ethics Committee (No. 2022/04/1444/CE/CNERSH/SP). Participation in the registry is voluntary and informed verbal consent is obtained from the patients or their surrogates.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

SN: Conceptualization, formal analysis, writing - original draft; **CJ**: Funding acquisition, methodology, writing - review & editing; **AC-M**: funding acquisition, writing - review & editing; **AC**: project administration, writing - review & editing; **AH**: formal analysis, writing - review & editing; **SIM**: writing - review & editing; **RO**: project administration, writing - review & editing; **FD-D**: project administration, writing - review & editing; **MY**: writing - review & editing; **KO**: writing - review & editing. **NB**- Field coordination, **DAT** – Field coordination, **NT** - writing - review & editing, **GNT** - writing - review & editing All authors read and approved the final manuscript.

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