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### Permalink

<https://escholarship.org/uc/item/4kd5j418>

### Journal

Injury, 45(11)

### ISSN

0020-1383

### Authors

McGreevy, Jolion  
Stevens, Kent A  
Monono, Martin Ekeke  
[et al.](#)

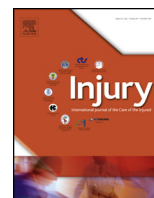
### Publication Date

2014-11-01

### DOI

10.1016/j.injury.2014.05.001

Peer reviewed



## Road traffic injuries in Yaoundé, Cameroon: A hospital-based pilot surveillance study



Jolion McGreevy<sup>a,\*</sup>, Kent A. Stevens<sup>a,f</sup>, Martin Ekeke Monono<sup>b</sup>,  
Georges Alain Etoundi Mballa<sup>c</sup>, Marquise Kouo Ngamby<sup>d</sup>,  
Adnan A. Hyder<sup>a</sup>, Catherine Juillard<sup>e</sup>

<sup>a</sup> Johns Hopkins Bloomberg School of Public Health, International Injury Research Unit, Baltimore, MD, United States

<sup>b</sup> World Health Organization, Africa Regional Office, Brazzaville, Congo

<sup>c</sup> Ministry of Public Health, Department of Disease Control, Yaoundé, Cameroon

<sup>d</sup> Ministry of Public Health, Department of Family Health, Yaoundé, Cameroon

<sup>e</sup> University of California, San Francisco, Department of Surgery, San Francisco, CA, United States

<sup>f</sup> Johns Hopkins Hospital, Department of Surgery, Baltimore, United States

### ARTICLE INFO

#### Article history:

Accepted 1 May 2014

#### Keywords:

Low-middle Income country  
Trauma systems  
Surveillance road traffic Injury  
Pedestrian  
Motorcyclist

### ABSTRACT

**Background:** Road traffic injuries (RTIs) are a major cause of death and disability worldwide. In Cameroon, like the rest of sub-Saharan Africa, more data on RTI patterns and outcomes are needed to improve treatment and prevention. This study analyses RTIs seen in the emergency room of the busiest trauma centre in Yaoundé, Cameroon.

**Methods:** A prospective injury surveillance study was conducted in the emergency room of the Central Hospital of Yaoundé from April 15 to October 15, 2009. RTI patterns and relationships among demographic variables, road collision characteristics, injury severity, and outcomes were identified.

**Results:** A total of 1686 RTI victims were enrolled. The mean age was 31 years, and 73% were male. Eighty-eight percent of road collisions occurred on paved roads. The most common user categories were 'pedestrian' (34%) and 'motorcyclist' (29%). Pedestrians were more likely to be female ( $p < 0.001$ ), while motorcyclists were more likely to be male ( $p < 0.001$ ). Injuries most commonly involved the pelvis and extremities (43%). Motorcyclists were more likely than other road users to have serious injuries (RR = 1.45; 95% CI: 1.25, 1.68). RTI victims of lower economic status were more likely to die than those of higher economic status.

**Discussion:** Vulnerable road users represent the majority of RTI victims in this surveillance study. The burden of RTI on hospitals in Cameroon is high and likely to increase. Data on RTI victims who present to trauma centres in low- and middle-income countries are essential to improving treatment and prevention.

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### Introduction

Road traffic injuries (RTIs) are a major cause of death and disability worldwide. While improved prevention and treatment have significantly decreased RTI death and disability in high-income countries, the RTI burden continues to grow in low- and middle-income countries (LMIC) [1–3]. It is estimated that in Africa, the mortality rate from RTI increases by an average of 8%

each year [4]. By 2030, RTI is predicted to be the fifth leading cause of disability-adjusted life-years (DALYs) lost globally [2]. RTIs also have a tremendous impact on the economies of developing countries, which lose more money as a result of RTI than they receive in development assistance [5]. In Africa, RTI mortality is 28.3 per 100,000 population, the highest in the world, and the economic cost of RTI in African countries is estimated to be 1–2% of gross national product [5,6].

In the Central African nation of Cameroon, 111 lives and 3170 DALYs are lost per 100,000 population annually as a result of injuries, according to World Health Organization (WHO) estimates [3,7]. RTI is the major contributor to Cameroon's injury burden, but

\* Corresponding author. Tel.: +1 6179904826.

E-mail address: [jolionmcgreevy@gmail.com](mailto:jolionmcgreevy@gmail.com) (J. McGreevy).

little is known about the epidemiological patterns of RTI in the country [3]. Since the 1970s, the number of road traffic deaths in Cameroon has steadily increased each year. According to police data, 990 fatal and 2471 non-fatal road traffic injuries were reported in 2007. WHO estimates that the majority of RTI fatalities occur among passengers in four-wheel vehicles (40%), while the smallest proportion occurs among pedestrians (10%) [2].

A study of police reports of RTIs between 2004 and 2007 on the 243 km road section between Douala and the capital city, Yaoundé, found that the number of people killed per 100,000 km driven was more than 35 times higher than on similar roads in Europe or the United States [8]. Previous work at the main referral hospital in Yaoundé demonstrated that nearly 60% of injuries were due to road traffic collisions and that 46% of RTI victims were pedestrians [9]. The goal of the present study is to determine characteristics of patients injured in road traffic collisions who seek care at the main referral hospital in Yaoundé and to identify associations between these characteristics and outcomes which can be used to improve treatment in Cameroon and other LMICs.

## Methods

This prospective injury surveillance study was conducted in the emergency room of the Central Hospital of Yaoundé, a 500-bed teaching and referral hospital that handles the largest trauma volume in the city. The hospital serves an estimated 1.5 million inhabitants and accepts patients 24 h a day. Injury patients are received in the emergency room and either cared for and discharged home, admitted to the general ward or the intensive care unit, or transferred to the operating room or another facility. The majority of patients arrive at the hospital via private or commercial vehicles.

All patients who were admitted for traumatic injuries to the emergency room of the Central Hospital of Yaoundé over a 6-month period between April 15 and October 15, 2009 were eligible to be enrolled in the surveillance system. Study data consisted of demographic information and details of the injury context, clinical presentation, care and disposition. All study data were collected directly from patients and care providers by trained research assistants. Demographic information included age, sex, residence, education, occupation, and a number of economic indicators, e.g., whether or not patients owned radios or televisions. The injury context was defined by the geographic location and activity at the time of injury, as well as the mechanism of injury. Injury mechanism included RTI as well as other common categories, such as falls, burns and gunshots. RTI was defined as injury involving pedestrians, bicycles, motorcycles or motor vehicles and was categorised by road user category: pedestrian, or driver or

passenger of a vehicle (motorcycle, private car, taxi, bush-taxi, pickup/van/jeep, truck, or bus). The clinical presentation included the body region and severity of injury, measured by the Kampala Trauma Score (KTS) and Injury Severity Score (ISS) [10]. Both scoring systems effectively predict mortality; however, the KTS requires minimal data collection and is thus especially well-suited to resource-limited settings [11]. Categories of care provided included the following: radiographic studies; pharmacologic resuscitation; analgesic and/or anaesthetic medication; minor surgical procedures such as sutures, debridement and closed reduction; and major operative treatment. Outcomes included discharge from the emergency room, admission to the general ward, death in or upon arrival to the emergency room, transfer to the ICU, transfer to the operating room, and transfer to another facility.

Data were captured 24 h a day using a pre-tested surveillance form based on WHO Guidelines of Injury Surveillance and previous data abstraction from Ghana and Uganda (Table 1) [12–14].

Data were entered into Excel and imported into Stata version 11.0 statistical software (Stata Corp, College Station, TX, USA) for analysis. Analyses were performed on demographic characteristics, mechanisms, injury severity and outcomes using the chi-square test for dichotomous variables and the Wilcoxon rank sum test for continuous variables. A *p*-value less than 0.05 was considered statistically significant.

The study was conducted in collaboration with the Ministry of Health in Cameroon and approved by the National Ethics Review Committee in Cameroon and the Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health, USA. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The authors have no competing interests.

## Results

A total of 3136 trauma victims presented to the emergency room at the Central Hospital of Yaoundé during the study period, and 2855 agreed to participate in the study (91% acceptance) 1686 of these were RTIs. This paper describes the demographics and injury patterns of the 1686 RTI victims. The mean age was 31 years (SD = 13.6) and was not significantly different between males and females. Seventy-five percent were between 15 and 45 years-old, and 73% were male; therefore, 59% were males between 15 and 45 years-old. Forty-two percent of RTI victims under 15 years-old were female (*p* < 0.001). The majority of RTI victims came from Yaoundé (87%), while the rest came from the surrounding villages (Table 1). Sixty-two percent arrived by ambulance and 22% by private automobile.

**Table 1**  
Demographic characteristics of road traffic injury victims in Cameroon.

Characteristic	Male <i>n</i> (% by sex)	Female <i>n</i> (% by sex)	<i>p</i> -value <sup>c</sup>	Total <i>n</i> (% by characteristic)
Age, years				
<15	91 (57.6)	67 (42.4)	<0.001	158 (9.6)
15–45	969 (76.8)	292 (23.2)	<0.001	1261 (76.6)
46–59	117 (69.6)	51 (30.4)	0.193	168 (10.2)
≥60	39 (65.0)	21 (35.0)	0.113	60 (3.6)
Total	1216 (73.8)	431 (26.2)		1647 <sup>a</sup>
Residence				
Yaoundé	1053 (73.1)	387 (26.9)	0.365	1440 (86.9)
Outlying villages	165 (76.0)	52 (24.0)	–	217 (13.1)
Total	1218 (73.5)	439 (26.5)		1657 <sup>b</sup>

<sup>a</sup> Age and sex data available for 1647 (97.7%) of RTI victims.

<sup>b</sup> Residence and sex data available for 1657 (98.3%) of RTI victims.

<sup>c</sup> Chi-square test comparing gender proportion by residence.

Thirty-four percent of RTI victims were pedestrians, 29% were motorcyclists, and 26% were automobile occupants (Fig. 1). Road user category was unavailable for fewer than 0.5% of RTI victims. Of the non-pedestrian RTI victims ( $n = 1123$ ), 52% were passengers, 35% were drivers, and 13% were unidentified (Fig. 1). Eighty-eight percent of the collisions occurred on paved roads, 5% occurred on dirt roads, and the remainder occurred in other locations (including homes, farms, schools, markets, sports/recreational fields or facilities, and industrial/construction sites).

Among 15–45 year-olds, the most common road user category was ‘motorcyclist,’ followed by ‘pedestrian.’ Among other age groups, ‘pedestrian’ was the most common category, followed by ‘motorcyclist’ (Fig. 2).

Age, sex and road user category were available for 97% of the sample ( $n = 1640$ ). Pedestrians and motorcyclists were on average younger, 30.0 years ( $p = 0.015$ ) and 29.1 years ( $p = 0.004$ ) respectively, than automobile and bus/truck occupants, 32.1 years ( $p < 0.001$ ) and 33.3 years ( $p < 0.001$ ) respectively. The overall female-to-male ratio for these 1640 subjects was approximately 1:3. Compared to the overall proportion of women in the study (26%), women were overrepresented among pedestrians (32% female,  $p < 0.001$ ) and automobile occupants (32% female,  $p = 0.002$ ) and underrepresented among motorcyclists (16%,  $p < 0.001$ ) (Table 2).

The most common body region injured was the bony pelvis and extremities (44%), followed by the head, neck and face (30%). The most common type of injury was a contusion or other superficial injury (30%), followed by a laceration or other (non-fracture) open wound (28%), and then by fracture (21%). Trauma to the thorax and abdominal/pelvic contents accounted for a small proportion (4%) of RTIs (Table 3).

Outcome was known for 93% of RTI victims ( $n = 1575$ ). Seventy-three percent were treated in the emergency room and discharged; 20% were transferred to the operating room; 3% were admitted to the general ward; 2% were transferred to another facility; 1% died prior to presentation or in the emergency room; and fewer than 1% were transferred to the ICU. Sex was not predictive of outcome. Pedestrians were less likely than other road users to die (relative risk [RR] = 0.92; 95% CI: 0.47, 1.78), while motorcyclists were more likely to die (RR = 1.44; 95% CI: 0.85, 2.46); however, the overall number of deaths among the RTI victims was small ( $n = 19$ ) and the relative risk calculations were not statistically significant.

Motorcyclists were more likely to have serious to critical injuries, Injury Severity Score (ISS)  $\geq 9$ , compared to other road users (RR = 1.45; 95% CI: 1.25, 1.68). Automobile occupants were less likely to have ISS  $\geq 9$  (RR = 0.76; 95% CI: 0.64, 0.91). A similar analysis was conducted using the Kampala Trauma Score (KTS) as a measure of injury severity [10]. There was no statistically

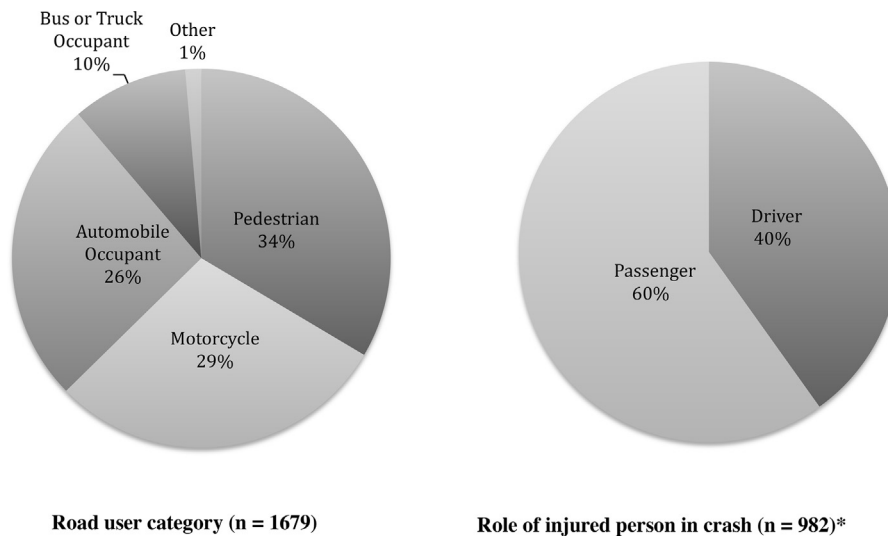


Fig. 1. Characteristics of road collision leading to injury in Cameroon ( $n = 1686$ ). \*The category, driver vs. passenger, applies only to non-pedestrian road users.

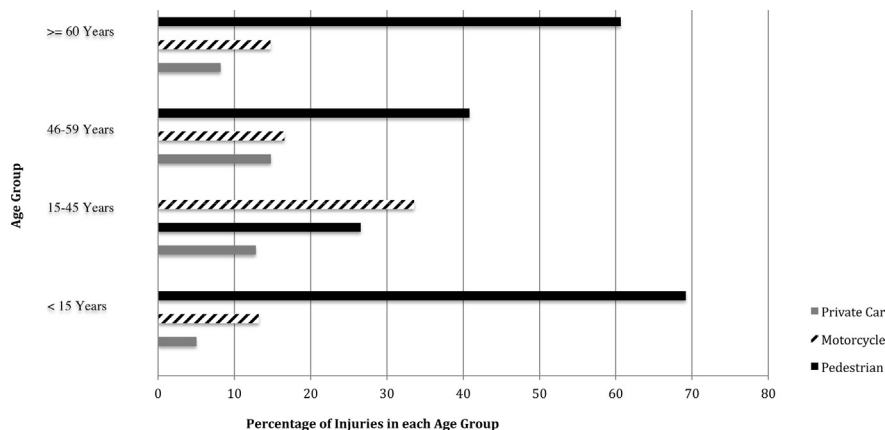


Fig. 2. Three most common types of crash by age group in Cameroon ( $n = 1240$ ).

**Table 2**  
Road user by age and gender in Cameroon (n = 1640).

Road user category	Age		Sex	
	Mean years (SD)	p-value <sup>a</sup>	% Female	p-value <sup>b</sup>
Pedestrian	30.0 (17.0)	0.015	31.8	<0.001
Motorcyclist	29.1 (10.7)	0.004	16.0	<0.001
Automobile occupant	32.1 (11.7)	<0.001	32.1	0.002
Bus or truck occupant	33.3 (11.6)	<0.001	25.9	0.872
Other	26.4 (13.7)	0.109	13.0	0.231
Total	30.6 (13.6)		26.3	

<sup>a</sup> Wilcoxon rank-sum comparing mean age across road user categories.<sup>b</sup> Chi-square test (or, for  $n < 5$ , Fisher's exact test) comparing gender proportion across road user categories.**Table 3**  
Nature of road traffic injury location and severity.

Injury characteristic	n (%)	Age	
		Mean years (SD)	p-value <sup>a</sup>
Body area, most severe injury (n = 1637)			
Bony pelvis and extremities	716 (43.7)	31.1 (13.3)	0.236
Head/neck/face	497 (30.4)	30.7 (14.1)	0.619
No significant injury	297 (18.1)	28.1 (13.4)	<0.001
Chest	66 (4.0)	35 (13.2)	0.008
Abdomen/pelvic contents	53 (3.2)	30.6 (13.2)	0.947
Spinal cord injury	8 (0.5)	33.8 (10.4)	0.367
Type, most severe injury (n = 1560)			
Bruise/other superficial injury	472 (30.3)	28.3 (13.1)	<0.001
Cuts/open wound	436 (28.0)	30.3 (13.2)	0.651
Fracture (extremities)	324 (20.8)	32.0 (14.4)	0.041
Sprain/strain/dislocation	136 (8.7)	33.9 (13.4)	0.003
Head injury	115 (7.4)	30.9 (14.4)	0.601
Thoracic (non-operative)	34 (2.2)	34.8 (11.9)	0.039
Abdominal/pelvic contents	29 (1.9)	31.8 (13.2)	0.547
Burn	12 (0.8)	28.6 (16.9)	0.474
Thoracic (operative)	2 (0.1)	42 (15.6)	0.198

<sup>a</sup> Wilcoxon rank-sum comparing mean age across injury characteristics.

significant increase in the risk of moderate to severe injury (KTS < 14) for one road user category compared to the others (Table 4).

Residence was predictive of injury severity as measured by both the ISS and the KTS. RTI victims from outlying villages were more likely to have serious to critical injuries as measured by the ISS (RR = 1.56; 95% CI: 1.21, 2.00) or moderate to severe injuries as measured by the KTS (RR = 1.63; 95% CI: 1.08, 2.47). RTI victims from outlying villages were less likely to be discharged (RR = 0.47; 95% CI: 0.36, 0.61) and more likely to die (RR = 2.77; 95% CI: 1.42, 5.39) or to be operated on (RR = 1.87; 95% CI: 1.42, 2.47) than RTI victims from Yaoundé.

RTI victims of lower economic status—those who, for example, did not have electricity, refrigerators, radios, or televisions—were less likely to be discharged and more likely to die than those of higher economic status ( $p < 0.05$ ).

**Table 4**  
Severity by road user category (n = 1628 for ISS; n = 1617 for KTS).

Road user category	ISS ≥ 9 (serious/critical), n (%)	ISS < 9 (minor/moderate), n (%)	KTS < 14 (moderate/severe), n (%)	KTS ≥ 14 (mild), n (%)
Pedestrian	203 (36.9)	347 (63.1)	38 (7.0)	502 (93.0)
Motorcyclist	224 (47.1)	252 (52.9)	28 (5.9)	446 (94.1)
Automobile occupant	136 (31.9)	290 (68.1)	22 (5.2)	398 (94.8)
Bus or truck occupant	49 (31.6)	106 (68.4)	11 (6.8)	150 (93.2)
Total	619 (38.0)	1009 (62.0)	101 (6.2)	1516 (93.8)

ISS, Injury Severity Score; KTS, Kampala Trauma Score.

## Discussion

RTI is a leading cause of death and disability in sub-Saharan Africa, but there are few published reports from the francophone region to inform RTI prevention and especially treatment strategies [3,8,15,16]. This study found that males overall and female pedestrians were more likely to present following RTI and that motorcycle use, residence in outlying village and low economic status were associated with a decreased likelihood of successful treatment and discharge from the emergency room. Awareness of these factors can be used to decrease overall RTI morbidity and mortality, as well as health inequity, through targeted prevention (e.g., increased attention to pedestrians and motorcyclists) and improved treatment strategies [17–20].

Nearly three quarters of the RTI victims were male, and 59% were males between 15 and 45 years-old. This is consistent with other literature in the region that shows males are at increased risk of RTI compared to females, probably as a result of greater mobility and an increased likelihood of work outside the home, but it is also consistent with data from police records from the inter-urban Yaoundé–Douala road section which show that men were more likely to be injured and killed compared to women [8,21,22]. More attention to RTI prevention in this group, especially with regard to motorcycle use, may have a significant impact on overall RTI morbidity and mortality [23,24]. The increased risk of death for motorcyclists was not statistically significant in this study; however, this may be due to selection bias; deaths in this sample did not include those who died on-scene. As motorcyclists were at increased risk of serious injury, it is likely that motorcyclists who die at the scene are transported to the morgue rather than the hospital, suggesting that the number of deaths observed in this road user category may be underestimated. Correlation with other RTI data, such as community surveys and police and newspaper records, may clarify how much motorcycle traffic injuries contribute to morbidity and mortality in and around Yaoundé [15,19,25]. Indeed, police reports from the Yaoundé–Douala road section from 2004 to 2007 showed that 17% of RTI victims died without reaching the hospital, compared to 3% who died at the hospital and that 'motorcyclist' was the second highest road user category involved in collisions [8].

The most common road user category for females was 'pedestrian,' which characterised 40% of RTIs in this group [26]. The need to frequently walk along roads near busy areas, such as markets, may place women at high risk for pedestrian-related RTI, and more attention should be paid to prevention of this injury scenario [8,27].

RTIs tend to disproportionately affect poor and urban populations, exacerbating health inequities [2,28,29]. Overall the majority (73%) of RTI victims that presented to the Central Hospital in Yaoundé were treated and discharged home; however, patients of lower economic status were significantly more likely to die and less likely to be discharged home after RTI. While the vast majority (87%) of RTI victims who presented to the emergency room of the Central Hospital lived in Yaoundé, the portion from the outlying

villages had more severe injuries and were more likely to be operated on or to die. One possible explanation for this difference may be that those from rural areas farther from the city centre may be less likely to come to the Central Hospital for minor injuries, choosing only to come when injuries were more life-threatening.

The nature of the most severe injuries—which most commonly involved the pelvis, extremities or head and neck and consisted of lacerations and both open wounds and fractures—are useful for determining what kind of care should be available for RTIs in a trauma centre in Yaoundé. A select number of surgeons with the operating equipment and training to manage complex injuries, coupled with the equipment and training for initial trauma care in the emergency department, would allow the most severe injuries to be managed, while other physicians and health care workers could be trained to manage more common injuries, such as those involving the extremities [30,31]. This sort of division of labour may lead to more rapid improvement in care for RTIs in developing countries, where there is a dearth of physicians, particularly specialists [30,32].

Hospital-based injury studies yield a limited picture of RTI patterns because they are biased in favour of injuries that are severe enough to cause patients or their families to seek care, while at the same time exclude patients who die at the scene or during transport to the hospital. Patients with severe injuries are more likely to be brought to the referral hospital. In fact, the association between severity of injury and likelihood of transport to the hospital is used in police reports of road collisions in this region: RTI victims are recorded as having severe injuries when they are transported to the hospital [8].

Hospital-based surveillance is also more likely to capture patients who are better able to afford medical care [33]. The majority (84%) of RTI victims in this study arrived at the hospital via taxi or private automobile. This may suggest overall higher economic status among those who reach the hospital compared to those who either die on scene or during transport or who do not seek care; since this study found higher mortality among RTI victims of low economic status, the overall relative risk of death from RTI may be underestimated. The proportion of serious injuries and deaths may be even higher in patients from outlying villages than the hospital-based data suggest since an even larger proportion of those with serious injuries may have died without reaching the hospital compared to patients from Yaoundé. This suggests a need for improved pre-hospital care, especially for those who live far from the tertiary care centre.

This study provides valuable information about RTIs that can be used to improve emergency care in Cameroon, as well as other developing countries in sub-Saharan Africa and elsewhere. This study highlights the importance of RTI prevention, especially in the young urban population. Sixty-three percent of Cameroon's 23 million people are less than 25 years-old. Fifty-two percent are urban, a proportion that is expected to increase by 3% per year [34]. It is likely, at least in the short term while prevention strategies (e.g., promoting safer behaviour among pedestrians and vehicle operators, and improving the design of vehicles and roads) are in their nascent stages, that the burden of RTI in Cameroon and other sub-Saharan African countries will continue to increase. It is, therefore, essential to have an adequate picture of the RTI victims that present to trauma centres and to use this information to improve treatment. Previous work on injury epidemiology in Cameroon has led to increased political will to improve injury prevention and treatment [8,9,20,35]. Hopefully, continued work in this area will build additional momentum to expand injury surveillance and support policies to reduce morbidity and mortality from road traffic injuries in Cameroon and around the world.

## Conflicts of interest

The authors have no conflicts of interest declare.

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