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Factors associated with road traffic injury in a high-risk zone of Bangladesh: a mixed-method study

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ABSTRACT

Introduction Road traffic injuries are a significant public health issue in low-income and middle-income countries. This study was designed to explore the pattern and factors associated with road traffic injury in a high-risk zone of Bangladesh.

Method This mixed-method study included a total of 363 road traffic injury victims for the quantitative component, and 10 traffic-related officials and 10 drivers for the qualitative element. Data were collected using a pretested questionnaire, key informant interviews and a focus group discussion using a focus group discussion guide. Quantitative and qualitative analyses were done using Stata V.17 and NVivo V.12, respectively.

Results Most participants were male, illiterate and young (<30 years) with age averaging 31.50±9.16 years. Of all road traffic injury victims, most had mild (45.18%) injuries, and the least had severe (5.79%) injuries, with head being the most common site (34.44%). The highest proportion of injuries were sustained by motor vehicle drivers (57.58%), followed by cyclists/rickshaw pullers (22.59%) and passengers (19.83%). Most vehicles were new (75.21%), and the rest were old (24.79%). Nearly one-third of the participants did not know about driving rules. The presence of knowledge was associated with less severe injury (p=0.031) compared with the absence of knowledge. The qualitative component of the study identified several factors related to road traffic injury, including driver factors (lack of sleep, bad driving habits and lack of helmets), driving activity factors (ignoring rules, overtaking, crossing speed limits and using bright headlights), road-related factors (broken roads, unplanned curves and angles, the need for spacious streets and the lack of appraisal of previous crash records) and traffic control factors (stringent traffic rules, effective implementation and training on using speed guns).

Conclusion The factors related to road traffic injury identified in this study could be used to plan targeted interventions for road safety improvement.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The burden of road traffic injury is increasing worldwide, including in Bangladesh, leading to an increasing number of people with disabilities and deaths. Consequently, it posits high economic pressure, especially in low-income and middle-income countries such as Bangladesh.

WHAT THIS STUDY ADDS

⇒ This study explores the views held by traffic officials and drivers on the factors responsible for road traffic injuries in a high-risk area of Bangladesh.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings of this study will help identify targets for priority interventions to prevent road traffic injuries in Bangladesh and in similar low-resources settings.

INTRODUCTION

Road traffic injuries (RTIs) are responsible for approximately 1.3 million deaths annually,[1] making these the eighth-leading cause of death worldwide.[2] Over the last three decades, the incidence of RTIs has been increasing each year.[3] More than 9/10 of the world's fatalities due to RTIs occur in low-income and middle-income countries (LMICs).[1] Bangladesh faces a high toll of injuries and deaths each year due to RTIs.[4]

RTIs are associated with considerable loss in the economy and productivity of a country. According to the WHO, most countries lose approximately 3% of their gross domestic product due to road traffic crashes.[1] Although a majority of the economic loss occurs in high-income countries, the highest disability-adjusted life-year loss is estimated in LMICs,[5] with RTI leading to catastrophic out-of-pocket expenditure in many households.[6] In Bangladesh, more than two-thirds of poor households reported a reduction in income and food consumption and dependence on loans following fatal RTIs.[7]

Globally, over half of the deaths due to RTIs occur among vulnerable road users like cyclists, motorcyclists or pedestrians.[2] Previous studies have associated many driver, vehicle, traffic and environment-related factors with road injury,[1 2 8 9] with the distribution of factors differing across countries. In Bangladesh, light-vehicle passengers and pedestrians have been found to be the most affected by RTIs.[10] Lack of knowledge and/or violation of traffic rules and driving unregistered and unfit vehicles are some of the common factors experienced in developing countries such as Bangladesh.[11] Although pedestrians face the most fatalities, drivers are assumed to be the primary mediators of vehicular crashes.[12] Hence, to delve deep into the causes of injury, we hypothesise that it

is essential to understand the experiences of both the individuals driving or commuting in the vehicle at the time of injuries and the stakeholders involved in road design and traffic control. A firsthand view from the driver or passenger perspective among RTI victims could unearth factors hitherto unseen from outside crash scenes.

Chittagong has been identified as one of the high-risk zones liable for RTI in Bangladesh.[13] Therefore, the present study was designed to explore the pattern of RTI, knowledge of driving rules among drivers and passengers and to do a qualitative investigation among drivers and other stakeholders to find out factors deemed liable behind RTIs.

METHODS

Study design, settings and duration

This mixed-method study was conducted between November 2020 and November 2021. The quantitative component involved a cross-sectional descriptive assessment of victims of RTIs treated in the emergency and casualty departments of Chittagong Medical College Hospital (CMCH). Considering the proportion of knowledge about traffic rules of 62% as determined by Islam *et al*[11] a CI of 95%, and a margin of error of 5%, the required sample size was calculated to be 362. Finally, during the study period, a total of 363 drivers and passengers among RTI victims were consecutively selected from the study site. Everyone in the emergency and casualty department of the hospital who suffered RTI was considered for inclusion in the quantitative component. Those who were critically injured or chose not to participate were excluded from the study. For the qualitative component, as there is no definite rule for determining sample size,[14] based on contextual judgement and expert opinions, we selected 10 relevant officials as key informants for key informant interviews (KII) and a group of ten drivers for a focus group discussion (FGD) session (check online supplemental file 1 for a detailed composition).

Data collection instrument

Quantitative component

For the quantitative component, data collection took place by means of a pretested semistructured interviewer-administered questionnaire (online supplemental file 2). In CMCH, the casualty physicians treating the patients with injury used the Abbreviated Injury Scale (AIS) 2005 update 2008 to assess and classify the severity of injury by calculating Injury Severity Score. The AIS is a comprehensive rating system for measuring tissue damage sustained in motor-vehicle crashes. First developed in the mid-1960s for tracking injury in automotive vehicles and aircraft, it has been continuously updated by the Association for the Advancement of Automotive Medicine and is now widely used for rating traumatic injuries.[15] Based on the AIS, each patient's injuries were given one of the following ratings: 1 (mild), 2 (moderate), 3 (serious: severe but not life-threatening), 4 (severe: severe and life-threatening) and 5 (critical: survival uncertain). This was allocated to one of the six body regions, namely, head, face, chest, abdomen, extremities including pelvis and external (skin and soft tissue). The severity of injury of a person is then calculated by summing the squares of the highest AIS code in each of the most severely injured regions. We collected the information on severity from the hospital records of the participating patient. However, for a person with multiple injuries, the injury with the highest severity rating on the AIS was considered for reporting the injury site.

Qualitative component

The qualitative interview asked the key informants about their mode of engagement with road traffic, opinion on the causes behind RTIs, and suggestions on the ways to prevent RTIs. In the FGD, drivers were asked about their thoughts on the causes of RTIs, their role behind injuries, and suggestions on how should these be prevented (online supplemental file 3). Each questionnaire was translated into Bangla by two investigators and was checked by a public health expert in the use of both languages (ie, Bangla and English). Any major deviance in the contextual meaning was identified and corrected on thorough discussion with the team before being dispatched for data collection.

Data collection method

The principal investigator (PI), along with a group of four trained physicians, conducted the quantitative data collection process. They approached patients with RTIs (including both drivers and passengers) who came for treatment in the emergency departments after an initial assessment of severity and when the patient was settled down to a state where an interview could be taken. A convenience sampling method was applied for patient recruitment. The PI conducted the KIIs and the FGD himself with help from two other research assistants. One of the research assistants worked as a facilitator during the discussion session. Another research assistant recorded the interview sessions in audio form, transcribed the audio files verbatim into Bangla and translated them into English for analysis. The research team checked for the accuracy of the transcription and translation at each step.

Patient and public involvement

We updated the questionnaire based on the responses from RTI victims during pretesting. The initial drafted questionnaire was pretested among 20 consecutive RTI victims who came for treatment in the casualty department of CMCH. Neither the patients nor the public was involved in the development of the research question and outcome measures. Neither were they involved in the design and conducting of the study or in the recruitment of participants. However, we plan to disseminate the study results to the traffic officials, drivers and rest of the RTI victims included in the study. We also plan to send copies of the results to the authorities responsible for road safety education, traffic control, road design and management of RTI victims. Additionally, we intend to disseminate our results to the wider community through news articles and mass media.

Data analysis

Quantitative component

Data analysis for the quantitative element was conducted using the Stata V.17 (StataCorp). Charts were created using Microsoft Excel 365. The normality of the quantitative data was checked using histograms and the Shapiro-Wilk test. Descriptive statistics were presented as mean±SD for continuous variables and frequency (percentage) for categorical variables. Bivariate analysis was conducted using the χ^2 test.

Qualitative component

We undertook a phenomenological approach during qualitative data analysis and interpretation. A descriptive thematic analysis as described by Sundler *et al* was followed.[16] The process began with a thorough reading of the transcribed data. The transcriptions were examined for ideas, events, and experiences relevant to RTI occurrence and prevention to develop an initial comprehension of participants' viewpoints. Then, each participant's

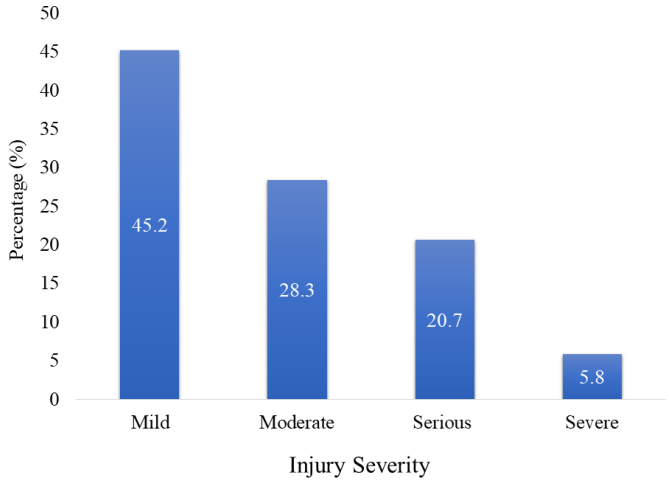

Figure 1 Distribution of participants treated in the emergency and casualty departments of Chittagong Medical College Hospital, Bangladesh in relation to injury severity (November 2020–November 2021).

audio transcripts were saved into separate text files and were put into qualitative analysis software (NVivo V.12) for autocoding of themes. Initially, a set of 23 codes relevant to factors associated with RTIs was initially generated by the software. An additional code was generated and incorporated manually after careful re-reading of transcripts and examining them in relation to automatically generated codes. Finally, four themes related to factors associated with RTI were created from the KIIs. The transcripts generated from FGD were thematically reduced through a similar approach. First, all the transcripts were read carefully to check consistency and relevancy of data. Repeated and irrelevant data were cleaned. Second, suspending any judgement of the researcher, themes were generated through listing, coding, recoding, reduction and clustering. Thus, a set of four factors responsible for injuries was determined from the transcripts of the FGD. A graph was generated using Microsoft Word 365 to express the concepts arising from the FGD.[17]

RESULTS

Quantitative results

As seen in figure 1, most injuries were mild (45.18%), and the least were severe (5.79%) (figure 1). Participants had an average age of 31.50±9.16 years (±SD), and more than half were aged ≤30 years (52.89%). The majority of RTI victims were male (93.29%), were illiterate (64.19%), had monthly income ≥BDT12 000 (US$112) (53.61%) and were married (89.81%). Nearly half of the participants (46.01%) were smokers, and only 2.48% of participants drank alcohol. Of all the participants, 12.95% had difficulty in visions and/or hearing and 7.44% had personal family issues. Types of injury severity were proportionately similar across different categories of demographic characteristics, habits and personal issues of the participants (table 1).

The majority of the RTI victims were motor vehicle drivers (57.58%), worked at morning shift (52.62%), worked 7 days a week (51.52%) and had knowledge of driving rules (63.09%). On the day of the injury, 13.22% of the study sample experienced bad weather, 24.79% were commuting in old vehicles and 29.75% were on high-risk places. More than two-thirds (68.87%) of vehicles crossed the speed limit, and only 10.24% wore seat belts. Torso/limbs were combinedly the most common injury sites (63.09%) than head/face (36.91%). The injury severity only differed considerably across the presence or absence of knowledge of driving rules, where the proportions of moderate and serious severity were relatively higher among those who lacked knowledge and mild severity was much higher among those who had knowledge of driving rules (table 2). Considered separately, the most common injury site with the highest severity rating on the AIS was the head, accounting for 34.44% of cases (online supplemental file 4).

Most of the participants did not know the traffic rules (87.6%). In addition, 67.77% and 61.71% of participants did not know about traffic signs and speed limits, respectively (figure 2). Nearly two-thirds (63.09%) knew at least one of the rules about driving (table 3). However, none of the factors (including age group, sex, education, monthly family income and marital status) were associated with knowledge of driving rules (Cramer's V<0.07 and p>0.05 for all) except the participant's role (ie, motor vehicle driver/cyclist/rickshaw pullers and passengers). A significantly higher proportion of passengers had knowledge about driving rules than drivers or cyclists or rickshaw pullers with a weak degree of association (Cramer's V=0.109, p=0.039).

Qualitative findings

The KIIs of key personnel revealed four themes and thirteen subthemes covering factors associated with injuries. The four themes include traffic control factors, driver factors, activities and road factors (figure 3). At the same time, the FGD among drivers revealed four determinants of injuries: speeding, overtaking, driving unregistered vehicles and substance abuse (figure 4).

Themes

Driver factors

Sleepiness, bad driving habits and lack of a helmet were identified as important reasons for injuries related to drivers. Truck or lorry drivers often do not take adequate rest and, hence, tend to fall asleep while driving. Moreover, drivers tend to violate traffic rules. They habitually overtake in narrow roads or junctions. Ambulance drivers frequently need to overtake other vehicles on busy roads due to a lack of traffic lanes. The chief engineer (KI5) opined that-

> The main problem is overtaking. On the other hand, lorry or truck drivers do not take rest properly.

Activities

While driving, drivers frequently ignore the speed limit on highways, leading to traffic collisions. Emphasising the importance of maintaining the speed limit, one officer-in-charge (OC) of a police station (KI7) said,

> It's difficult to get a solution if a person doesn't maintain the speed limit.

Bright halogen headlamps can create obstacles to the views of opposite-side drivers. Particularly, headlamps used by trucks and highway buses during the night had been found to be responsible for some of the injuries on narrow two-lane roads. This was mirrored in the voice of the engineer (KI5),

> Halogen [head] light also creates a problem for the opposite side driver and causes an injury.

Table 1 Demographic characteristics, habits and personal issues of the participants treated in the emergency and casualty departments of Chittagong Medical College Hospital, Bangladesh by injury severity (November 2020–November 2021) (n=363)

Variable	Injury severity				Total n (%)
	Minor (n=164)	Moderate (n=103)	Serious (n=75)	Severe (n=21)	
Age (years), mean±SD	31.78±9.24	31.93±9.35	30.15±8.56	32.05±9.96	31.50±9.16
Age categories, n (%)					
≤30	85 (44.27)	52 (27.08)	43 (22.40)	12 (6.25)	192 (52.89)
31–40	31 (43.06)	24 (33.3)	15 (20.83)	2 (2.78)	72 (19.83)
>40	48 (48.48)	27 (27.27)	17 (17.17)	7 (7.07)	99 (27.27)
Sex, n (%)					
Female	13 (54.17)	8 (33.33)	3 (12.50)	0 (0.00)	24 (6.61)
Male	151 (44.54)	95 (28.02)	72 (21.24)	21 (6.19)	339 (93.29)
Education, n (%)					
Illiterate	106 (45.49)	68 (29.18)	48 (20.60)	11 (4.72)	233 (64.19)
Primary	45 (42.86)	32 (30.48)	19 (18.10)	9 (8.57)	105 (28.93)
Secondary	13 (52.00)	3 (12.00)	8 (32.00)	1 (4.00)	25 (6.89)
Monthly family income in BDT, n (%)					
<12 000 (<US$112)	81 (48.50)	42 (25.15)	33 (19.76)	11 (6.59)	167 (46.39)
≥12 000 (≥US$112)	82 (42.49)	60 (31.09)	42 (21.76)	9 (4.66)	193 (53.61)
Marital status, n (%)					
Unmarried	21 (56.76)	4 (10.81)	9 (24.32)	3 (8.11)	37 (10.19)
Married	143 (43.87)	99 (30.37)	66 (20.25)	18 (5.52)	326 (89.81)
Smoking habit, n (%)					
Non-smoker	97 (49.49)	58 (29.59)	32 (16.33)	9 (4.59)	196 (53.99)
Smoker	67 (40.12)	45 (26.95)	43 (25.75)	12 (7.19)	167 (46.01)
Alcohol intake, n (%)					
Does not drink	160 (45.20)	100 (28.25)	73 (20.62)	21 (5.93)	354 (97.52)
Drinker	4 (44.44)	3 (33.33)	2 (22.22)	0 (0.00)	9 (2.48)
Difficulty in vision and/or hearing, n (%)					
No	141 (44.62)	92 (29.11)	62 (19.62)	21 (6.65)	316 (87.05)
Yes	23 (48.94)	11 (23.40)	13 (27.66)	0 (0.00)	47 (12.95)
Personal family issues, n (%)					
Present	12 (44.44)	7 (25.93)	7 (25.93)	1 (3.70)	27 (7.44)
Absent	152 (45.24)	96 (28.57)	68 (20.24)	4 (5.95)	336 (92.56)

Road factors

One of the key informants opined that previous crash records can inform traffic control authorities in focusing and prioritising activities in certain areas. Moreover, constructing spacious roads or modifying existing narrow roads to make them wider could decrease the number of injuries. According to another deputy commissioner (KI2),

> We need the specious road, emphasizing [setting up of] traffic signs for the drivers…… We need to follow the statistical reports of recent years. Random blaming is not the way to identify action areas.

One OC (KI9) identified broken roads, unplanned curvatures and angles to be responsible for most injuries,

> It seems that the injuries occur at the same place and almost in the same pattern in regular intervals. Mostly broken roads are liable, while angles and curvatures are [also] irregular and mostly unplanned.

Traffic control factors

The presence of stringent traffic rules, implementation of existing rules and use of speed guns to detect speeding vehicles were three important traffic control-related subthemes derived from the KIIs. We have standard existing traffic rules, which need to be updated and properly implemented for traffic control. Although traffic police have speed guns at their disposal, lack of training might have led to the failure to use the guns properly on roads by the police. As KI7 complained,

> Our traffic police [tried] regulating [traffic] with the speed gun, though [they] failed to control. They should be educated properly regarding its use.

Drivers' perspective on factors behind injuries

In the FGD, in response to the question about the causes of RTIs, all the drivers acknowledged their responsibility for the occurrences of injuries. The bus driver who participated in the FGD confessed that sometimes they tend to overtake on the roads,

> …Sometimes we do overtake to avoid the [traffic] jam.

Overall, four factors were identified to be contributing to injuries by the drivers (figure 4). Using unregistered unfit vehicles on the roads is prohibited by law in the country. However, these are often used on roads disregarding traffic rules to avoid registration fees. Substance abuse behaviour, although very uncommon, was, nevertheless, recognised as a problem by the drivers. The truck driver noted,

> I know some drivers who are addicted to drugs…

Table 2 Work, vehicle, crash day factors, knowledge of driving and injury site among participants treated in the emergency and casualty departments of Chittagong Medical College Hospital, Bangladesh by injury severity (November 2020–November 2021) (n=363)

Variable	Injury severity				Total n (%)
	Minor (n=164)	Moderate (n=103)	Serious (n=75)	Severe (n=21)	
Role, n (%)					
Motor vehicle driver	95 (45.45)	59 (28.23)	46 (22.01)	9 (4.31)	209 (57.58)
Cyclist/rickshaw puller	36 (43.90)	22 (26.83)	15 (18.29)	9 (10.98)	82 (22.59)
Passenger	33 (45.83)	22 (30.56)	14 (19.44)	3 (4.17)	72 (19.83)
Working shift, n(%)					
Evening	34 (46.58)	23 (31.51)	12 (16.44)	4 (5.48)	73 (20.11)
Morning	88 (46.07)	52 (27.23)	39 (20.42)	12 (6.28)	191 (52.62)
Both	42 (42.42)	28 (28.28)	24 (24.24)	5 (5.05)	99 (27.27)
Workdays per week, n (%)					
≤6 days	71 (40.34)	54 (30.68)	38 (21.59)	13 (7.39)	176 (48.48)
7 days	93 (49.73)	49 (26.20)	37 (19.79)	8 (4.28)	187 (51.52)
Bad weather on the crash day, n (%)					
Yes	24 (50.00)	8 (16.67)	14 (29.17)	2 (4.17)	48 (13.22)
No	140 (44.44)	95 (30.16)	61 (19.37)	19 (6.03)	315 (86.78)
Vehicle status*, n (%)					
New	123 (45.05)	77 (28.21)	57 (20.88)	16 (5.86)	273 (75.21)
Old	41 (45.56)	26 (28.89)	18 (20.00)	5 (5.56)	90 (24.79)
Occurrence of the event in high-risk place, n (%)					
Yes	49 (45.37)	30 (27.78)	21 (19.44)	8 (7.41)	108 (29.75)
No	115 (45.10)	2 (28.63)	54 (21.18)	13 (5.10)	255 (70.25)
Knowledge of driving rules					
Present†	115 (50.22)	55 (24.02)	44 (19.21)	15 (6.55)	229 (63.09)
Absent	49 (36.57)	48 (35.82)	31 (23.13)	6 (4.48)	134 (36.91)
Crossed speed limit, n (%)					
Yes	114 (45.60)	67 (26.80)	57 (22.80)	12 (4.80)	250 (68.87)
No	50 (44.25)	2 (36.31)	18 (15.93)	9 (7.96)	113 (31.13)
Wearing seatbelt at the time of crash‡, n (%)					
Yes	6 (35.29)	4 (23.53)	7 (41.18)	0 (0.00)	17 (10.24)
No	69 (46.31)	43 (28.86)	29 (19.46)	8 (5.37)	149 (89.76)
Injury site, n (%)					
Head/face	61 (45.52)	41 (30.60)	3 (17.91)	8 (5.97)	134 (36.91)
Torso/limbs	103 (44.98)	62 (27.07)	51 (22.27)	13 (5.68)	229 (63.09)

*Purchased and licensed within the last 2 years.
†Knows at least one of the following—driving rules, speed limit and road signs.
‡Among drivers of cars, lorries and trucks only.

They also opined that hangovers or sudden onset cravings caused by the drugs could lead to injuries and decreased attention.

DISCUSSION

The demographic patterns of this study match the findings of previous studies conducted among hospitalised RTI victims in Bangladesh,[10 13 18 19] identifying adolescents and young adults as the most affected age group and males as the most affected sex. This pattern is nearly universal around the globe,[3] with one-fourth of the fatal traffic injuries occurring in the 18–24 years age group.[8] Males are two times more likely to be victims of RTI than females.[3] Adolescents show impulsivity, sensation seeking and risky behaviour as a result of a major brain reorganisation that selectively affects the prefrontal cortex.[20] Particularly, young male drivers are prone to speeding, hurrying, careless and reckless driving, explaining the increased risk of injuries in this age group.[21] In the FGD, we found that drivers acknowledged their tendency to high-speed driving and overtaking, which emphasises the point of risk-taking behaviour. The sleepiness of drivers and bad driving habits were also identified as important factors behind the road traffic crashes from the KIIs.

Our study found that nearly two-thirds of the participants had knowledge of driving rules. A concordant finding was also observed among the motor-bikers of Dhaka city (the capital of Bangladesh) by Das *et al*.[22] They explored bikers' responses on a detailed list of traffic and driving related questions and found that only 54.6% of the bikers had good knowledge. Taxi drivers in other developing countries like Iran[23 24] and India[25] also tend to show a low to moderate level knowledge of traffic rules. Therefore, traffic education tailored for drivers is essential in these settings. We also found that passengers were significantly more likely to have knowledge of driving rules than drivers or cyclists or rickshaw pullers, which is dissimilar to that previously found by Islam *et al*.[11] Drivers are supposed to have a better knowledge of traffic rules, as they are obliged by law to learn and follow these rules while driving. However, contrary to expectation we found an opposite picture. This low proportion of good

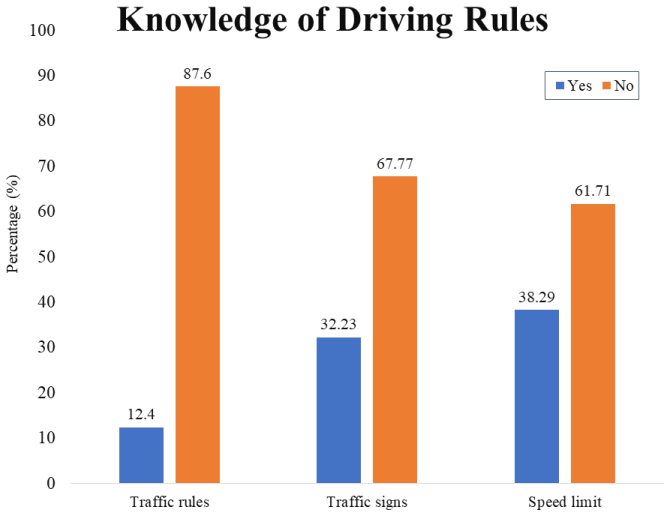

Figure 2 Distribution of participants treated in the emergency and casualty departments of Chittagong Medical College Hospital, Bangladesh in relation to the knowledge of driving rules (November 2020–November 2021).

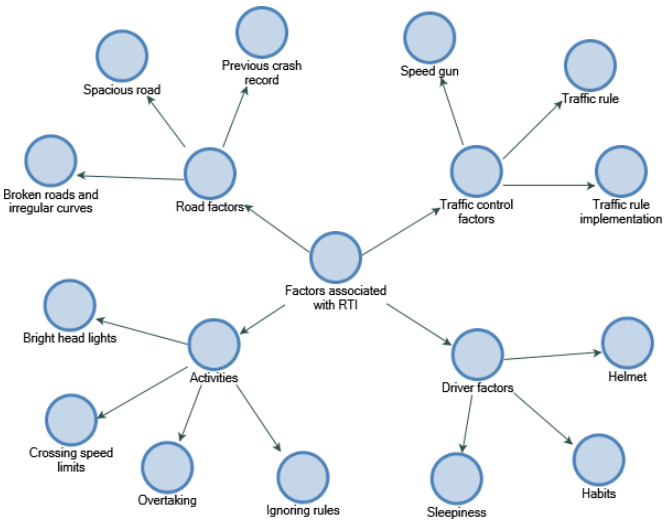

Figure 3 Factors associated with road traffic injuries (RTIs) among participants treated in the emergency and casualty departments of Chittagong Medical College Hospital, Bangladesh (November 2020–November 2021).

knowledge about driving rules among our drivers, cyclists and rickshaw pullers might have been affected by their level of education. In support, we found that a considerately higher proportion of drivers or cyclists/rickshaw pullers had lower education level compared with passengers in our study (online supplemental file 5). Moreover, similar to Islam *et al*,[11] Das *et al*,[22] and Hossain *et al*,[26] we found that participants with a lower level of education were less likely to have knowledge of driving rules.

A study from Iran[27] suggested that the higher level of education among drivers is significantly associated with lower mortality due to RTI. This means crashes which lead to fatal injuries are less common among drivers who are highly educated. In contrast, we did not find any association between severity of RTI and with education level of participants. But, as we did not include victims of fatal and critical RTIs, a conclusive remark on the association is difficult to make. However, in concordance

Table 3 Factors associated with the presence of knowledge regarding driving rules among participants treated in the emergency and casualty departments of Chittagong Medical College Hospital, Bangladesh (November 2020–November 2021) (n=363)

Factors	Knowledge		χ^2 statistic	P value	Cramer's V
	Present	Absent			
n (%)	229 (63.09)	134 (36.91)			
Age groups in years, n (%)					
≤30	122 (63.54)	70 (36.46)	1.728	0.421	0.069
31–40	41 (56.94)	31 (43.06)			
>40	66 (66.67)	33 (33.33)			
Sex, n (%)					
Female	18 (75.00)	6 (25.00)	1.567	0.211	−0.066
Male	211 (62.24)	128 (37.76)			
Education, n (%)					
Illiterate	144 (61.80)	89 (38.20)	0.551	0.759	0.039
Primary	68 (64.76)	37 (35.24)			
Secondary	17 (68.00)	8 (32.00)			
Monthly family income in BDT, n (%)					
<12 000 (<US$112)	111 (66.47)	56 (33.53)	1.317	0.251	−0.061
≥12 000 (≥US$112)	117 (60.62)	76 (39.38)			
Marital status, n (%)					
Single	25 (67.57)	12 (32.43)	0.355	0.551	−0.031
Married	204 (62.58)	122 (37.42)			
Role, n (%)					
Drivers/cyclists/rickshaw pullers	176 (60.48)	115 (39.52)	4.273	0.039*	0.109
Passenger	53 (73.61)	19 (26.39)			

P values were determined by the χ^2 tests.
*Significant at p<0.05 level.

Figure 4 Factors contributing to road traffic injuries as acknowledged by the drivers.

with Roy *et al*,[18] we found that the presence of knowledge was associated with a lower severity of injury. The possible reason for such finding could be that awareness of rules is likely to curtail the tendency of speeding. While speeding is recognised by the WHO as a factor associated with the severity of the consequence of a crash.[1]

Most of the RTI patients experienced motor vehicle crashes as opposed to motorless vehicle (like bicycles or human pulled rickshaws or vans) crashes and the majority of the participants sustained head injuries. This finding is similar to that of Roy *et al*[18] both in terms of vehicles involved and injury site. They noted that nearly four-fifths of the injury victims were in motor vehicles and had head, and/or face involvement. The head of a person is subjected to direct and shearing forces during a road crash. Hence, one of the ways to prevent head injury during crashes is to wear seat belt. However, nearly 9/10 of our RTI victims were not wearing seat belts. Which probably explains the high proportion of severe head injury in this study.

The qualitative component of our study recognised speeding motor vehicles as a crucial factor contributing to injuries. This view was endorsed by both key informants and the drivers and is supported by observations on a global scale.[1]

The KIIs in our qualitative step captured four themes related to determinants of injuries, including factors related to driver, driving activities, roads and traffic control. Almost all these factors were denoted and reported by Rolison *et al*,[9] who explored the law enforcement agency views and ordinary drivers' opinions on determinants of injuries as well as reviewed the road crash records. Among the road-related factors, broken roads and irregular or poorly designed curvatures, and lack of spacious roads were two important limitations identified by the key informants. Road problems were reported to be a major factor behind RTIs in other South Asian countries like India[28] and Nepal,[29] which support our observations. However, bad weather could work as an add-on to the existing risk of poor road conditions.[30] More than 1/10 of our participants experienced bad weather on the day of the crash.

Among the activities conducive to injuries, ignoring traffic rules was suggested as an important determinant of RTI by the key informants. Selvan and Mohanraj[31] noted that drivers' non-compliance with traffic rules and regulations was one of the important explanations behind RTIs, alongside the lack of knowledge of traffic rules. Islam *et al*[11] described breaking traffic rules as the second-most important reason behind RTI in Bangladesh. The provision of safe road infrastructure and safe vehicles is not enough if traffic rules are violated by the drivers. Overtaking may lead to a head-on crash, and speeding increases the risk of crash. However, both from traffic personnel and drivers we found that overtaking and speeding are common phenomenon on the roads in Bangladesh.

Our key informants also proposed that glare from bright halogen headlights from the oncoming vehicles often blocks sight of the driver, leading to injuries during the nighttime. Particularly, drivers failing to recognise pedestrians due to the headlight glare of oncoming vehicles is a global problem behind injuries.[32 33]

The key informants indicated that traffic police should be trained in the use of speed guns to detect overspeeding vehicles on roads. Moreover, the existing traffic rules should be strengthened, and implementation should be ensured for the prevention of injuries. Bangladesh has undertaken several major initiatives, including policy formulation, research, education, legislation and engineering intervention to combat RTI. These interventions have been shown to reduce number crashes around the world.[34] However, the progress in Bangladesh has been slow compared with the magnitude of the problem.[35] Hence, it is imperative that the traffic controlling authority review the traffic safety goals and strategies of nations with lower frequency of RTI[36] and update and contextualise the existing laws and rules in order to decrease incidence of RTI in the country.

Limitations and strength

This study's limitations include that it was conducted in a single district, and thus lacks a reflection of RTI and injury scenarios from other parts of the country. Second, the participants were consecutively selected from a specific hospital rather than the community, potentially missing individuals with minor injuries who might not have sought treatment from the hospital or those seeking treatment from other health facilities. The non-random sampling approach limits the generalisability of the result. However, to approach every possible patient entering the emergency unit within the stipulated time, a consecutive sampling was done to reach the sample size. Third, passengers' views were not obtained in the qualitative section of the study, potentially missing the perspective of individuals who were commuting in the vehicle at the time of the crash. However, it was one of the first studies which used a mixed-method approach to identify the pattern and factors behind RTIs in a developing country.

CONCLUSION

RTIs are a serious public health concern for developing countries such as Bangladesh. It is crucial to plan and implement practical solutions, including strengthening road infrastructure, promoting safe driving habits, educating about driving rules, applying traffic rules and raising public awareness to prevent RTIs. These initiatives can lessen the burden of RTIs while also enhancing the general health and well-being of the community through enhancement of health-awareness.

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