Injury severity levels and associated factors among road traffic collision victims referred to emergency departments of selected public hospitals in Addis Ababa, Ethiopia: the study based on the Haddon matrix

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Abstract

Background: Globally, about 1.25 million people die annually from road traffic collisions. Evidence from global safety report shows a decreasing trend of road traffic injury in developed countries while there is an increasing trend in many developing countries including Ethiopia. This study is aimed at assessing factors affecting injury severity levels of road traffic collision victims referred to selected public hospitals in Addis Ababa based on the Haddon Matrix.

Methods: A hospital-based cross-sectional study design was implemented to randomly select a total of 363 road traffic collision victims. The collected data was cleaned and entered into Epidata version 3.1 and exported to SPSS Version 21 for analysis. Bivariate and multivariate logistic regression models were used to examine the association between explanatory and outcome variables.

Results: A total of 363 individual sustained road traffic injuries were included to the study. The prevalence of severe injury among road traffic accident victims was 36.4%. The following variables were significantly associated with increased injury severity: motorbike rider or motorbike passenger without helmet, adjusted odds ratio (AOR) 4.7 (95% CI: 1.04–21.09); driving under the influence of alcohol, crude odds ratio (COR) 2.64 (95% CI: 1.23–5.64); victim with multiple injuries, AOR 3.88 (95% CI: 2.26–6.65); vehicle size, AOR 2.14 (95% CI: 1.01–4.52); collision in dark lighting condition, AOR 1.93 (95% CI: 1.01–3.65); collision in cross city/rural, AOR 1.95 (95% CI: 1.18–3.24) and vehicle occupant travelling unrestrained on the back of a truck, AOR 3.9 (95% CI: 1.18–12.08). On the other hand, victims extricated at the scene by health care professional, AOR 0.33 (95% CI: 0.13–0.83); victims extricated at the scene by police AOR 0.47 (95% CI: 0.24–0.94); strict traffic police control at the scene of the collision, AOR 0.49 (95% CI: 0.27–0.88) were significantly associated with less severe injuries.

Conclusions: Findings reported in this paper suggest the need for immediate and pragmatic steps to be taken to curb the unnecessary loss of lives occurring on the roads. In particular, there is urgent need to introduce road safety interventions.

Keywords: Road traffic accident, Injury severity, Haddon matrix, Ethiopia

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Background

Globally, about 1.25 million people die annually from road traffic accident. This means more than 3400 death claims on a daily basis as a result of road traffic accident [1]. In addition, about 20 to 50 million people sustain non-fatal injuries as a result of road traffic crashes [2, 3]. The problem is anticipated to become the fifth leading cause of death with the annual death toll reaching 2.4 million by the year 2030 owing to an increased motor vehicle ownership and use associated with economic growth in developing countries [3, 4]. Indeed, it results in 3% loss of the gross domestic product worldwide and up to 5% in low and middle-income countries [1].

Accident pattern observed in developed countries show a decrease in road traffic accident while injury trends are notably increasing in middle and low-income countries including Ethiopia [3]. This trend will go further with the noticeable disparity between developed and developing countries [2, 3].

In 2015, the proportion of vehicle was 46.6 per 1000 people in Africa while 510.3 per 1000 people in Europe. However, the highest death rate from road traffic accident recorded in Africa when compared with Europe stands at 26.6 per 100,000 population versus 9.3 respectively [5].

In Ethiopia, road traffic collision is one of the critical road transport problem [6]. According to a 2015 global road safety report, the total numbers of vehicles registered in 2011/2012 Ethiopia fiscal year were 478,244. However, the WHO estimated fatality rates were 25.3 per 100,000 populations. This rate was far greater than rate registered in developed countries [1].

Even though Ethiopia has numerous problems related to road traffic safety, the study on road traffic collision (RTC) in the country is limited. Only a few published studies show the burden of road traffic accident in the country [7–12]. To the best of investigators’ knowledge, there is no study conducted on factors affecting injury severity of RTC in Ethiopia. As a result, the causal relationship between injury severity of road traffic accident victims and potential risk factors in Ethiopia remains unknown. So this study is aimed at assessing factors affecting injury severity levels of RTC victims referred to selected public hospitals in Addis Ababa based on Haddon Matrix.

Methods

Study setting and period

This study was conducted from March 1 to May 10, 2017 in selected public hospitals in Addis Ababa. The selected hospitals were the only hospitals in Ethiopia that provided trauma care at the national level. These public hospitals were Tikur Anbessa Specialized Teaching Hospital (TASTH), St. Paul Millennium Medical College and Hospital (SPMMCH) and All Africa Leprosy, Tuberculosis, Rehabilitation and Training Center (ALERT) Hospital.

Study design

A hospital-based cross-sectional study design was conducted to determine injury severity levels and associated factors at selected public hospitals in Addis Ababa, Ethiopia.

Source population

All patients attending the Emergency Department of the above mentioned public hospitals in Addis Ababa during the study period were the source population.

Inclusion criteria, exclusion criteria and study subject

Road traffic collision victims who were referred to Emergency departments of selected public hospitals in Addis Ababa during the study period, regardless of their injury severity level and consented to participate were included in the study. However, victims or the family of the victims (for those unconscious and/or under 18 years old) that failed to give consent were excluded from the study. In addition, road traffic injuries as a result of non-motorized vehicles like bicycles and carts were excluded from this study.

Sample size and sampling procedure

Sample size (n) was determined using single population proportion formula with the following assumptions: Based on the study conducted at Bugando Medical Centre in Northwestern Tanzania the prevalence of severe road traffic injury was 38.6% [13]. The level of confidence (α) was taken as 0.05 (Z α = 1.96); the margin of error was taken as 0.05. Accordingly, 363 road traffic collision victims were included in this study. In addition, to select study subject, sampling frame was developed from triage entry point and each respondent was accessed based on sampling frame by simple random sampling technique.

Data Collection techniques and instruments

A pre-tested, structured, interviewer-administered questionnaire was used to collect data from study subjects. The questionnaire was developed after reviewing a number of literature [14–17]. The questionnaire has both open and close-ended questions. The key factors that were associated with road traffic collisions severity were classified based on Haddon Matrix. Furthermore, medical records of the victims were reviewed to check for consistency between information obtained from the interview and information recorded on the patient’s chart. Additional information were collected from police.
and medical staff in a condition that needs further information about the collision. The data collectors were Nurses. They were recruited based on their competence and data collection experiences.

**Measurement**

Kampala Trauma Score II (KTS II) was applied to measure injury severity scores. It was adopted from a previous study [18]. KTS II was applied to this study because of its similar performance with injury severity score (ISS), Revised Trauma Score (RTS), and Trauma Score and Injury Severity Score (TRISS) method to classify injury severity level [19]. Apart from this, the KTS II is considered as a potential tool for triage in resource-constrained setting [19]. And also, KTS II is able to provide a reliable measurement for injury severity classification in emergency setting [18]. Indeed, KTS has clinically significant ability to predict the need for hospitalization and fatality in resource-constrained settings [20, 21]. See (Table 1) for description of KTSII.

**Operational definitions**

**Severe injury**

Any RTC related injury resulting in a Kampala trauma score II of 6 or less [18].

**Not severe injury**

Any injuries resulting in a KTSII of 9 to 10 were considered as mild while KTSII of 7 to 8 were considered as a moderate [18]. However, for the purpose of this study, mild and moderate injuries were categorized under not severe injury.

**Data entry, processing, and analysis**

The data was checked for completeness and consistency. Then it was cleaned and coded. The collected data was entered into EpiData version 3.1 (EpiData Association, Odense, Denmark) and then exported to SPSS version 21.0 (IBM Corp., Armonk, NY, USA) for further statistical analysis.

Descriptive statistics were used to summarize the data. Bivariate logistic regression was used to explore the association of each independent variable with the dependent variable. Initially, the crude odds ratio (COR) for each independent variable was calculated at 95% confidence interval (CI). All variables with P-value of < 0.25 were considered for multivariate logistic regression to control the effect of other confounders. Lastly, the significance level was set at P < 0.05.

**Ethical clearance**

Ethical clearance was obtained from Addis Ababa University Emergency Medicine Department Research Ethics Committee (REC). Letter of permission was granted from TASTH, ALERT and AaBET administration officials. Informed consent was obtained from all conscious victims prior to proceeding data collection from them. The information collected from each participant was kept confidentially.

**Results**

**Socio-demographic characteristics of the respondents**

This study found that about three fourth 278(76.6%) of those who sustained RTC were males. Age group 21 to 30 years were mainly affected by RTC; followed by age group 12 to 20 years, and they account for 141(38.8%) and 74(20.4%) respectively (Table 2).

**Basic characteristics of respondents**

**Host-related characteristics**

About 215(59.2%) of the RTC were happened by light vehicles followed by medium vehicles, 107(29.5%). In addition, collisions with pedestrian (144(39.7%)) and vehicle to vehicle collisions71(27.3%) were the main collision types in this study respectively (Table 4).
Bivariate and multivariate analysis of factors associated with injury severity level

Host-related characteristics that determine road traffic collision severity level

In this study, victim type was found to have a statistically significant association with road traffic collision injury severity. Accordingly, vehicle occupants were 58% less likely to be severely injured compared to pedestrians, AOR 0.42 (95% CI; 0.20–0.88) (Table 6).

A multivariate analysis shows that individual with multiple injuries was nearly four times more likely to have a severe injury than their counterparts, AOR 3.88 (95% CI; 2.26–6.65) (Table 6).

Helmet utilization by motorist or motorbike occupants was associated with road traffic collision injury severity. Motorist or occupants who did not use helmet were nearly five times more likely to sustain a severe injury compared to those who used a helmet (Table 6).

Agent related characteristics that determine road traffic collision severity level

Road traffic collision injury severity was associated with the type of motor vehicle involved. This study depicted that victims involved in large heavy vehicle collision were 2.14 times more likely to develop severe injury than those involved in alight heavy vehicle with AOR 2.14 (95% CI; 1.01–4.52) (Table 6).

Moreover, collisions occurring due to two-vehicular crash were 52% less likely to cause severe injuries compared to collisions occurring due to vehicle and pedestrian collisions after adjusting for potential confounders, AOR 0.48 (95% CI; 0.24–0.93) (Table 6).

Environmental characteristics that determine road traffic collisions severity level

Road traffic collisions which happened in dark environments were nearly two times more likely to be severe than those which happened in daylight with AOR 1.93 (95% CI; 1.01–3.65). In addition, collisions which happened in across-city or rural area were 1.95 times more likely to be severe than road traffic collisions which happened in the urban area, AOR 1.95 (95% CI; 1.18–3.24) (Table 6).

The accidents which happened to individuals in an environment with tight traffic police control were 51% less likely to be severe injuries than a place where there was no tight traffic police control, AOR 0.49 (95% CI; 0.27–0.88).

The availability of traffic signal or a tool like zebra crosswalk, traffic light, guardrail, pictures, symbols and speed breakers affects severity related to road traffic collisions. Collisions occurring in such environments were 42% less

Table 2 Description of socio-demographic characteristics of the respondents

| Variable                         | Categories                  | Frequency (Percentage) | Injury severity level | x²  |
|----------------------------------|-----------------------------|------------------------|-----------------------|-----|
| Sex                              | Male                        | 278 (76.6)             | Severe 105 Not severe 173 | 0.314 |
|                                  | Female                      | 85 (23.4)              | Severe 27 Not severe 58 |     |
| Age                              | 12 to 20                    | 74 (20.4)              | Severe 33 Not severe 41 | 0.490 |
|                                  | 21 to 30                    | 141 (38.8)             | Severe 49 Not severe 92 |     |
|                                  | 31 to 40                    | 70 (19.3)              | Severe 22 Not severe 48 |     |
|                                  | 41 to 50                    | 48 (13.2)              | Severe 16 Not severe 32 |     |
|                                  | > 50                        | 30 (8.3)               | Severe 12 Not severe 18 |     |
| Occupation                       | Own work (including merchant)| 136 (37.5)             | Severe 45 Not severe 91 | 0.738 |
|                                  | Driver                      | 34 (9.4)               | Severe 14 Not severe 20 |     |
|                                  | Government/Private employee | 66 (18.2)              | Severe 27 Not severe 39 |     |
|                                  | Student                     | 54 (14.9)              | Severe 20 Not severe 34 |     |
|                                  | Daily laborers              | 28 (7.7)               | Severe 11 Not severe 17 |     |
|                                  | Farmers                     | 31 (8.5)               | Severe 12 Not severe 19 |     |
|                                  | Others                      | 14 (3.8)               | Severe 5 Not severe 9  |     |
| Region at which accident happened| Oromia                      | 172 (47.4)             | Severe 61 Not severe 111| 0.734 |
|                                  | Amhara                      | 52 (14.3)              | Severe 18 Not severe 34 |     |
|                                  | SNNPE                       | 34 (9.4)               | Severe 14 Not severe 20 |     |
|                                  | Addis Ababa                 | 87 (24)                | Severe 32 Not severe 55 |     |
|                                  | Others                      | 18 (4.9)               | Severe 8 Not severe 10 |     |

aDriver assistant, retired, jobless
bTigray, Benishangul, Harar, Afar, Gambella, Ethiopia Somali
likely to be severe than environments without them with AOR of 0.58(95% CI; 0.35–0.96) (Table 6).

Vehicle occupants seating location has a statistically significant association with road traffic collision injury severity in this study. Vehicle occupant travelling unrestrained on the back of a truck were nearly four times more likely to sustain severe injuries than vehicle occupants sat in the middle of a passenger vehicle, AOR 3.9(95% CI; 1.18–12.080) (Table 6).

Victims who were extricated at the scene by health care professionals were 67% less likely to suffer severe injuries than those extricated by bystanders, AOR 0.33(95% CI; 0.13–0.83). Those extricated at the scene by police officers were fifty-3 % less likely to be severely injured than those extricated by bystanders with AOR of 0.47(95% CI; 0.24–0.94) (Table 6).

**Discussion**
This study identified that the prevalence of severe injury among road traffic collision victims was 36.4%. This study’s finding was nearly similar to a study conducted in Bugando Medical Center of Tanzania with 38.6%

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**Table 3** Distribution of host-related characteristics

| Variables                  | Categories                          | Frequency (Percentage) | Injury severity status | $\chi^2$ |
|----------------------------|-------------------------------------|------------------------|------------------------|---------|
|                            |                                     |                        | Severe | Not severe |         |
| Victims type               | Pedestrian                          | 144 (39.7)             | 52     | 92        | 0.081   |
|                            | Driver                              | 39 (10.7)              | 43     | 98        |         |
|                            | vehicle occupant                    | 141 (38.8)             | 20     | 19        |         |
|                            | Motorbike rider or Occupant         | 39 (10.7)              | 17     | 22        |         |
| Duration of having driving license prior to accident | ≤2 years | 107 (29.5) | 43 | 68 | 0.474 |
|                            | 3 to 4 years                        | 113 (31.1)             | 35     | 78        |         |
|                            | ≥5 years                            | 111 (30.6)             | 40     | 73        |         |
| Driver violate right of way | Yes                                 | 127 (35)               | 48     | 79        | 0.67    |
|                            | No                                  | 236 (65)               | 84     | 152       |         |
| Driver used alcohol        | Yes                                 | 34 (9.4)               | 19     | 15        | 0.011   |
|                            | No                                  | 148 (40.8)             | 48     | 100       |         |
|                            | Unknown                             | 182 (50.1)             | 66     | 116       |         |
| Multiple injuries          | Yes                                 | 221 (60.9)             | 107    | 114       | 0.000   |
|                            | No                                  | 142 (39.1)             | 25     | 117       |         |
| Driver used Seat belt      | Yes                                 | 21 (53.8)              | 11     | 10        | 0.232   |
|                            | No                                  | 18 (46.2)              | 6      | 12        |         |
| Vehicle occupant used Seat belt | Yes | 17 (12.1) | 6 | 11 | 0.261 |
|                            | NO                                  | 124 (87.9)             | 42     | 75        |         |
| Motorist or occupant used helmet | Yes | 17 (43.6) | 5 | 12 | 0.016 |
|                            | No                                  | 22 (56.4)              | 15     | 7         |         |

*About 32 drivers either didn’t have driving license or unknown license status*

**Table 4** Distribution of vehicle and collision type

| Variables                  | Categories                          | Frequency (Percentage) | Injury Severity status | $\chi^2$ |
|----------------------------|-------------------------------------|------------------------|------------------------|---------|
|                            |                                     |                        | Severe | Not severe |         |
| Vehicle type               | Light vehicle                       | 215 (59.2)             | 67     | 148        | 0.024   |
|                            | Medium Heavy vehicle                | 107 (29.5)             | 44     | 63         |         |
|                            | Large Heavy Vehicle                 | 41 (11.3)              | 21     | 20         |         |
| Accident type              | Collision with pedestrian           | 144 (39.7)             | 52     | 92         | 0.045   |
|                            | Collision with animate/an inanimate object | 30 (8.3) | 14 | 16 |         |
|                            | Vehicle to vehicle collision        | 71 (27.3)              | 16     | 55         |         |
|                            | Overturning                         | 96 (26.4)              | 39     | 57         |         |
|                            | Falling from moving vehicle         | 22 (6.1)               | 11     | 11         |         |
prevalence [13]. On the other hand, it was higher than the finding reported from Ethiopia and Kenya which were 10.87 and 19% respectively [7, 14]. The discrepancy could be due to the nature of the studies. This study was conducted in three public hospitals that mainly provide trauma care at the national level while the previous studies in Ethiopia and Kenya were conducted in none hospital.

Regarding the age of road traffic collision victims, majority 141 (38.8%) of them were within the age group of 21–30 years (Table 2). This finding was in line with previous studies from Ethiopia [22, 23]. Concerning sex, males 278 (76.6%) were more frequently affected by road traffic accident than females (23.4%). The higher male prevalence in road traffic accidents was previously reported by several studies [7, 13, 23, 24].

The proportion of RTC was higher among pedestrians 144 (39.7%) followed by vehicle occupants 141 (38.8%) (Table 3). This finding was in agreement with previous studies conducted in Ethiopia and other studies from low and middle-income countries [8, 13]. This might be due to inadequate sidewalks for pedestrians, poor road design and inadequate road traffic signals in the country for pedestrians. It could be also due to inadequate public awareness of road traffic rules, the discourteous behavior of drivers or motorists, violation of traffic rules by drivers and pedestrians in the country [23].

The Ethiopian government is enforcing preventive measures such as seat belt use for both drivers and vehicle occupants, and helmet use for both motorists and motor occupants [1]. However, only 17 (12.1%) of the vehicle occupants and 21 (53.8) of injured driver used seat belts-while 17 (43.6%) of the motorist or motorbike occupants used a helmet (Table 3). The latter finding was similar with a study done in Tanzania, 43.3% [24].

Majority of the collisions happened in the daylight, 260 (71.6%) (Table 5). This finding was consistent with other studies [13, 23]. In addition, the majority of the collisions occurred in urban settings, 195 (53.7%). This finding was in contrast to the study done in Iran [15]. The existence of traffic jam during the daytime, poor road network and mixed traffic flow system in urban areas might be the reasons for higher collision during daylight and in urban areas [25].

Majority of the victims arrived healthcare facilities by private vehicles, 252 (69.4%), followed by ambulances 89 (24.5%) (Table 5). Though the proportion of victims that arrived the health facilities by ambulance was low, this finding is slightly higher than the result reported by previous studies in Addis Ababa [8, 22]. Concerning pre-hospital care, only 52 (14.3%) of the victims had prehospital care. This finding was higher than reports from previous studies in Ethiopia and Tanzania, which reported 0% prehospital services for RTA victims [7, 13]. The higher ambulance utilizations and the prehospital services received by victims in this study could be due to the establishment of organized prehospital services in Addis Ababa and involvement of private business groups in the ambulance and the pre-hospital services such as Tebita Ambulance in Addis Ababa.

The drivers who drove under influence of alcohol were 2.64 times more likely to cause severe injury to themselves or to others than when compared with their counterparts on bivariate analysis, COR 2.64 (95% CI; 1.23–5.64). However, it is statistically not significant on multivariate analysis, AOR 2.1 (95% CI; 0.93–4.71) (Table 6). Alcohol consumption and driving had a clear effect on injury severity as reported by previous studies from Philippines, United States and Canada [26–28].

The protective effect of helmet use on injury outcomes has been well documented in previous studies [29, 30]. In line with other studies, the present study found statistically significant association between injury severity level and helmet use on multivariate analysis, AOR 4.7 (95% CI; 1.04–21.09) (Table 6). The study revealed that vehicle to vehicle collisions were 52% less likely to cause severe injury than vehicle to pedestrian collisions, AOR 0.48 (95% CI; 0.24–0.93) (Table 6). A study from Iran and Germany also reported existence of association between crash type and injury severity [15, 31]. Moreover, the crash involved large heavy vehicles were 2.14 times more likely to be severe than light vehicles with AOR of 2.14 (95% CI; 1.01–4.52). This finding is in agreement with other studies [32–35].

The collisions happening in dark conditions were almost two times more likely to be severe than those happening in daylight, AOR 1.93 (95% CI; 1.01–3.65) (Table 6). This finding is consistent with other studies conducted in the developing and developed world [14, 17, 26, 27, 36]. A road traffic collision that occurred in the cross-city or rural environment is more likely to be severe than collisions that happened in urban areas, AOR 1.95 (95% CI; 1.18–3.24) (Table 6). This finding is consistent with the study conducted in Sweden [37]. This might be attributed to excessive speeding, low traffic police presence, inadequacy or absence of emergency medical services, and greater distance to hospitals in the rural areas [7].

Victims who sustained road traffic injury in environments equipped with safety tools like traffic lights, guardrails, speed breakers and safety signals such as traffic symbols, pictures, and a zebra crosswalk were 42% less likely to sustain severe injuries than their counterparts with AOR of 0.58 (95% CI; 0.35–0.96). Furthermore, this study shows that injuries occurring in environments with tight traffic police control were 51% less likely to be severe than those occurring in locations without tight traffic police control, AOR 0.49 (95% CI; 0.27–0.88).
Table 5 Environmental characteristics of RTC victims. Environment-related characteristics of respondents

| Variables                        | Categories                        | Frequency (percentage) | Severity status | x²     |
|---------------------------------|-----------------------------------|------------------------|-----------------|--------|
|                                 |                                   |                        | Severe | Not | Severe | Not |        |
| Time of collision               | 8 am to 2 pm                       | 144 (39.7)             | 52 | 92 | 0.471 |
|                                 | 2 pm to 8 pm                       | 127 (35)               | 41 | 86 |        |
|                                 | 8 pm to 2 am                       | 45 (12.4)              | 20 | 25 |        |
|                                 | 2 am to 8 am                       | 47 (12.9)              | 19 | 28 |        |
| Lighting condition              | Day light                          | 260 (71.6)             | 88 | 172 | 0.039 |
|                                 | Dusk or dawn                        | 40 (11)                | 13 | 27 |        |
|                                 | Dark                               | 63 (17.4)              | 31 | 32 |        |
| Place of collision              | Urban road                         | 195 (53.7)             | 55 | 140 | 0.000 |
|                                 | Rural/cross city road              | 168 (46.3)             | 77 | 91 |        |
| Weather condition               | Raining                            | 65 (17.9)              | 20 | 45 | 0.431 |
|                                 | Not raining                         | 298 (82.1)             | 113 | 185 |        |
| Road surface condition          | Asphalt                            | 324 (89.3)             | 120 | 204 | 0.442 |
|                                 | Gravel                             | 39 (10.7)              | 12 | 27 |        |
| Availability of Safety tools or signals | Yes                           | 117 (32.2)             | 33 | 84 | 0.030 |
|                                 | No                                 | 230 (63.4)             | 92 | 138 |        |
|                                 | Unknown                             | 16 (4.4)               | 8 | 8 |        |
| Persons extricated the victim at the scene | Bystanders                | 266 (73.3)             | 107 | 159 | 0.039 |
|                                 | Police                             | 64 (17.6)              | 17 | 47 |        |
|                                 | Healthcare professionals           | 33 (9.1)               | 8 | 25 |        |
| Received pre hospital care      | Yes                                | 52 (14.3)              | 14 | 38 | 0.126 |
|                                 | No                                 | 311 (85.7)             | 118 | 193 |        |
| Tight traffic police monitoring | Yes                                | 99 (27.3)              | 22 | 77 | 0.001 |
|                                 | No                                 | 264 (72.7)             | 110 | 154 |        |
| Mode of transport               | Ambulance                          | 89 (24.5)              | 31 | 58 | 0.865 |
|                                 | Other motorized Vehicle            | 252 (69.4)             | 92 | 160 |        |
|                                 | Carried by people or non-motorized | 22 (6.1)               | 9 | 13 |        |
|                                 | transportation                     |                        |    |    |        |
| Pedestrian location from the road at the moment of collision (N = 144) | Middle of the road | 82 (56.9) | 32 | 50 | 0.579 |
|                                 | Left side for pedestrian           | 30 (20.8)              | 9 | 21 |        |
|                                 | right side for pedestrian          | 32 (22.2)              | 10 | 22 |        |
| Vehicle occupant seating location (N = 141) | Front seat of any vehicle | 52 (36.9) | 12 | 40 | 0.042 |
|                                 | Middle seat                        | 54 (38.3)              | 14 | 40 |        |
|                                 | Rear seat                          | 16 (11.3)              | 6 | 10 |        |
|                                 | At the back of truck               | 19 (13.5)              | 10 | 9 |        |

(Table 6). This finding was consistent with the study conducted in Bangladesh [17].

Victims extricated from collision scenes by health care providers and by the police were 67 and 53% less likely to sustain severe injury respectively than those extricated by ‘Good Samaritans’ with AOR of 0.33 (95% CI; 0.13–0.83) and 0.47 (95% CI; 0.24–0.94) respectively (Table 6). This finding is in agreement with the study conducted in Iran [38].

Limitations of the study
Self-reporting of certain variables may have caused overestimation or underestimation of the outcomes. This also may have caused possible bias in some individual responses from fear of legal punishment, which has a tendency to underestimate or overestimate the association. This study excluded vehicle speed at the moment of collision due to missing data and exaggerated response bias. Moreover, no
restriction was placed on the vehicle model year in this study.

**Conclusion**

This study found helmet use, victim type and presence of multiple injuries as the most important host-related factors that determine RTC injury severity levels. Meanwhile, vehicle type and crash type were agent related determinant of injury severity. In addition, lighting condition, place of collisions, the seating position of the vehicle occupant, availability of traffic signals and tools at accident location, availability of tight traffic police control

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**Table 6** Bivariate and multivariate analyses of factors affecting injury severity levels of road traffic collision victims

| Variable | Categories | Injury severity level | COR 95% CI | AOR 95% CI |
|----------|------------|-----------------------|------------|------------|
|          |            | Severe | Not severe |       |            |
| Victims type | Pedestrian | 52    | 92 | 1 | |
|            | Driver     | 17    | 22 | 1.36 (0.67–2.80) | 1.11 (0.53–2.32) |
|            | Motorist/Motor occupant | 20 | 19 | 1.86 (0.91–3.80) | 1.56 (0.74–3.26) |
|            | Vehicle occupant | 43 | 98 | 0.78 (0.47–1.27) | 0.42 (0.20–0.88) |
| Driver used alcohol | Yes | 19 | 15 | 2.64 (1.23–5.64) | 2.1 (0.93–4.71) |
|            | No         | 48    | 100 | 1 | |
| Motorist/motorbike occupant used helmet | Yes | 5 | 12 | 1 | |
|            | No         | 15    | 7 | 5.14 (1.30–20.36) | 4.7 (1.04–21.09) |
| Presence of multiple injuries | Yes | 107 | 114 | 4.4 (2.65–7.29) | 3.88 (2.26–6.65) |
|            | No         | 25    | 117 | 1 | |
| Vehicle type | light vehicle | 67 | 148 | 1 | |
|            | medium heavy vehicle | 44 | 63 | 1.54 (0.95–2.50) | 1.62 (0.96–2.75) |
|            | large heavy vehicle | 21 | 20 | 2.31 (1.18–4.56) | 2.14 (1.01–4.52) |
| Crash type | Crash with Pedestrian | 52 | 92 | 1 | |
|            | Two vehicle collision | 16 | 55 | 0.51 (0.27–0.99) | 0.48 (0.24–0.93) |
|            | Over turning | 38 | 57 | 1.18 (0.69–2.01) | 1.38 (0.65–2.92) |
|            | Animate/inanimate | 14 | 16 | 1.55 (0.70–3.42) | 1.34 (0.59–3.01) |
|            | Falling from moving vehicle | 12 | 11 | 1.93 (0.80–4.68) | 1.45 (0.58–3.64) |
| Lighting Condition | Daylight | 88 | 172 | 1 | |
|            | Dusk or dawn | 13 | 27 | 0.94 (0.46–1.91) | 0.99 (0.45–2.17) |
|            | Dark | 31 | 32 | 1.89 (1.08–3.30) | 1.93 (1.01–3.65) |
| Place of accident | Urban | 55 | 140 | 1 | |
|            | Cross city/rural | 77 | 91 | 2.15 (1.39–3.33) | 1.95 (1.18–3.24) |
| Traffic signals or safety tools available | Yes | 32 | 85 | 0.59 (0.36–0.95) | 0.58 (0.35–0.96) |
|            | No | 93 | 137 | 1 | |
| Persons extricating the victim from scene | Bystanders | 107 | 159 | 1 | |
|            | Police | 17 | 47 | 0.54 (0.29–0.99) | 0.47 (0.24–0.94) |
|            | Healthcare professionals | 8 | 25 | 0.48 (0.21–1.09) | 0.33 (0.13–0.83) |
| Received pre-hospital care | Yes | 14 | 38 | 1 | |
|            | No | 118 | 193 | 1.66 (0.86–3.19) | 1.23 (0.61–2.51) |
| Traffic police control at the scene | Yes | 22 | 77 | 0.40 (0.23–0.68) | 0.49 (0.27–0.88) |
|            | No | 110 | 154 | 1 | |
| Vehicle occupant seating position | Front seat | 12 | 40 | 0.86 (0.35–2.08) | 1.21 (0.44–3.28) |
|            | At the back of truck | 10 | 9 | 3.17 (1.01–9.41) | 3.9 (1.18–12.080) |
|            | Rear seat | 6 | 10 | 1.71 (0.53–5.58) | 1.95 (0.53–7.23) |
|            | Middle seat | 14 | 40 | 1 | |

*P < 0.05, **P < 0.01, ***P < 0.001
and the persons who extricated the victim from the scene of collisions were among environmental factors that determine injury severity levels.

Results reported in this paper also suggest the need for immediate and pragmatic steps to be taken to curb the unnecessary loss of lives occurring on the roads. In particular, there is urgent need to introduce road safety interventions that target basic identified factors in this study (host-agent and environment) and time sequence of collisions (pre-crash, crash and post-crash events).

Abbreviations
AA: Aklilu Azazh; AaBET Hospital: Addis Ababa burn and trauma hospital; AB: Arasoo Baru; AOR: Adjusted odds ratio; COR: Crude odds ratio; ISS: Injury severity score; KTS II: Kampala trauma score II; LB: Lemlem Beza; MAIS: Maximum abbreviated injury scale; REC: Research Ethics Committee; RTC: Road traffic collision; RTS: Revised trauma score; SNNPE: Southern nations and nationalities, and peoples of Ethiopia; SPMMCH: St. Paul Millennium Medical College and Hospital; SPSS: Statistical package for social Science; TASTH: Tikur Anbessa Specialized Teaching Hospital; TRISS: Trauma score and injury severity score

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors’ contributions
AB (principal investigator) made substantial contributions to conception, design, acquisition of data, analysis, interpretation of data, drafting of the manuscript and the critical review of the manuscript drafts. AA assisted in design, analysis, commenting, and critical review of the manuscript. All authors read and approved the final draft of the manuscript.

Ethics approval and consent to participate
Before any attempt to collect data, ethical approval was obtained from Addis Ababa University College of Health Science. Letter of permission was obtained from each voluntary client, police officers, health care the questions would have no effect on their care. Finally, a written Consent was informed about the purpose of the study, the right to refuse to participate in this study, and anonymity and confidentiality of the information gathered. They were assured that they will not be penalized for not participating if they wished not to participate and that their responses to the questions would have no effect on their care. Finally, a written Consent was obtained from each voluntary client, police officers, health care providers and family (in case of the unconscious client and under 16 years old clients).

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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