

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES



**Injury Severity Levels and Associated Factors
among Road Traffic Accident Victims Referred To Emergency
Departments of Selected Public Hospitals in Addis Ababa, Ethiopia:
The Study Based On Haddon Matrix**

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This is to certify that the thesis prepared by Ararso Baru, entitled: Injury Severity Levels and Associated Factors among Road Traffic Accident Victims Referred To Emergency Departments of Selected Public Hospitals in Addis Ababa, Ethiopia: The Study Based On Haddon Matrix and submitted in partial fulfillment of the requirements for the degree of Master of Science complies with the regulation of the University and meets the accepted standards with respect to originality and quality

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ACRONYM AND ABBREVIATIONS

AaBET Hospital Addis Ababa Burn and Trauma hospital

AOR Adjusted odds ratio

COR Crude odds ratio

GDP Gross Domestic Product

ISS Injury Severity Score

KTS II Kampala Trauma Score II

MAIS Maximum Abbreviated Injury Scale

REC Research Ethics Committee

RTS Revised Trauma Score

RTA Road Traffic Accident

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

USA United States of America

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ABSTRACT

Background: Globally, approximately about 1.25 million people die annually from road traffic accident (RTA). Moreover, about 20 to 50 million people sustain nonfatal injuries as a result of road traffic crashes. Evidence from global safety report shows that, the trend of road traffic injury in developed countries is decreasing while accident trend in developing countries including Ethiopia is notably increasing. This trend will go further owing to increased motor vehicle ownership and use associated with economic growth in developing countries.

Objective: to determine injury severity of Road Traffic accident and associated factors among victims referred to selected public hospitals of Addis Ababa based on Haddon Matrix.

Methods and Materials; the study was conducted in public health facilities of Addis Ababa, Ethiopia from March 1 to May 10, 2017. Hospital based descriptive cross sectional study design were implemented to select 363 victims using systematic random sampling method. Interviewer administered structured questionnaire were used to collect the data while Kampala trauma score II were applied to measure injury severity of RTA victims. The collected data was cleaned and entered into Epidata version 3.1 and exported to SPSS Ver.21 for analysis. Multiple logistic regression models were used to indicate the association between variable.

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%. Victims type AOR 0.42(95% CI; 0.20-0.88), helmet use AOR 4.7(95%CI; 1.04-21.09), presence of multiple injury AOR 3.88(95% CI; 2.26-6.65), vehicle type AOR2.14(95% CI; 1.01-4.52), Vehicle occupant seating place AOR3.9(1.18-12.080),crash type AOR 0.48(95% CI; 0.24-0.93), lighting condition AOR 1.93(95% CI; 1.01-3.65), availability of traffic signals and tools AOR1.95(95% CI; 1.18-3.24), tight traffic police control AOR 0.49(95% CI; 0.27-0.88) and person extricate the victims AOR 0.33(95% CI; 0.13-0.83)were factors significantly associated with injury severity level.

Conclusion and Recommendation; Results reported in this paper suggest the need for immediate and pragmatic steps to be taken to curb the wanton destruction of lives that are occurring on the roads. In particular, there is urgent need to introduce road safety interventions to address this public health hazard that is claiming the lives of economically productive age group.

Key words: Road traffic accident, injury severity, Haddon Matrix, Ethiopia

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1. INTRODUCTION

1.1 Background

As world health organization (WHO) defines, road traffic accident (RTA) is an accident that happened on a way or street open to public traffic; resulted in one or more persons being killed or injured, and at least one moving vehicle was involved. Thus, RTA is collisions between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and fixed obstacles(1).

Globally, approximately about 1.25 million people die annually from road traffic accident. This means more than 3,400 death claims on daily basis as a result of road traffic accident(2). Moreover, about 20 to 50 million people sustain nonfatal injuries as a result of road traffic crashes(3)(4). Indeed, it results in 3% loss of the gross domestic product (GDP) worldwide and up to 5% in low and middle income countries (2).

Even though the number of registered vehicle in Africa is relatively low, the estimated road traffic death rate is high. In 2015, the proportion of vehicle per 1000 people in Africa was 46.6 meanwhile 510.3 in Europe. Notwithstanding, estimated road traffic death rates of 26.6 per 100,000 population recorded in Africa whereas 9.3 in Europe region(5)

In 2013 only, about 246,718 people killed as a result of RTA in Africa. This number was approximately a fifth of the global total number of deaths(5). RTA constitutes 25% of all injury-related deaths in the Africa. Moreover, RTA is responsible for almost one in ten deaths of young men(aged 15-29) in the region(6).

In Ethiopia, road traffic accident is one of the critical road transport problem (7). According to 2015 global road safety report the total numbers of vehicles registered in 2011/2012 Ethiopia fiscal year were 478,244. However, the WHO estimated fatalities rate per 100,000 populations were 25.3. This rate was far greater than rate registered in developed countries (2).

1.2 Statement of the problem

Accident pattern observed in developed countries shows decrement in road traffic accident while injuries trend are notably increasing in middle and low income countries including Ethiopia (4).

This trend will go further with noticeable disparity between developed and developing countries(3)(4). The problem will become the fifth leading cause of death and the annual death toll will reach 2.4 million by the year 2030 owing to increased motor vehicle ownership and use associated with economic growth in developing countries (4)(8).

Road traffic injuries affect people all throughout their lives, but the biggest impact is predominantly in economically the most active age group. According to 2013 global safety report, young adults aged between 15 and 44 years account for 59% of global road traffic deaths and about seventy seven percent of all road traffic deaths occur among men(4). In Africa region, it is responsible for almost one in ten deaths of young men aged 15 to 29(6).

The death and injury severity from RTA can be minimized by use of restraint such as seatbelt use. It reduces injury by preventing the occupant from hitting the interior parts of the vehicle or being ejected from the car. However, they remained underuse especially in developing countries(9)

Even though the Ethiopian Government invest a lot of money on road network expansion and rehabilitation, the extent and severity of road traffic accident in the country remains high(7). According to global safety report 2015, the estimated road fatalities in Ethiopia during 2011/12 were twenty three thousand eight hundred and thirty-seven people(2).

Ethiopia is enforcing various RTA preventive measures like speed limit; sit belt law; helmet law; drink-driving law; mobile phone use while driving law; and child restraint law. Accordingly, maximum speed for urban road is 60 km/h whereas 70 km/h in rural; motorcycle helmet law applies to both drivers and passengers meanwhile national seat-belt law applies to drivers, front and rear seat occupants (2). However, RTA is exerting huge burden on human and financial resources in the country. For instance, according to prospective cross sectional study conducted at Tikur Anbessa Specialized Teaching Hospital (TASTH) on injury characteristics and outcome of road traffic accident victims, from a total of 230 RTA victims visited adult emergency department; 7.4% victims died during course of treatment, 6.3% discharged with permanent disability while 10.3% of the victims referred to other health facilities for further treatment. Furthermore, about 37.9% of the victims encountered moderate injuries whereas 10.87 % of the victims encountered severe injuries (10). Another study conducted in Addis Ababa assessed the

burden of road traffic accident in emergency department of Zewditu memorial hospital and identified the following; from a total of 779 emergency department admission, 17% of them hospitalized 17% of them referred to other hospital while 1% of them died in emergency department (11). These studies highlights economic and human resource burden of RTA in the country.

1.3 Rational for the study

Even though Ethiopia has numerous problem related to road traffic safety, the study on road traffic accident in the country is limited. Only few published study shows burden of road traffic accident in the country. From the studies, the one conducted in Tikur Anbessa Teaching Hospital assessed the injury characteristics of road traffic accident and its outcome. It addresses types of vehicle involved in injury, classified severity of injury, identified situation of the victims during accident and body region injured by the accident(10). Another study conducted at TASTH assessed incidence of RTA and factors associated with road traffic injury(12). Other studies also assessed the burden of RTA and some of them identified factors contributing to crashes in the country(11)(13)(14)(15)(16). However, all of them failed to assess association between injury severity and the underlying cause.

To the best of investigators knowledge, there is no study conducted on factors affecting injury severity of road traffic accident in Ethiopia. As a result the significant factors contributing for injury severity in the country remains unknown. Moreover, the causal relationship between injury severity of road traffic accident victims and potential risk factors in Ethiopia remains unknown. So this study is aimed to assess factors affecting injury severity levels of RTA victims referred to selected public hospitals of Addis Ababa based on Haddon Matrix.

1.4 Significance of the study

Despite road traffic injuries have been a leading cause of mortality for many years, most of the road traffic accidents are both predictable and preventable(2). Furthermore, the accident severity can be minimized by use of restraint like seat belt application which can be used as defense line to prevent injury and death(9).

So, the finding of this study will be helpful in different setting. It may serve as reference for the policy makers to develop evidence-based interventions in order to overwhelm impact of road traffic accident in the country. In addition it can be used not only to prevent road traffic accident but also to mitigate physical, psychological and financial effect of RTA on individuals, groups and the communities. Thus, it will benefit public at large by identifying the most important factors that contributes to severe injury and forward possible interventions that have a tendency to minimize the impact of road traffic accidents to the pedestrian, drivers and vehicle occupant.

Moreover, it may use as a baseline data for researchers who are interested to conduct further studies on road traffic accident especially for those in the area of emergency medicine, public health and other related discipline.

2. LITERATURE REVIEW

According to the Haddon matrix, factors associated with accident occurrence were described in three groups; host, agent, and environment(17).

2.1 Host related factors

Age has strong association with injury severity. To substantiate this argument, the study conducted in Iran identifies that; age greater than 50 results in severe road traffic injury (18). Study conducted in United States of America (USA) also shows existence of strong association between age and injury severity, with the greatest risk in age group of greater than 85 (19). Moreover, study in Switzerland identifies as advanced age determines severity of road traffic injury (20). Pedestrian age greater than 65 when compared with young adult aged 14-64 has a significant association for injury severity that involve torso and lower extremity but not for head injuries(21).

According to the study conducted in Southern Europe, being males, and pedestrians have a higher risk of suffering a more severe injury, even after adjusting for other potentially related variables such as age, sex, and type and location of the injury(22).

Use of safety measure like helmet and sit belt has strong contribution to severity of road traffic accident (18). Seat belt prevents death and minimizes injury severity by preventing occupant from preventing the occupant from hitting the interior parts of the vehicle or being ejected from the car. According to case-control study conducted in Canada, Ontario, not using seat belts was independently and strongly associated with the risk of fatal injury crashes (23). Similarly, study in Iran identified as sit belt use determines injury severity (24). Study conducted at Bucknell University, Pennsylvania, United States; found that unbelted occupants have statistically significant injury severity risk than belted once(25).Moreover, as study conducted in China identified as the absence of helmets significantly increase the injury severity of riders(26).

Study by Pfortmueller et al shows that, the risk of severe injury is significantly higher in a victims with non-zebra crosswalk accidents than in victims with zebra crosswalk accidents(20). Similarly, according to study in Canada pedestrian road crossing location has great impact on injury severity level. Thus, crossing at uncontrolled mid-block locations resulted in greater injury severity compared with crossing at signalized intersections in urban setting(27)

Alcohol consumption increased the risk of fatality in crashes by a factor of 2.3 for those drinking and driving(23).

According to prospective cohort study conducted in Germany, body region injured determines severity of the road traffic injury related to drivers. As indicated by maximum abbreviated injury scale (MAIS), the most severe injuries involved the leg bone, the head and the arms in descending order(28).

2.2 Agent related factors

As study conducted in Iran shows there is a strong association between severity of injury and mechanism of trauma. Accordingly, the most common mechanism of trauma that resulted in critical injuries was rollover (72.5%), motorcycle-pedestrian crash (23.8%), and car-motorcycle (13.14%) accidents ($p < 0.001$)(18). Similarly, study conducted in Germany shows rollover increase mortality by 8.8% and frontal collision results in highest injury severity when compared with others mechanism(28).

According to retrospective study in Switzerland, the injury severity is strongly related to size of the vehicle. Consequently, victims hit by a truck are at significantly greater risk of being severely injured than victims hit by two or four wheel vehicle (20). Correspondingly, the risk of severe injury or death is higher for pedestrians struck by trucks or vans than by cars According to Tefft et al (29). Study by Roudsari et al., also identified as vehicle type determines severity of injury. For instance, risk of moderate or severe injuries in adults was higher for light truck vehicles (50%) than for passenger vehicles (40%) or vans (36%) (30)(31).Furthermore, study in Southern Europe found that severe injury is related to two-wheel motor vehicle riders(22).On the other hand, vehicle type has no statistically significant effect on vehicle occupant injury severity according to study at Bucknell University (25).

2.3 Environmental factors

A cross sectional study conducted in Kenya revealed that night-time road crashes are associated with injury severity(31). Correspondingly, study conducted in United States and Singapore found similar results (32)(33). In addition, time between 2 pm to 8 pm is associated with severe injury according to study conducted in Iran(18). Furthermore, time of crashes between 8 pm and midnight has significant effect on injury severity according to study conducted in Canada (23).On the other hand according to Quddus et al, more severe injury occurs during the early morning (midnight to 3:59 am) (33). Sze and Wong found that the odds of a fatality are higher for crashes occurring between 7 p.m.–7 a.m. They found as dark period is specifically related to injury severity (34).

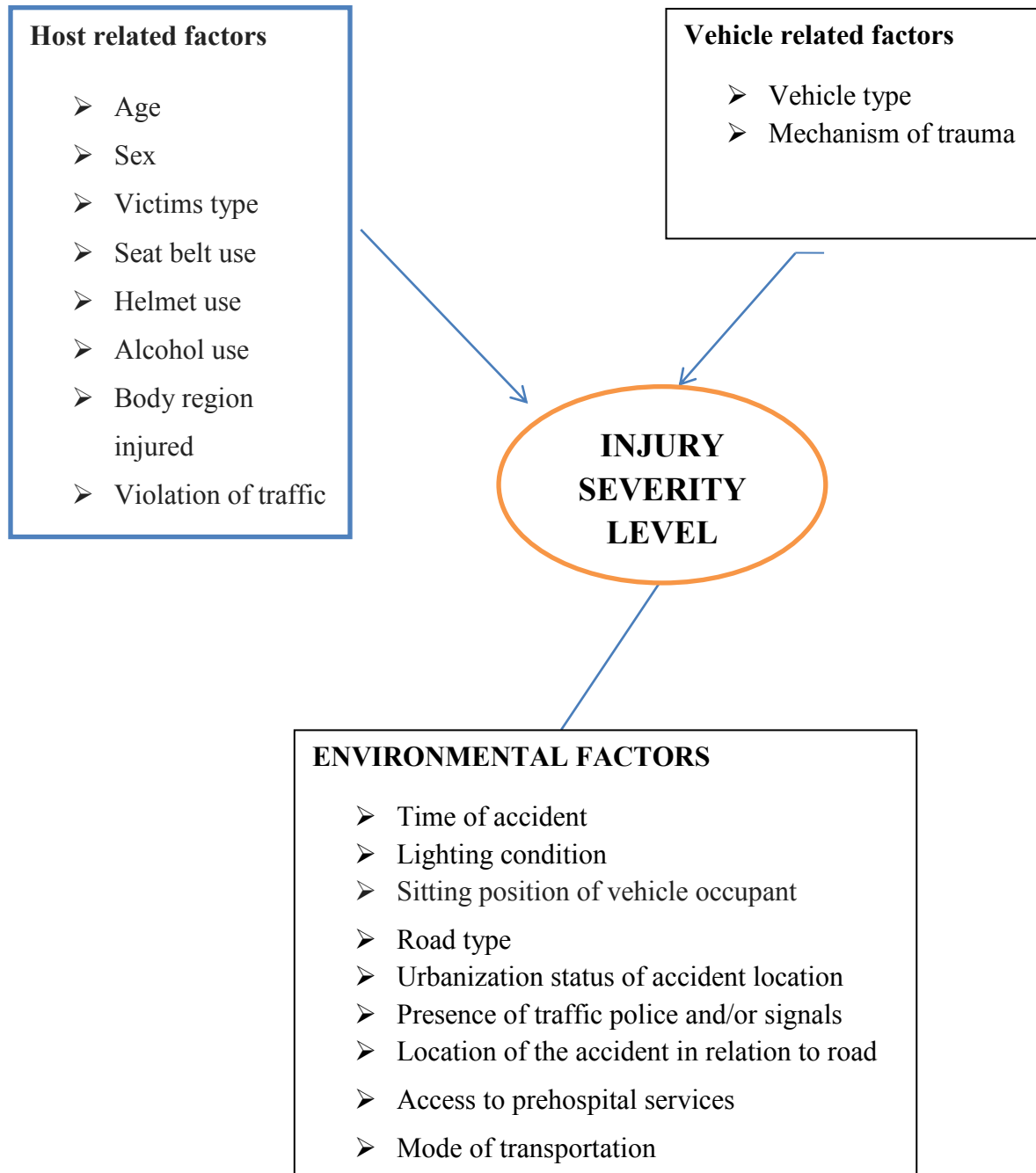
Research shows that road way locations where traffic are controlled and monitored by the traffic police are associated with a lower level of injury severities compared to locations where there are no traffic police enforcements or other traffic controls, like signals(35).

According to Tainio et al., place at which accident took place is determinant factor for injury severity. For instance, the injuries in rural areas were 1.3 times more severe than injuries in urban area(36).

According to the study conducted in Khon Kaen University of Thailand based on WHO report of country-level data on estimated traffic death rate per 100 000 population , existence of prehospital care system significantly decrease death rate secondary to traffic accident(37)

2.4 Conceptual framework of the study

The Conceptual framework of the study is developed after reviewing previous similar studies to conceptualize the whole research process and to aid as guide for tool development and analysis. The most important factors are classified based on Haddon Matrix.



3. OBJECTIVE

3.1 GENERAL OBJECTIVE

The objective of this study is to assess factors associated with severity of road traffic injury among road traffic accident victims referred to Emergency Department of Selected Public Hospitals in Addis Ababa, Ethiopia

3.2 Specific Objective

The objective of this study is;

- ❖ To determine individual related factors that affect severity of road traffic injury among victims referred to Emergency department of Selected Public Hospitals in Addis Ababa, Ethiopia
- ❖ To determine vehicle related factors that affect severity of road traffic injury among victims referred to Emergency department of Selected Public Hospitals in Addis Ababa, Ethiopia
- ❖ To determine environmental factors that affect severity of road traffic injury among victims referred to Emergency department of Selected Public Hospitals in Addis Ababa, Ethiopia

4. METHODS AND MATERIALS

4.1 Study Area and Study Period

This study was conducted in public hospitals of Addis Ababa city, Ethiopia. Addis Ababa is the capital city of Ethiopia and the seat for Africa union. In Addis Ababa there were a total of 13 public hospitals that provides health services to the community. All of them were referral hospitals(38). Among these public hospitals, 11 of them provide care for trauma patients. However, 3 of them provide trauma service predominantly. These 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. This study was conducted at purposively selected three of the public hospitals that provide trauma care in Addis Ababa. These hospitals were; Tikur Anbessa Specialized Teaching Hospital, ALERT and St. Paul Millennium Medical College and Hospital.

TASTH is one of the largest tertiary level referral hospitals in Ethiopia. It has organized emergency department and provides emergency service throughout 24 – hour basis (39). Similarly, SPMMCH is one of the largest and tertiary level referral hospitals in the country and located in the capital of Ethiopia, Addis Ababa. It was established in 1968 as hospital and became teaching hospital in 2007 and named St Paul’s Millennium Medical College in 2010 by decree of the Council of Ministers. The hospital is giving trauma services at its center known as Addis Ababa Burn and Trauma hospital (AaBET Hospital)(40). ALERT Hospital provides care on dermatology, surgery, orthopedics, emergency and trauma, ophthalmology. In addition, it is serving as research and rehabilitation center.

The study was conducted from March 1 to May 10, 2017 at selected public hospitals in Addis Ababa, Ethiopia.

4.2 Study Design

Hospital based cross sectional study design was implemented to determine injury severity levels and associated factor at selected public hospitals in Addis Ababa, Ethiopia

4.3 Source and Study Population

4.3.1 Source population

All patients attending Emergency Department of public hospitals in Addis Ababa during the study period as a consequence of road traffic accident injury

4.3.2 Study Population

All road traffic accident victims in the adult Emergency Department of selected public hospitals in Addis Ababa during the study period

4.4 Inclusion and exclusion criteria

4.4.1 Inclusion criteria

Road traffic victims who referred to Emergency department of selected public hospitals in Addis Ababa from March 1 to May 10, 2017 regardless of their injury severity level and agreed to participate were included to the study.

4.4.2 Exclusion criteria

Road traffic victims who referred to Emergency department of selected public hospitals in Addis Ababa and he or his family (if comatose) refused to secure consent were excluded from the study

Moreover, road traffic injury as a result of non-motor vehicle like bicycle and cart were excluded from the study.

4.5 Sample size determination and sampling procedure

4.5.1 Sample size determination

Sample size (n) was determined based on single population proportion formula with the following assumptions. Based on the study conducted at TASTH, the incidence of road traffic injury was 36.8% (12). The level of confidence (α) was taken as 0.05 ($Z (1-\alpha/2) = 1.96$); the margin of error was taken as 0.05.

Accordingly; the calculated sample size using the following formula was:

$$n = \frac{[Z(1-\frac{\alpha}{2})]^2 \times P(1-P)}{d^2}$$

Where; n = Minimum sample size for a statistically significant survey

Z = Normal deviant at the portion of 95% confidence interval two tailed test is; = 1.96

P = Incidence of RTA at TASTH = 36.8%.

$q = 1 - p$, d = margin of error taken as 5% = 0.05

Accordingly, $n = 357$

In addition with consideration of 5% non-response rate, the total sample size was 375.

4.5.2 Sampling Procedure

To select study subject sampling frame was developed from triage entry point and each respondent was accessed based on sampling frame. Then, study subjects were selected using systematic random sampling technique and included to the study until the pre-determined sample size is obtained.

4.6 Variables

4.6.1 Dependent variables

- Injury severity levels of road traffic accident victims

4.6.2 Independent variable

Host related variable

- Age
- Sex
- Seat belt use
- Helmet use
- Alcohol use
- Body region injured
- Violation of speed limit

Vehicle related variable

- Type of Accident
- Vehicle type

Environment related variable

- Lighting condition
- Seating place of vehicle occupant
- Location of the accident in relation to road
- Urbanization status of accident location
- Road surface condition
- Weather condition

4.7 Data collection techniques and instrument

To collect data from road traffic victims; interviewer administered questionnaire were used. The structured questionnaire used to assess all independent variables were developed after reviewing some literatures(31)(18)(24)(35). However, Kampala Trauma Score II were adapted and applied to collect data related to dependent variable. The questionnaire has both open and close ended questions. The key factors that associated with road traffic accidents severity were classified based on Haddon Matrix, which explains injuries in terms of factors (Host-Agent – Environment) and also in terms of a time sequence (Pre-crash, Crash, Post-crash). Moreover, medical records of the victims were reviewed to check for consistency between information obtained by interview and information recorded on patient chart. Additional information was collected from police and medical staff in a condition that need further information about the accident. Data collectors were BSC Nurses. They were recruited based up on their competence and data collection experience.

4.8 Measurement

There are numerous methods to score injury severity levels. However, there is no gold standard tool to measure injury severity level (41). Notwithstanding, for this study Kampala Trauma Score II (KTS II) was applied to measure injury severity of RTA victims as a consequences of

the following reasons. As stated by MacLeod JBA, et al., Kampala Trauma Score KTS has 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. KTS II is considered as potential tool for triage in resource constrained setting (42). Moreover, KTS II is able to provide reliable measurement for injury severity classification in emergency setting(43). Indeed, KTS has clinically significant ability to predict need for hospitalization and fatality in resource-constrained setting(44)(45). The following table describes KTS II

Table 1 Description of Kampala Trauma Score II (KTS II)

<i>Label</i>	<i>Description</i>	<i>Score</i>
A	Age (in years) 5-55	1
	<5 or >55	0
B	Systolic Blood pressure on admission More than 89 mm Hg	2
	Between 89–50 mm Hg	1
	Equal or below 49 mm Hg	0
C	Respiratory rate on admission 0-29/minute	2
	30+	1
	≤9/minutes	0
D	Neurological status Alert	3
	Responds to verbal stimuli	2
	Responds to painful stimuli	1
	Unresponsive	0
E	Score for serious injuries None	2
	One injury	1
	More than one injury	0
Total (A+B+C+D+E) = _____		

4.9 Data quality assurance

The quality of data was assured through careful design, pre-testing of the questionnaire, proper training of the interviewers and supervisors, close supervision of the data collecting procedures, proper categorization and coding of the data. The questionnaire was pretested before data collections go ahead at Zawditu Memorial Hospital and correction were made for some questions. The principal investigators and the supervisors checked the accuracy and reliability of the data collection process. They gave clarifications when ambiguity occurred during data collection. Discussions were held among the principal investigators, supervisor, and data collectors, as necessary. Based on the feedback from the supervisors and data collectors, immediate corrective measures were taken.

4.10 Data entry, processing and analysis

Data was checked for completeness, inconsistencies, cleaned, coded. The collected data was entered into EpiData 3.1 (EpiData Association, Odense, Denmark) and then exported to SPSS version 21.0(IBM Corp., Armonk, NY, USA) for 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. Variable with P-value of < 0.25 were considered for multivariate logistic regression to control the effect of other confounders. Then, the significance level was set at $P < 0.05$.

4.11 Ethical clearance

Ethical clearance was secured from Research Ethics Committee (REC) of the Emergency Medicine Department as mandated by Addis Ababa University. Letter of permission was obtained from TASTH, ALERT and AaBET administration officials.

Informed consent was obtained from all conscious victims prior to proceeding data collection from them. In case of unconscious victims consent was secured from attendant. This was done after clear description of the objectives of the study and of its procedures. Then, each respondent was asked to check whether information provided on the purpose of the study has been adequately understood or not. Confidentiality of the information obtained from each participant was maintained.

4.12. Dissemination plan

At the end, the result of the study will be disseminated to the governmental and non-governmental organizations to provide information about factor associated to road traffic accident severity among RTA victims referred to Public Hospitals of Addis Ababa. In addition, it will be submitted to Addis Ababa University health science library. Further efforts will be made to publish the findings on national or international journal.

4.13. Operational Definition and Definition of terms

This study used binary scale to express outcome of injury severity, severe injury versus not severe injury. They were defined as the following;

Severe injury: -any RTA related injury resulted in Kampala trauma score II of 6 or less(43).

Not severe injury:- According to Mutooro et al., injuries resulted in KTSII of 9 to 10 were considered as mild while KTSII of 7 to 8 as moderate (43). However, for the purpose of this study mild and moderate injuries were combined and named as not severe injury.

5. RESULT

A total of 375 road traffic accidents were recruited for the study. However, analysis of only 363 individuals sustained road traffic injuries were included in the study due to a response rate which was 96.8%. Twelve respondents were excluded from the study as a result of incomplete response to the survey. This section presents profile of respondents and host, agent and environmental factors associated with road traffic injury severity.

5.1. Socio-demographic characteristics of the respondents

This study depicts that more than three fourth 278(76.6%) of the respondents sustained Road Traffic Accident (RTA) was male. Age group 21 to 30 were the most affected age group by RTA followed by age group of 12 to 20, and they accounts 141(38.8%) and 74(20.4%) respectively. Regarding the place at which accident happened, about 172(47.4%) of the accident occurred in Oromia followed by Addis Ababa 87(24%).

Table 2: Description of socio-demographic characteristics of the respondents

Variable	Categories	Frequency (Percentage)	Injury severity level		χ^2
			Severe	Not severe	
Sex	Male	278(76.6)	105	173	0.314
	Female	85(23.4)	27	58	
Age	12 to 20	74(20.4)	33	41	0.490
	21 to 30	141(38.8)	49	92	
	31 to 40	70(19.3)	22	48	
	41 to 50	48(13.2)	16	32	
	>50	30(8.3)	12	18	
Occupation	Own work(including merchant)	136(37.5)	45	91	0.738
	Driver	34(9.4)	14	20	
	government/private employee	66(18.2)	27	39	
	Student	54(14.9)	20	34	
	daily laborers	28(7.7)	11	17	
	Farmers	31(8.5)	12	19	
	Others ¹	14(3.8)	5	9	
Region at which accident happened	Oromia	172(47.4)	61	111	0.734
	Amhara	52(14.3)	18	34	
	SNNPE	34(9.4)	14	20	
	Addis Ababa	87(24)	32	55	
	Others ²	18(4.9)	8	10	

5.2. Basic characteristics of respondents

5.2.1. Host related Characteristics

About 144(39.7%) of the road traffic victims included to this study were pedestrians while 141(38.8%) of them were vehicle occupant. With regard to driver's driving experiences, 113(31.1%) of the drivers had 3 to 4 years of driving experience prior to the date of accident. In addition, 127(35%) of the drivers violates recommended right of way while 34(9.4%) of the driver used alcohol on the prior to accident.

Concerning injury severity level, about 132(36.4%) of the road traffic victims sustained severe injury while the rest of respondents sustained non-severe injuries.

¹Driver assistant, retired, jobless

² Tigray, Benishangul, Harar, Afar, Gambella, Ethiopia Somali

With regard to helmet and seat belt utilization, table 3 below shows that 21(53.8%) of drivers and 17(12.1%) of vehicle occupants sustained road traffic injury used seat belt while 17(43.6%) of motorist or motorbike occupants used helmet.

Table 3: Distribution of host related characteristics (Source: survey, 2017)

Variables	Categories	Frequency (Percentage)	Injury severity status		χ^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	
	Motor bike driver 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 injury	Yes	221(60.9)	107	114	0.000
	No	142(39.1)	25	117	
Driver used Seat belt (N=39)	YES	21(53.8)	11	10	0.232
	NO	18(46.2)	6	12	
Vehicle occupant used Seat belt (N=141)	YES	17(12.1)	6	11	0.261
	NO	124(87.9)	42	75	
Motorist or occupant used helmet (N=39)	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

5.2.2. Agent related Characteristics

Regarding types of vehicle involved in traffic accident more than half 215(59.2%) were light vehicle followed by medium vehicle, 107(29.5%).

Concerning accident type, about 144(39.7%) of RTA related injury were as a consequence of vehicle to pedestrian collision while vehicle overturning was responsible for 96(26.4%) of trauma in this study. Thereupon, accidents happened as result of two or more vehicle collision, collision with animate or inanimate object and falling from moving vehicle were 27.3%, 8.3% and 5.2% respectively.

Table 4: Distribution of vehicle and accident type (Source: Survey, 2017)

Variables	Categories	Frequency (Percentage)	Injury Severity status		χ^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/ 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	

5.2.3. Environment related characteristics of respondents

Out of total 363 RTA included to this study, 144(39.7%) of them were happened from 8am to 2pm. Concerning lighting condition most of accidents 260(71.6%) happened during day light followed by dark 63(17.4%).

With regard to place of accident, more than half of accidents were happened in urban road 195(53.7%). Sixty-five accidents (17.9%) were happened in rainy weather condition while

324(89.3%) of the accidents happened in asphalt road. This data might have been influenced by the fact that data collection period was mainly during lighter rainy season

Concerning availability of safety tools or signals in accidents location, 117(32.2%) accidents happened in the environment where there were at least one of the following signals or tools available; zebra cross walk, guard rail, speed breaker, traffic signals and traffic light. Furthermore, 99(27.3%) respondents reported presence of tight traffic police monitoring at the accident location.

Nearly three fourth 266(73.3%) of victims were extricated from accidents place by bystander while 33(9.1%) them were extricated by health care professionals. Likewise, 52(14.3%) received pre-hospital care. Moreover, 252(69.4%) of victims were transported to health care facilities by motorized vehicle other than ambulance while 89(24.5%) of them were transported by ambulances.

Majority 82(56.9%) of pedestrian sustained accidents on middle of the road while 33(22.9%) of the accidents were on zebra cross walk. Regarding vehicle occupant seating location; 54 (38.3%) vehicle occupants sat front, 52(36.9%) sat middle and 19 vehicle occupant were either stood or sat at the back of truck.

Table 5: Environmental characteristics of RTA victims (Source: Survey, 2017)

Variables	Categories	Frequency (percentage)	Severity status		x ²
			Severe	Not severe	
Time of accident	8am to 2pm	144(39.7)	52	92	0.471
	2pm to 8pm	127(35)	41	86	
	8pm to 2am	45(12.4)	20	25	
	2am to 8am	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 accident	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	
Person extricate the victim from 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 transportation	22(6.1)	9	13	
Pedestrian accident location (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	

5.3. Bivariate and multivariate analysis for factors associated with injury severity

Initially, crude odd ratio (COR) for each independent variable was calculated at 95% confidence interval (CI). Then, a variable with p-value less than 0.25 were included to multivariate logistic regression analysis to control effect of other covariates. After adjusting for potential risk factor in multivariate logistic model, a statistically significant association was seen with ten variables. Selected results of these statistically significant variables are described in text and table 7 below.

Host related characteristics that determine road traffic accident severity level

Injury severity as a consequence of road traffic accident has statistically significant association with victim type. Accordingly, vehicle occupants were fifty-eight percent less likely to be severely injured when compared to pedestrians, AOR 0.42 (95% CI; 0.20-0.88).

Victims with multiple injuries were highly associated with injury severity. Adjusted odds ratio shows that individual with multiple injuries were nearly four times more likely to have severe injury than their counterparts, AOR 3.88(95% CI; 2.26-6.65).

Bivariate analysis showed statistically significant association between driver's alcohol consumption and injury severity level. Drivers who consumed alcohol and drive were 2.6 times more likely to cause severe injury to themselves or others than those without alcohol and drive. COR 2.64(95% CI; 1.23-5.64). Nonetheless, this association was not significant after control for potential covariates in multivariate analysis, AOR 2.1(0.93-4.71).

Moreover, helmet utilization by motorist or motorbike occupants was associated with road traffic accident injury severity. Motorist or occupants who did not use helmet were nearly five times more likely to sustain severe injury than those used helmet.

Agent related characteristics that determine road traffic accident severity level

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

Furthermore, collision type determines injury severity. Accident happened to individual as a consequence of two vehicle crash were fifty-two percent less likely to cause severe injury than accident happened to individual as a result of vehicle to pedestrian collision after adjusting for potential covariates, AOR 0.48(95% CI; 0.24-0.93).

Environmental characteristics that determine road traffic accident severity level

Lighting condition at the moment of accident predict road traffic accident injury severity level. Accident happened in dark environment were nearly two times more likely to be severe than accident happened in day light with AOR 1.93(95% CI; 1.01-3.65). In addition, urbanization status of the place at which accidents happened determines road traffic accident injury severity. As depicted in table 7, accidents happened in cross city or rural area were 1.95 times more likely to be severe than road traffic accidents happened in urban area, AOR 1.95(95% CI; 1.18-3.24).

An environment at which tight traffic police control exist determined injury severity in this study. Accordingly, accidents happened to individual in environment with tight traffic police control were fifty-one percent less likely to be severe injury than place where there were no tight traffic police control, AOR 0.49(95% CI; 0.27-0.88) . Thereupon, availability of traffic signals or tools like zebra cross walk, traffic light, guard rail, pictures, symbols and speed breakers predicts severity related to road traffic accident. Accident occurred in such environment were forty-two percent less likely to be severe than an environment without them with AOR of 0.58(95% CI; 0.35-0.96).

Vehicle occupants seating place have statistically significant association with road traffic accident injury severity in this study. Vehicle occupants who seat or stand at the back of truck were nearly four times more likely to sustain severe injury than vehicle occupants seated in the middle of passenger vehicle, AOR 3.9(95% CI; 1.18-12.080).

Moreover, person extricates the victims from the scene determines road traffic injury severity level. Victims extricated by health care professionals were sixty-seven percent less likely suffered severe injuries than the one extricated by bystanders, AOR 0.33(95% CI; 0.13-0.83). Those extricated by police were also fifty-three percent less likely to be severely injured than those extricated by bystanders with AOR of 0.47(95% CI; 0.24-0.94).

On the other hand time of accidents, road surface conditions, weather conditions, location of accident happened to pedestrian in relation to road, mode of transport to health care facilities and prehospital care have no statistically significant association in this study.

Table 6: Bivariate and Multivariate analyses of host, agent and environment related predictors of road traffic accident victims' injury severity levels (Source: Field survey, 2017)

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)
Driver used alcohol	Vehicle occupant	43	98	0.78(0.47-1.27)	0.42(0.20-0.88)*
	Yes	19	15	2.64(1.23-5.64)*	2.1(0.93-4.71)
	No	48	100	1	1
Motorist/motor bike occupant used helmet	Yes	5	12	1	1
	No	15	7	5.14(1.30-20.36)	4.7(1.04-21.09)**
Presence of multiple injury	Yes	107	114	4.4(2.65-7.29)	3.88(2.26-6.65)***
	No	25	117	1	1
Vehicle type	light vehicle	67	148	1	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	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	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	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	1
Person extricate the victim from scene	Bystanders	107	159	1	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	1
	No	118	193	1.66(0.86-3.19)	1.23(0.61-2.51)
Traffic police control at the scene a	Yes	22	77	0.40(0.23-0.68)	0.49(0.27-0.88)*
	No	110	154	1	1
Vehicle occupant seating location	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	1

*P<0.05, **P<0.01, ***P<0.001

6. DISCUSSION

This study revealed that the prevalence of severe injury among road traffic accident victims was 36.4%. The study finding is nearly similar with study conducted in Bugando Medical Center of Tanzania. The recorded prevalence for severe injury was 38.6% (46). On the other hand, this result is higher than the finding reported from Ethiopia (10) and the finding from Kenya (31). They found prevalence of severe injury as 10.87% and 19% respectively. This study was conducted in three public hospitals which mainly provide trauma care at the national level while the study in Ethiopia and Kenya conducted were conducted in single hospital, this could be the reason for the discrepancy with the present study.

With regard to age of road traffic victim, majority 141(38.8%) of them were within the age group of 21-30 years. In line with our finding, this age group was the most affected age group according to previous studies from Ethiopia (12)(47). Concerning sex, male 278(76.6%) was more frequently affected by traffic accident than female (23.4%) with male to female ratio of 3.2:1. The male predominance in traffic accident were previously reported by many studies(10)(46)(47)(48). The reason for young age group and male predominance in road traffic accident might be due to their large involvement in occupationally high risk activities and their massive movement from place to place for business activities. In addition, young adults more likely involved in risky behaviors like traffic rule violation, reckless driving and alcohol use.

Pedestrians accounted for higher proportion 144(39.7%) of road traffic accident followed by vehicle occupant 141(38.8%). This finding was in agreement with previous studies in Ethiopia and other studies in low and middle income countries (11)(46). This might be due to inadequate sidewalks for pedestrian, poor road design and signals in the country for pedestrian. Furthermore, inadequate public awareness on road traffic rules, discourteous behavior of driver or motorist, violation of traffic rules by drivers and pedestrian might be the reason for pedestrian predominantly affected in Ethiopia (47).

Ethiopian government is enforcing preventive measure like seat belt use for both drivers and vehicle occupant, and helmet use for both motorist and motor occupant (2). However, only 17(12.1%) of the vehicle occupants and 21(53.8) of injured driver used seat belt. The reason for low seat belt use by vehicle occupants could be absence of seat belt in passenger vehicle, passenger overload and absence of public awareness on seat belt use. Moreover, 17(43.6%) of motorist or motorbike occupants used helmet. Though the sample size for helmet utilization in this study is low, this finding is nearly similar with previous study in Tanzania, 43.3% (48). The underutilization of helmet in this study might be due to lack of strict traffic rule enforcement on helmet and low public awareness on benefit of helmet use for motorist or motor bike occupant in preventing head injury.

Majority of the accident were happened in the day light, accounted 260(71.6%). This finding is consistent with other studies (46)(47). In addition, majority of the accident were occurred in urban, 195(53.7%). The present study is discordant with the study conducted in Iran concerning accident location (18). Existence of traffic jam during the day time, poor road network and mixed traffic flow system in urban might be the reason for increased accident occurrence during day light and urban (49).

With regard to mode of arrival to health care facilities majority of the victims arrived health care facilities by private vehicle, 252(69.4%) followed by ambulance 89(24.5%). Though proportion of victims arrived to health facilities by ambulance was low, this finding is slightly higher than the result reported by previous studies in Addis Ababa (11)(12). Concerning prehospital care, only 52(14.3%) of the victims had prehospital care. The present finding is higher than reports of previous studies in Ethiopia and Tanzania, both of them reported zero percent for victims received prehospital service(10)(46). The increased number of victims used ambulance and received prehospital service in the present study might be due to establishment of organized prehospital service in Addis Ababa and involvement of private business group in ambulance and pre hospital services such as Tebita Ambulance in Addis Ababa.

Two-hundred fifteen (59.2%) of the accidents were happened by light vehicles followed by medium heavy vehicles, 29.5%. This finding is consistent with previous studies in Ethiopia and low and middle income countries(10)(11)(46).

Even though the alcohol status of numerous driver were missing, driver who suspected for being driving under the influence of alcohol were 2.64 times more likely to cause severe injury to themselves or to others when compared with the drivers who were driving without alcohol on bivariate logistic regression, COR 2.64(95% CI; 1.23-5.64). However, this result has no statistically significant association on multivariate when adjusted for potential confounders, AOR 2.1(95% CI; 0.93-4.71). This might be due to impact of missing value on multivariate analysis. In line with this study, the use of alcohol had clear effect on injury severity as reported by previous studies in Philippines, United States and Canada (23)(32) (50).

The protective effect of helmet use on injury outcomes has been well documented in previous studies (26)(51). In line with other studies the present study found statistically significant association between injury severity level and helmet use even after adjusted for other potential confounders, AOR 4.7(95% CI; 1.04-21.09).

Crash characteristics were associated with injury severity in present study. The study revealed that two vehicle collisions were 52% less likely to cause severe injury than vehicle to pedestrian crash after adjusting for potential confounders, AOR 0.48(95% CI; 0.24-0.93) . Though it didn't compared association between types of collision in terms of odds ratio, study conducted in Iran revealed existence of statistically significant relationship between injury severity and collision type(18). Moreover, study in Germany revealed association between crash type and injury severity. Accordingly, severe injury was associated with frontal collision when compared with other mechanism (28).

This study also found statistically significant relationship between vehicle size and road traffic accident injury severity. Interestingly, crash involved large heavy vehicles were 2.14 times more like to be severe than crash from light vehicles with AOR of 2.14(95% CI; 1.01-4.52). The present finding is in agreement with other studies (20)(29)(30)(22).

Lighting condition determines injury severity level. Accident occurred in the dark lighting condition were 1.93 times more likely to be severe than accident occurred during the day light after adjusting for other covariates, AOR 1.93(95% CI; 1.01-3.65). The present study finding is consistent with study conducted in developing and developed world. They found that night-time

road crashes were associated with injury severity than accident happened during day time (23) (31) (32)(33)(34)(35).

A road traffic accident occurred in cross city or rural environment was more likely to be severe than accident happened in urban area. These differences persist even after controlling for the confounding effects of all other covariates, AOR 1.95(95% CI; 1.18-3.24). This finding is consistent with a study of Tainio *et al* (36). This might be attributed to speedy driving, lower traffic police presence, inadequacy or absence of emergency medical services, and greater distance to hospitals in rural road.

This study found statistically significant association between availability of safety tools or signals at accident location and road traffic accident injury severity. Individuals who sustained road traffic injury at environment equipped with safety tools like traffic light, guard rail, speed breakers and safety signals such as traffic symbols, pictures and zebra cross walk were 42% less likely to sustain severe injury than their counterparts with AOR of 0.58(95% CI; 0.35-0.96). Furthermore, this study found that injury occurred at accident location with existence of tight traffic police control were 51% less likely to be severe than the location without tight traffic police control even after adjustment for potential confounders, AOR 0.49(95% CI; 0.27-0.88). Similarly, study conducted in Bangladesh found that presence of both police and signal based control mechanism would reduce the severity level (35). This is not surprising because the drivers take more care if they see a traffic police around compared to uncontrolled locations as observed in different cities of Ethiopia including Addis Ababa. In addition, drivers take care when they see traffic signals especially if they are new for that road.

A victim extricated from the accident by health care providers and police from the scene was 67% and 53% less likely to sustain severe injury respectively than those extricated by Good Samaritan. This finding were statistically significant with adjusted odds ratio for those extricated by health care professionals and police were, 0.33(95% CI; 0.13-0.83) and 0.47(95% CI; 0.24-0.94) respectively. In agreement with the present study, the study in Iran reported injury severity difference among victims extricated by healthcare professionals, police and lay person (52).

Existence of prehospital care system significantly decrease injury severity and death rate secondary to traffic accident (37). It has been reported as the most important factors in predicting

ultimate outcome of injury (53). Nevertheless, this study did not find statistically significant association between prehospital care and injury severity level in both bivariate and multivariate logistic regression analysis, COR 1.66(95% CI; 0.86-3.19) and AOR 1.23(0.61-2.51). The lower coverage of pre-hospital 52(14.3%) in present study might have influence on the finding; it is too small sample and has no statistical power to test significant association.

Limitation and Strength of The study

This study has several limitations. It only reflects characteristics of victims referred to selected hospital. Victims dead at the scene and those didn't seek health care were not included to the study. In addition some variables were collected using self-report which has a potential for overestimation or underestimation. For instance, though the respondent informed absence of any harm or damage to them as a result of their response, the driver might respond 'No' to alcohol use and 'Yes' to seat belt use. This could be attributable to fear of legal punishment which has a tendency to underestimate or overestimate the association. This study excluded vehicle speed at the moment of accident due to missing data and exaggerated response bias. Vehicle speed at the moment of accident determines injury severity in many literatures. Moreover, no restriction was placed on the vehicle model year in our studies.

On the other hand this study have a number of strength; the study used the three referral hospitals available to provide trauma care at the national level, which increase credibility to our finding that have a potential to show the clear picture of traffic accident burden in Ethiopia. Furthermore, the study used Haddon matrix to include numerous variable that have a potential to affect injury severity and identified the point to cut the chain of traffic accident in the country.

7. CONCLUSION AND IMPLICATIONS

This section concludes the main objective of the study. It synthesizes the major findings of the study based on presentations and triangulations of results in previous chapters. Contingent up on the major findings of the study, this chapter also suggested implications for further research, policy and theory that are believed to enhance the comprehensive understanding and intervention of the theme under investigation.

7.1. Conclusion

Based on our study result we conclude the following;

More than one third of the study subject sustained severe injury as a consequence of traffic accident. Male and young age groups were predominantly affected by road traffic accident. Pedestrian and vehicle occupant were vulnerable to road traffic accident than other types of victims. Majority of the accident were happened by light vehicle

Lower extremities and head were the most common victim's body region frequently affected by road traffic accident.

Almost one tenth of the vehicle occupant used seat belt while half of the driver used it. Regarding helmet utilization, more than half of motorist and motor occupant didn't used helmet.

Nearly three fourth of the accident were happened in day lighting condition and more than half of the accident happened in urban road.

Majority of the victims arrived health care facilities by private vehicle while one fourth of them arrived by ambulance. Less than one sixth of the victims received pre hospital care.

Alcohol and driving, helmet use, victim type and presence of multiple injuries were among host related statistically significant predictors of road traffic accident injury severity level. Driver used alcohol and driving were more likely to cause severe injuries to themselves and others victim. Helmeted motorist or motorbike occupants were less likely severely injured. Injury happened to vehicle occupant were less severe when compared with injury of pedestrian.

Vehicle type and crash type were agent related determinant of injury severity level. Large heavy vehicle more likely cause severe injury than light vehicle. Moreover, accident happened to pedestrian were more likely to be severe than accident from two vehicle collision.

Lighting condition, place of accident, seating position of vehicle occupant, availability of traffic signals and tools at accident location, availability of tight traffic police control and person extricate the victim from scene were among environmental factors that determine injury severity level. Interestingly, accident happened in the dark lighting environment were more likely to cause severe injury than that occurred in day light.

Accident happened in cross city or rural environment were more likely cause severe injury. Environment with tight traffic police control and equipped with traffic safety tools and signals were less likely related with severe traffic accident injuries.

Moreover, victims extricated from the scene by healthcare professionals and police were less likely to sustain severe injury than those extricated by Good Samaritan.

7.2. Implication of the finding

Results reported in this paper suggest the need for immediate and pragmatic steps to be taken to curb the wanton destruction of lives that are occurring on the roads. In particular, there is urgent need to introduce road safety interventions to address this public health hazard that is claiming the lives of economically productive age group. So, this study forwarded the following recommendations;

7.2.1. Implication for policy and interventions

This study identified predictors of road traffic accident using Haddon Matrix; host, agent and environment as well as in terms of time sequence, pre-event, event and post-event. The results have important implications for pedestrian, passenger and driver safeties and vehicle design

- I. Alcohol use and helmet utilization were among identified pre-crash host related predictors of injury severity. In Addis Ababa, the government started random alcohol test for all drivers. This should be encouraged and could be applied in massive scale.

Moreover, helmet related rule should be effectively enforced in order to minimize the impact of road traffic accident.

- II. Being pedestrian were another pre-crash host related determinant of injury severity in this study. To minimize this effect, collaborative work between the public, drivers and government is needed. Pedestrian and drivers should be abided to traffic rules and regulation while the government should enforce strict traffic rules for both pedestrian and drivers. In addition media should work more on public awareness about traffic accident
- III. Multiple injuries to the victims were considered as post-crash host related factors. Prompt and timely management of the victims reduce the impact associated with multiple injuries. This can be achieved by training of paramedics or triage personnel. So, the government and concerned bodies should work on trained man power capacity building.
- IV. Vehicle type was associated with pre-crash agent related factors while collision type was during crash and agent related factors determinant of injury severity in this study. Though cautious driving is recommended for all drivers, the drivers of large heavy vehicles should be more cautious. Furthermore, collision with pedestrian were related to severe injury as a result government and concerned bodies should work more on facilitation of safe environment for pedestrian.
- V. Lighting condition, accident location, vehicle occupant seating location, availability of traffic signals and tools at accident location, availability of tight traffic police control were among pre-crash environmental factors. Government should enforce rules for driving in dark environment and driving in rural area. Tight traffic police control should be encouraged in urban and rural environment. In addition, place with high traffic should be equipped with traffic signals and traffic tools.
- VI. Public education campaign in first aid, target-group training for professional drivers, police officers and volunteers are encouraged to minimize injury severity secondary to extrication in post-crash event.
- VII. Over all, Safety and education campaigns aimed at raising awareness of these issues are likely to have a beneficial impact on reducing injury severity levels

7.3. Implication for researchers

This study used cross sectional study to determine factors affecting injury severity. So, the investigators recommend strong design such as case-control or cohort studies for researchers interested to conduct further studies. In addition, the investigators recommend large sample size and inclusion of driving speed for further study for those interested to the topic.

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ANNEXS

ANNEX 1- Participant Information Sheet and informed Voluntary Consent Form

Dear respondent my name is _____. I am working as data collector for the study being conducted in this facility by Ararso Baru, who is studying for his Master degree at Addis Ababa University, College of Health Science, and Department of Emergency Medicine.

I am interviewing road traffic accident victims about factors contributing for injury severities in order to generate information necessary for the policy makers to provide feedback for their policy, and other researchers to draw base line finding for further investigation in the area. To attain this objective, your cooperation to be honest and genuine participant by responding to the question prepared is very important and highly appreciated.

I will proceed to the interview after you understand the following points

Objective – The objective of this study is to assess factors associated with severity of road traffic injury among road traffic accident victims referred to Emergency Department of selected public hospitals in Addis Ababa

Benefit: The study may have no direct benefit for the participants. But the information generated from the study help the government administrator's to enforce the implementation of the regulation to road traffic accident prevention, to minimize the burden of road traffic accident on economy and human resources. Moreover, it is used as base line data for further investigation. Indeed, it will help the researcher to write up his thesis for partial fulfillment of Master of Science degree.

Harm: The participants do not have any harm by participating to the study or for not participating to the study, except taking few minute from your time. There wouldn't be any direct payment for participating in this study.

Procedures and duration: Participants are interviewed once and the interview may take from 30-40 minutes. So, I kindly request you to spare me this time for the interview.

Alternatives to participation: You do not have to take part in this research if you do not wish to do so, and refusing to participate will not affect you and your family. If you have question that is unclear you have a right to ask for clarification. If you have also a question that you don't want to answer you can skip it. You may stop participating in the research at any time.

Confidentiality: Your answers are completely confidential. Your name will never be used in connection with any information you tell us. The questionnaire will be coded to exclude showing names. All information given by you will be kept confidential.

Informed consent: I have read this form or it has been read to me in the language that I understand. I understand all conditions stated above. Therefore, I am willing to participate in this study.

If there is any questions or enquires any time about the study or the procedures, please contact:

Name of Principal investigator: Ararso Baru

Address: Tell +251912370380

E-mail: ararsob@gmail.com

Name of interviewer _____

Signature _____

Result of interview:

1. Completed
2. Refused
3. Partially completed

Checked by:

Supervisor Name-----signature-----Date-----

Annex-2-Information Sheet and Informed Voluntary Consent Form for Heads of Hospital

Preamble: My name is Ararso Baru, MSc student at Addis Ababa University. I am here to conduct the study in your hospital. I will conduct a study under Addis Ababa University, college of health sciences for partial fulfilment of Master of Science in Emergency Medicine and Critical Care. The study will have a paramount importance to identify factors contributing for severity of road traffic accident in Ethiopia. So, I kindly request your permission to do the study on road traffic accident victims referred this hospital.

Study/project title:

Injury Severity Levels and Associated Factors among Road Traffic Accident Victims Referred to Emergency Departments of Selected Public Hospitals in Addis Ababa, Ethiopia: The Study Based on Haddon Matrix

Objective – The objective of this study is to assess factors associated with severity of road traffic injury among road traffic accident victims referred to Emergency Department of selected public hospitals in Addis Ababa

Benefit: The study may have no direct benefit for the participants. But the information generated from the study help the government administrator's to enforce the implementation of the regulation to road traffic accident prevention, to minimize the burden of road traffic accident on economy and human resources. Moreover, it is used as base line data for further investigation. Indeed, it will help the researcher to write up his thesis for partial fulfillment of Master of Science degree. There wouldn't be any direct payment for the hospital or for the participant as a result of participating to the study.

Harm: The study has no harm to the hospital and to the participant. The participants do not have any harm by participating to the study or for not participating to the study, except taking few minute from his/her time.

Procedures and duration:

The study will be conducted from April to May 2017 on road traffic accident patient referred to emergency department of this hospital. To access the patients, first the data collector will use

register of road traffic accident victims from triage logbook. Then, their card number will be taken and they will be accessed accordingly by the data collectors. Written informed consent will be taken from each study participant if they are conscious and will be taken from family for unconscious patient. The interview will be done after life threatening condition is managed by their care provider. Moreover, their medical record will be reviewed for further information as needed.

Confidentiality

The information gathered from participants will be confidential. The finding of this study will be general for the study community and will not reflect anything particular of individual persons. The questionnaire will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the research.

Rights

Participation in this study is voluntary basis. Considering the importance of the research to your hospital you are free to decide on it. If any violation of rules and conduct is seen throughout the study, your hospital has full right to withdraw the study at any time.

If there are any questions or enquires any time about the study or the procedures, please contact:

Principal investigator

Name: **Ararso Baru**

Tel: 0912370380

E- mail: ararsob@gmail.com

Sign _____

Name of Hospital _____

Head of the Hospital: _____

Tel: _____

E-mail: _____

Sign: _____

Annex-3- English Version Questionnaire

Addis Ababa University

College of Health Sciences

Department of Emergency Medicine

Preamble

Dear respondent! The purpose of this questionnaire is to collect data about injury severity level of road traffic accident and associated factors in this hospital. Questions included in this questionnaire enable researcher to get information pertaining to the level of victim's injury severity and factors which contributes for road traffic accident severity. Information you give will serve only this stated academic purpose and confidentiality will also be strictly kept. Your genuine response to the questions is very important in achieving goal of the study. Thus, I cordially ask your cooperation for interview on this questionnaire honestly.

General instruction: For close ended questions choose the appropriate response that reflect victim's situation and write the number of your choice in the corresponding provided box. For open ended question, specify the respondent view and write on space provided.

Segment 1: Certification

Interviewer's Name: _____

Signature: _____

Date western (D-M-Y): _____

Field Supervisors Name: _____

Signature: _____

Name of the hospital: _____

Questionnaire ID Number.....

Segment 2: Demographic and Socio-economic issues

1. Sex (Male=1, Female=2) ☐
2. Age ☐ ☐
3. What is your occupation? (1=merchant, 2=driver, 3=driver assistant, 4=private employee, 5=government employee 6= others ☐
4. Can you tell me your estimated monthly income?
5. What was the name of the place where accident took place? Write the name of the place including the regional state of the place
6. Can you tell me the estimated distance of the place where accident took place from Addis Ababa in KM?

Segment 3: Host related Characteristics

Instruction: question related to driver will be asked if the victim by him/herself is the driver. If the victim is not driver skip the question. The same instruction works for other types of victims (pedestrian and vehicle occupant).

7. In which type you classify the victim? (1=Pedestrian, 2=driver, 3=motorbike driver, 4=motorbike occupant, 5=vehicle occupant)..... ☐
8. Does the driver have driving license? (1=yes, 2=no)..... ☐
9. For how long you have been driving?
10. What was driving speed at the time of accident? km/hr.
11. Does the driver use seat belt at the moment of accident? (1=yes, 2=no)..... ☐
12. For how long hour you have been working at the moment of accident without rest? _____ hr.
13. Does the vehicle occupant use seat belt at the moment of accident? (1=yes, 2=no)..... ☐
14. Are used helmet at the moment of accident as motorist? (1=yes, 2=no)..... ☐
15. Are used helmet at the moment of accident as motorbike occupant? (1=yes, 2=no)..... ☐

16. Are you used alcohol at the day of accident (ask only if the victim is driver or pedestrian and incircle types of victm ? (1=yes, 2=no) (1=driver, 2=pedastrian).....☐
17. What drug you used other than alcohol at the moment of accident? (1=khat, 2= shisha, 3= Others(spacificy_____)).....☐
18. Which part of the victim's anatomic region injured? (1=Head, 2=neck, 3=thorax, 4=abdomen, 5=upper limb, 6=lower limb, 7=spine).....☐☐☐☐☐
19. Does the patient have multiple injuries? (1=yes, 2=no).....☐
20. Does the pedestrian violate recommended way to cross the road or not used recommended road side for walking (left side walking)? (1=yes, 2=no).....☐
21. Does the driver violate recommended road side for driving? (1=yes, 2=no).....☐

Segment four: Agent related characteristics

22. What was the type of vehicle that resulted in accident? (1=Motor cycle, 2=Bajaj /three wheel vehicle, 3= Automobile, 4=City mini bus, 5=Cross city mini bus, 6=Bus (city bus or long distance), 7= Light truck (Pickup trucks) , 8=Isuzu , 9=Sino truck, 10=Truck with trailer, 11=Construction equipment, 12=Cart, 13=Others).....☐☐☐
23. In which type of road traffic accident you classify the accident? (1=Collision with pedestrian, 2=Collision with motorcycle/bicycle, 3=Two vehicle collision, 3=Overturning, 4=Collision with animal, 5=Fixed object collision, 6=Falling from moving vehicle, 7=others (Specify _____).....☐

Segment five: Environment related characteristics

24. What was the status of the place where accident took place? (1=urban road, 2=rural road/cross city road).....☐
25. Can you tell me the time of accident? _____
26. Can you tell me the road surface condition of the place where accident took place? (1=asphalt, 2=gravel, 3=other).....☐
27. What was the lighting condition at the moment of accident? (1=Daylight, 2=Dark, 3=Dusk/dawn).....☐
28. What was the pedestrian accident occurrence location in relation to road? (1= On the middle of the road, 2=on the left side for pedestrian, 3= On the right side for pedestrian)

29. Which safety method is available at accident location? (1= Zebra cross walk, 2=traffic light, 3=Guard rail, 4=others (specify_____))......☐☐☐
30. What was your seating place at the moment of accident? (1=Front seat near to driver, 2=front seat away from driver, , 3=middle seat and toward the center of the vehicle, 4=middle seat and at side of the vehicle, 5=at the back of commercial vehicle, 5=rear seat and toward the center of the vehicle, 6=rear seat and at the side of the vehicle)
31. Do you think there was tight traffic police control in the area of accident? (1=Yes, 2=No).....☐
32. What was the weather condition at the moment of accident at accident location? (1=raining, 2=Not raining).....☐
33. Did you get prehospital care? (1=Yes, 2=No).....☐
34. Who extricate the victims from accident place? (1=Health professionals, 2=Bystanders, 3=Police).....☐
35. Which transport mode you have been used to arrive from scene to health facility? (1=Ambulance, 2=commercial vehicle, 3=Police vehicle, 4=Automobile, 5= Taxi, 6=Lada, 7=Carried by the people, 7=others (specify_____))......
☐

Segment Six: Kampala Trauma Score (KTS II) of the Victim

Label	Description	Score
A	Age (in years) 5-55	1
	<5 or >55	0
B	Systolic Blood pressure on admission More than 89 mm Hg	2
	Between 89–50 mm Hg	1
	Equal or below 49 mm Hg	0
C	Respiratory rate on admission 0-29/minute	2
	30+	1
	≤9/minutes	0
D	Neurological status Alert	3
	Responds to verbal stimuli	2
	Responds to painful stimuli	1
	Unresponsive	0
E	Score for None	2
	serious injuries One injury	1
	More than one injury	0
Total (A+B+C+D+E) = _____		

THANK YOU FOR YOUR COOPERATION