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Magnitude and determinants of road traffic accident in Mekelle city, Tigray, Northern Ethiopia: A cross sectional study

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Abstract

Objective: Road Traffic Accident is becoming a threat to public health in many developing countries including Ethiopia. Therefore, this study aimed to assess the magnitude and determinants of road traffic accidents.

Method: A cross-sectional study was done using a simple random sampling technique and data were collected from drivers from Feb to Jun 2015 in Mekelle city, Ethiopia. A binary logistic regression was used to identify factors associated with road traffic accident.

Results: The magnitude of road traffic accident was found to be 23.17%. According to the drivers' perceived cause of the accident, 22 (38.60%) of the accident was due to violation of traffic rules and regulations. The majority of the victims were pedestrians, 19 (33.33%). Drivers who were driving a governmental vehicle were 4.16 (AOR=4.16; 95% CI: 1.48- 11.70) times more likely to have road traffic accident compared to those who drive private vehicles. Drivers who consumed alcohol were 2.29 (AOR=2.29; 95% CI: 1.08-4.85) times more likely to have road traffic accident compared to those drivers who do not consume alcohol.

Conclusion: Magnitude of RTA was high. Driving a governmental vehicle and alcohol consumption were the factors associated with Road Traffic Accident. Monitoring blood alcohol level of drivers should be in place. Holistic study should be done to identify the causes of RTA.

Keywords

Road Traffic Accident; Drivers; Mekelle city; Tigray; Ethiopia

Strength and Limitation

- Data quality was assured under close supervision of principal investigators.
- Findings of the study were based only by quantitative study which may loss the quality that can be addressed by qualitative study.
- The cross-sectional study design limits the factors to establish temporal relationship; hence inference of causation is not applicable

1. Introduction

Road Traffic Accident (RTA) is an accident that happens unexpectedly, unintentionally and unpredictably under unexpected conditions. Accordingly, RTAs are collisions between vehicles, between vehicles and pedestrians, between vehicles and animals, or fixed obstacles [1]. RTA contributes to poverty by causing loss of productivity, material damages, injuries, disabilities, grief and deaths [2]. Road traffic injuries are increasing worldwide with unequal number occurring in developing countries [3]. Road traffic injuries account for 2.1% of all deaths worldwide and ranked 10th killer health problem globally. Twenty three percent of all injury related deaths occurred by traffic accident worldwide, of which 90% occurred in low and middle income countries, where 81% of the world's population live and own about 20% of the world's vehicles. Predictions indicated that RTA mortality will be 67% by 2020 if appropriate actions are not taken [4].

World Health Organization (WHO) in 2011 reported that the RTA in Ethiopia reached 22,786 which accounted 2.77% of all the deaths. The report showed that RTA is the 9th killer health problem in the country. Road traffic accident makes Ethiopia 12th and 9th in the world and in the Africa continent respectively [5]. Poor conditions of quality of vehicles and less road safety are determinant factors for RTA in Africa [6] including Ethiopia [7]. Despite infrastructure and quality

of vehicles, evidences also noted that human behavior is the most common factor accounting for more than 85% of all traffic accidents [8]. Mekelle is a fast growing regional city, which owes a heavy traffic flow, especially during peak hours [9]. In Mekelle city it was reported that road traffic accidents had increased from year to year and it was shown that 96% of the causes were related to human risk behavior whereas 4% was due to the vehicle problem [10]. Therefore, this study was aimed to assess the magnitude and determinants of road traffic accidents Mekelle city.

2. Methods

Study setting

The study was conducted among drivers in Mekelle city, Tigray, northern Ethiopia from Feb to Jun 2015. Mekelle is the capital city of the Tigray regional state which is found at 783 Km north of the capital city of Ethiopia, Addis Ababa. Regarding road infrastructure: Mekelle city has 55 km asphalted, 23 km cobble stone and 152 km gravel road [11].

Study design

A cross-sectional study design was used.

Participants

All drivers who were based in Mekelle city, had a legal driving license and who were driving taxi, Bajaj (three wheel taxi), private owned car and governmental car in Mekelle city were included in the study. Heavy truck drivers, drivers who were not working and sick during the study period, those who drive more than two vehicle types and those who came from other areas to Mekelle city were excluded from the study.

The sample size was calculated from a previous study, where the prevalence of road traffic accident was reported, p=22% in Mekelle city [10]. Using 5% marginal error and 95% confidence interval by the following formula:

$n= (Z\alpha/2)^2 P (P-1)/D^2$

Where n = Minimum sample size required

Z = Standard score corresponding to 95% confidence interval

P = Assumed proportion of drivers

D = Margin of error (precision) 5%

n = 3.84 x 0.1716/0.0025= 263

Since the source population for the study was less than 10,000(i.e. 1500) the sample size correction formula was used:

nf= n/1+ (n/N)

Where nf= desired sample size

n=calculated sample size

N=total population

nf= n/1+ (n/N) =263/1+ (263/1500)=263/1.175=223.8~224

By adding 10% contingency for non-response, the sample size was 224+22=246

Sampling procedures

A sampling frame was constructed by a vehicle plate number, which was obtained from Mekelle city transport office. The frame was sub categorized based on the type of the vehicle as a taxi, Bajaj, governmental vehicles, and private/house vehicles. Sub samples were calculated for each category of vehicles proportional to the number of vehicles in the respective categories. Then, study subjects were selected using simple random sampling method (see Figure 1).

Data collection procedures and tools

The study subjects (drivers) were traced and interviewed for data collection. The drivers were traced at their destination for taxi and Bajaj, house cars in their working area and governmental cars at their offices using the car plate number. A structured interviewer administered questionnaire, adapted from different literatures, was used. The questionnaire was initially prepared in English ("See S1 in the Supporting information for the questionnaire") and was translated into the local language Tigrigna ("See S2 in the Supporting information for the local language (Tigrigna)). The instrument included: socio-demographic characteristics of drivers, risk factors and risky driving factors associated with road traffic accidents for the previous two years. Trained data collectors and supervisors handled the data collection process.

Patient and Public Involvement

Drivers from Mekelle city have involved in the study for interview regarding RTAs.

Data Quality Control

Pre-test was done on 5% of the sample at Adigrat town, Tigray region. Based on the pretest findings, necessary corrections were made to the questionnaire. Adequate supervision was undertaken by the supervisors and principal investigator during the data collection. Daily spot-

checking of filled questionnaires for errors or any incompleteness was done by the supervisors and the principal investigator.

Data management and analysis

The collected data were entered and cleaned in Microsoft excel 2007. Then, the data were exported and analyzed using STATA version 12. Values of categorical variables were presented as frequencies and percentages. All statistical tests were performed at the 5% significance level.

The dependent variable was a Road Traffic Accident (RTA) which was dichotomized into Yes (labeled "1") and No (labeled "0"). Each independent variable was cross tabulated with the outcome variable and variables which showed significant association were further entered into the bivariable binary logistic regression. Finally, variables significant in the bivariable analysis were entered into multivariable binary logistic regression analysis to identify independent determinants of RTA.

Multi-collinearity was checked using Variance Inflation Factor (VIF) at a cutoff value of 10. Variables with greater than 10 VIF value were handled by removing the most inter-correlated variable(s) from the model and substitute their cross product as an interaction term. The final model was developed using a step-wise logistic regression. Final model fitness was checked using the Hosmer-Lemshew method. Receiver Operating Characteristic (ROC) curve was used to show how much the independent variables in the final model predicted the dependent variable.

3. Results

Socio-demographic characteristics of the respondents

The response rate in this study was 100%. The median (IQR) age of the respondents was 30 (10) years. The majority of study participants (98.37%) were males. Regarding the marital status of the respondents, 102 (41.46%), 101(41.06%), 30 (12.20%) and 13 (5.28%) were divorced, married, single and widower respectively. The majority of the drivers, 170 (69.11%) were Christian Orthodox, followed by Muslims, 54 (21.95%). With regard to their educational status, 225 (91.46%) had attained at least grade 5. The median (IQR) monthly income (in Birr) of the study participants was 1000 (1200) (Table 1).

Table 1: Socio-demographic and economic characteristics of drivers in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables		Frequency	Percentage
Age in years, median (IQR)*		30 (10)	
Monthly income in Birr, median (IQR)		1000 (1200)	
Sex	Male	242	98.37
	Female	4	1.63
Marital status	Married	101	41.06
	Single	30	12.20
	Divorced	102	41.46
	Widower	13	5.28
Religion	Orthodox	170	69.11
	Muslim	54	21.95
	Protestant	8	3.25
	Catholic	14	5.69
Educational status	Illiterate	17	6.91
	Primary (Grade 1-4)	4	1.63
	Secondary (Grade 5-10)	121	49.19

	Preparatory & above (Grade 11 & above)	104	42.28
Ethnicity	Tigraway/ti	222	90.24
	Amhara	17	6.91
	Afar	7	2.85

* IQR: Inter Quartile Range

Magnitude of road traffic accidents

Among all the drivers included in this study, 57 (23.17%) had encountered a road traffic accident in the past two years, from the time of the current study. Most of the accidents happened on Monday, 22 (38.60%) and Friday, 13 (22.81%) even though accidents were reported in all the seven days. The causes of the accidents, as reported by the drivers, were mainly due to violation of traffic law in 22/57 ((38.60%) of the cases. A significant number of the accidents, 25/57 (43.86%) happened at dawn. Pedestrians and Cyclists constituted the major share of the RTA, 31/57 (54.40%). About two third of the accidents, 43/57 (75.44%) happened at either T-junction road or cross road (Table 2).

Table 2: Characteristics and Setting of RTA in Mekelle City, Northern Ethiopia. 2015. (n=246)

Variables		Frequency	Percentage
Accident occurrence	Yes	57	23.17
	No	189	76.83
Type of accident	Injury	29	50.88
	Injury and Property damage	14	24.56
	Property damage	8	14.0
	Death	6	10.5
Light Condition	At dawn	41	71.93
	Day time	16	28.07
Victim	Pedestrian	19	32.14
	Cyclist	12	21.43
	Passenger	14	25.00
	Driver	12	21.43
Accident site road	T-junction	15	26.32
	Cross Road	28	49.12
	Straight road	14	24.56
Date of accident	Monday	22	38.60

	Tuesday	4	7.02
	Wednesday	6	10.53
	Thursday	3	5.26
	Friday	13	22.81
	Saturday	9	15.79
Number of accidents (life time experience)	1	42	73.68
	2	12	21.05
	3	3	5.26
Reason for the accident	Lack of general safety awareness of pedestrians	10	18.52
	Violation of traffic rules and regulations	22	40.98
	Violation of speed Limit	9	15.73
	Lack of vehicle maintenance	13	24.77

Risky driving behaviors

Concerning risky driving behaviors, 92 (37.40) of the drivers drunk alcohol before driving. About 43 (17.48%) of the drivers were chat chewers and 30 (12.20%) were smokers. More than one third of the drivers, 96 (39.02%) reported that they used mobile for communication while driving (Table 3).

Table 3: Risky driving behaviors among drivers in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables		Frequency	Percentage
Mobile use while driving	Yes	96	39.02
	No	150	60.98
Substance use	Alcohol	92	37.40
	Chat	43	17.48
	Cigarette	30	12.20
Seat belt use	Yes	204	82.93
	No	42	17.07

What do you do when another vehicle tries to pass?	I advise him to slow down	32	13.01
	I give him priority	144	58.54
	I speed up	70	28.46
A measure taken when there is heavy traffic	Pass accordingly	3	1.22
	Speed up	16	6.50
	Slow down speed	227	92.28

Factors associated with Road Traffic Accidents

Multivariable logistic regression analysis

Multivariable binary logistic regression showed that drivers who consumed alcohol on driving were 2.29 times (AOR=2. 29; 95% CI: 1.08-4.85) more likely to have RTA compared to drivers who did not consume alcohol. Drivers who drove governmental vehicles were 4.16 (AOR=4. 16; 95% CI: 1.48- 11.70) times more likely to have RTA compared to drivers of privately owned vehicles. As the driver's experience increased by one year, the probability of RTA decreased by 26% (AOR=0. 74; 95% CI: 0.60-0.90) (Table 4).

Table 4: Bivariable and multivariable logistic regression of road traffic accident by background characteristics in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables		COR(95% CI)	AOR(95% CI)
Age		0.08(0.041, 0.121)*	1.05(0.98, 1.12)
Marital status	Married	0.85(0.348, 2.086)*	1.62(0.60, 4.39)
	Single	0.37 (0.141, 0.972)*	0.94(0.25, 3.45)
	Divorced	1(Ref.)	1(Ref.)
	Widower	2.72(0.711, 10.408)	
Religion	Protestant	1(Ref.)	1(Ref.)
	Orthodox	0.22(0.052, 0.940)*	0.24(0.05, 1.26)
	Muslim	0 .45(0.102, 2.059)	
	Catholic	0 .55(0.095, 3.245)	
Ethnicity	Afar	1(Ref.)	1(Ref.)
	Amhara	0 .12(0 .011, 1.195)	

	Tigraway/ti	0 .04(0.004, 0.351)*	0.04(0.005, 0.58)*
Vehicle ownership	Private (Driver is employee)	1(Ref.)	1(Ref.)
	Governmental	3.5(1.464, 8.168)*	4.16(1.48, 11.70)*
	Driver (Driver is the owner)	2.38(1.225, 4.660)*	1.64(0.71, 3.339)
License grade	1st	1(Ref.)	
	3rd	1.36(0.329, 5.632)	
	4th	0.55(0.138, 2.241)	
	Special	1.52(0.249, 9.294)	
Alcohol use	No	1(Ref.)	1(Ref.)
	Yes	1.88(1.034, 3.437)*	2.29(1.08, 4.85)*
Substance use other than alcohol	Chat	2.12.(1.010, 4.478)*	2.18(0.78, 6.05)
	Cigarette	2.55(1.105, 5.884)*	1.11(0.39, 3.18)
	I do not use	1(Ref.)	1(Ref.)
Mobile use	No	1(Ref.)	1(Ref.)
	Yes	2.27(1.246, 4.150)*	1.80(0.86, 3.74)
What do you do when another vehicle tries to pass	I advise him to slow down	1(Ref.)	
	I give him priority	2.88(0.952, 8.724)	
	I speed up	1.3(0.38, 4.463)	
Income		1.00(0.999, 1.000)	
Distance travelled		1.00(0.999, 1.005)	
Driver's experience		0.86 (0. 749, 0.999)*	0.74(0.60, 0.90)*
Vehicle service		1.24(1.103, 1.398)*	1.18(0.99, 1.40)

*P-value less than 0.05

The residuals were checked for influential outlier observations and the result showed that there were no suspicious influential outlier observations. Hosmer and Lemshow test showed a chi-square value of 9.41 (p=0. 3085) which is greater than 0.05. The null hypothesis is not to be rejected, which implies that the model estimates adequately to fit the data at an acceptable level. The area under ROC curve was 0.7536 (See figure 2). The predicting power of the independent variables for the dependent variable was 75.36%. Therefore, it can be concluded that the model fits the data reasonably well.

4. Discussion

The main aim of the study was to assess the magnitude and determinants of road traffic accidents among drivers in Mekelle city, Tigray, Northern Ethiopia. The study revealed that the magnitude of self-reported RTA in Mekelle city was 23.17%.

There was a slight increment of accidents in this study compared to the previous study done in Mekelle city, which showed that the prevalence of road traffic accident was 22% [9]. This variation might be due to the fact that the city is expanding where the population size is increasing. However, it is lower when compared with a similar study conducted among taxi drivers with 4 wheels, of which 26.4% of them reported RTA encounter within the past 3 years [12]. The difference might be due to the differences in the RTAs report period where the current study included reports of RTA in the past 2 years from the time of the study.

The study identified that ownership of the vehicles was found to be predictor of road traffic accident. Road traffic accident was 3.78 times more likely among those who drove governmental vehicles. Though literatures did not show supportive or contradicting idea for this finding, this finding might be due to the fact that governmental drivers might violate the traffic rules and use high speed to take their workers to their offices especially at the peak hours.

This study revealed that driver behavior on alcohol consumption while driving was found to be an aggravating factor for RTA. Drivers who drive after consuming alcohol was 2.29 more likely to have RTA compared to those who don't drink alcohol. This finding is similar to a similar study which indicated that individuals who drank alcohol were 3.2 times more likely to get road traffic accident [13]. It was also supported by the Great Britain department for Transport provisional estimates for 2013, which showed that between 230 and 290 people, were killed in accidents in

Great Britain, where at least one driver was over the drink drive limit [14]. This might be due to the nature of alcohol that has a range of psycho-motor and cognitive effects, including attitude, judgment, vigilance, perception, reaction, and controlling [15]. This can cause an increase in accident risk on reaction times by lowering cognitive processing, coordination, attention, vision and hearing.

This study has also revealed that as a driver's experience increases by one year, the probability of getting RTA decreased by 26 percent. This finding was similar to the finding of a study in 2003 which showed as the drive miles and experience increases, the probability of self-reported crash was decreased [16]. This might be due to the anticipation of potentially hazardous traffic situations require years of practice.

Mobile usage while driving was significantly associated with RTA. This study is consistent with a previously done study in Mekelle city [12]. This is because of loss of attention to surroundings while driving. The findings of this study showed that part time and visual impairment were not found to be a predictor variable for road traffic accident. But a study done in Ibadan town Nigeria showed that drivers who had part time jobs were 2.6 times more likely to have traffic accident [3]. Similarly the study of Ibadan indicated that drivers who had visual impairment were 1.6 times more likely to have traffic accident [3]. Therefore, this needs further investigation to explain these relationships.

5. Conclusion

The magnitude of RTA was high. Driving a governmental vehicle and alcohol consumption were the factors associated with RTA. Monitoring blood alcohol level of drivers should be in place.

Holistic study should be done to identify the causes of RTA. This study may have a role in monitoring the RTAs which is the main public health problem at this time.

6. Disclosure section

Acknowledgments

We are glad to extend our gratitude to the data collectors and participants of the study. We would like to extend our gratitude to Mekelle University as well for funding the research.

Author contributions

AW and AD conceptualized and designed the study. AW, AD, and TW were involved in data analyses, drafting the manuscript, critically revising the manuscript and final review.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics and consent

Ethical clearance and approval was given by Mekelle University, school of public health Ethical Review Committee with the approval number of ERC 0017/2014. Written consent was taken from each participant during the interview. All authors read and approved the final manuscript.

Data availability

The data set of the study findings are available from the corresponding author upon reasonable request.

Funding

This study was funded by Mekelle University for research and community services.

Supplementary Materials

S1. This is the S1 File questionnaire. This is the S1 File questionnaire in English version which was used to collect data for this study.

S2. This is the S2 File questionnaire. This is the S2 File questionnaire in local language (Tigrigna) version which was used to collect data for this study.

Figures

Fig 1. Sampling Procedure. Schematic presentation of the sampling technique

Fig 2. ROC curve. Predicting power of the independent variables for the dependent variable

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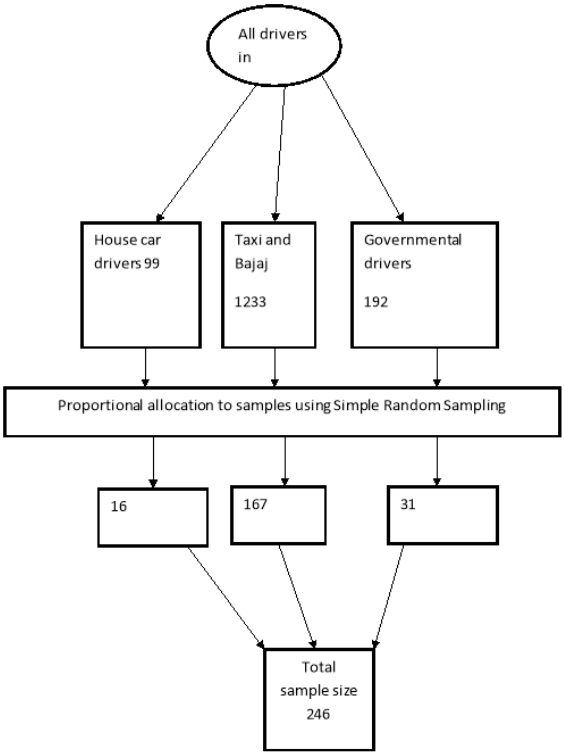

Figure 1: Sampling Procedure. Schematic presentation of the sampling technique.

Schematic presentation of the sampling procedure

69x89mm (300 x 300 DPI)

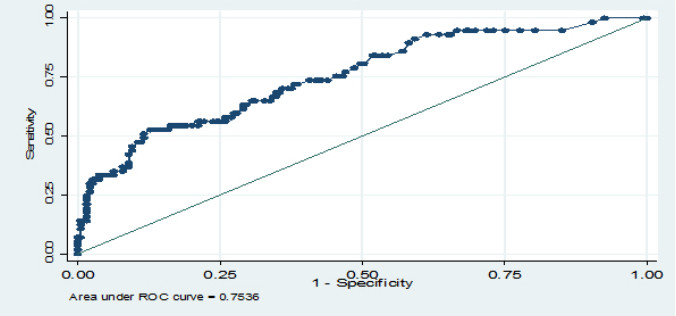

Figure 2: ROC curve. Predicting power of the independent variables for Road Traffic Accident.

ROC curve

69x89mm (300 x 300 DPI)

Supplementary Files

S1 Questionnaire in English Version

I. Questionnaire related to socio-demographic characteristics of drivers

1) Age of the driver_____
2) Sex of the driver A)Male B)Female
3) Marital status A) Married B)Single C)Divorced D)widowed
4) Religion of the driver A)Orthodox B)Muslim C)Protestant D)Catholic
5) Educational status of the driver A) Illiterate B) 1-4 C) 5-10 D) Greater than grade 10
6) Ethnicity A)Tigray B) Amhara C)Oromo D) Others
7) Monthly income _____

II. Questionnaire related to determinant factors of road traffic accident

1. What is the type of road mostly you use? A)Gravel B)Asphalt C)Coble stone
2. What kind of vehicle do you drive most often??

   A) Automobile B) Minibus C) truck D) Bus E) Liquid Cargo F) Bajaj
3. Vehicle Years of Service/This is the number of years since the date the vehicle is manufactured/ _____
4. What did you tell me about your vehicle insurance A)Insured B)Non-insured/
5. Work experience in years? _____ years
6. To whom does the car belongs to? A)Governmental B) Private employer C)Driver
7. Did you provide service to your car? A.)Yes B) No
8. If yes to the above question how many times per a year? A)1 B)2 C)3 D)4 E)5
9. What is your License grade of driving? A)No License B Special C)1st D)3rd E)4th F)2nd

10. Did you use alcohol before or after deriving A.)Yes B) No

11. Which one of the following substance did you use before or after deriving

A.)Chat B) Cigarette C) Shisha D) Mariwana E) Others

12. Did you use seat belt while you are driving? A.)Yes B) No

13. Distance traveled per day_____

14. Have you faced road traffic accident? A.)Yes B) No

15. If yes what was the day_____

16. What was the Light Condition

A Day Light B) Dusk C) Dawn D) Night with Light E) Night with Weak Light

17. What was the reason for the accident

A. Lack of general safety awareness by pedestrians

B. Disrespect of traffic rules and regulations

C. Animal drawn carts and animals frequently using in main highways

D. Violation of speed Limit

E. Lack of vehicle maintenance

F. Others/specify

18. Who was the victim of your accident A, Pedestrians B, cyclist C, passengers D, Driver E)animal

19. What was the road Junction/ A)T-Shape, B)Cross Road, C)Roundabout/

20. How many accidents did you faced_____

21. Type of accident A)injury B)kill animals C)property damages D)Kill pedestrian

22. What did you do when somebody wants to pass you?

A) I tend to pass other cars more often than other cars pass me

B) I tend to pass me more often

C) If possible I told him/her to slow down in order to pass

23. What did you do in heavy traffic?

A) Stay with the slower moving traffic B) Keep up with the faster traffic

C) Both or about equally

24. Have you ever received a ticket, citation, or warning for any traffic violation other than parking a.)yes b) No

25. Did you use mobile while you are driving your vehicle? A.)yes b) No

26. Do you have visual impairment A.)yes b) No

27. While you drive did you limit your speed A.)yes b) No

28. Did you have part time work? A.) yes b) No

29. Did you listen radio? A.) yes b) No

S2 Questionnaire in local language (Tigrigna) Version

I. ውልቃዊ መረዳእታ ዝምልከቱ ሕቶታት

1. ዕድመ_____

2.ፆታ ሀ) ተባዕታይ ለ) ኣነስታይ

3.ኩነታት ሓዳር ሀ) ዝተመርዓወ/ት ለ)ዘይተመርዓወት ሐ)ዝፈትሐ/ት መ)ሰበይቱ/ሰብኣያዝሞቶ/ታ

4.ሃይማኖትሀ) ክርስትያንለ) ሙስሊምሐ) ካቶሊክመ) ፕሮትስታንት

5.ደረጃትምህርቲሀ) ዘይተምሃረለ) ካብ 1ይ-4ይሐ) ካብ 5ይ-10ይመ) ካብ 10ይንላዕሊ

6.ዓሌትሀ) ትግራዋይለ) ኣምሓራይሐ) ኦሮሞመ) ዓፋር

7.ወርሓዊ ኣታዊካክንደይእዩ _____

II.መንቀሊሓደጋትራፊክዝምልከቱሕቶታት

1.መብዛሕትኡ ግዘ እትጓዓዘሉ ዓይነት መንገዲ ሀ) ኣስፋልቲ ለ) ፀፀር ሐ) ኮብል ስቶን

2.እትዝውራ ዓይነት መኪና ሀ) ኣውቶሞቢል ለ)ታክሲ ሐ)ኣውቶቡስ መ) ናይ ረሳሕ ፈሳሲ መጓዓዚ ረ) ባጃጅ

3.ካብ እትስረሐሉ እዋን ጀሚሩ ግልጋሎት እታ መኪና ክንደይ ዓመት እዩ _____

4.ኩነታት ኢንሹራንስ መኪናኻ እንታይ ይመስል

ሀ)ኢንሹራንስ ኣለዋ ለ) ኢንሹራንስ የብላን

5.ስራሕ ልምዶም ክንደይ እዩ _____ ዓመት

6.እዛ መኪና ናይ መን እያ ሀ) መንግስታዊ ለ) ባዓል ሃፍቲ ሐ) ባዕለይ

7. መኪናኣም ዓመታዊ ፅገና ይገብሩላዶ ሀ) እወ ለ) ኣይገብርን

8.መልሶም እወ እንተኾይኑ ክንደይ ግዘ ሀ) 1 ለ) 2 ሐ) 3 መ) ልዕሊ 4

9.ደረጃ መዘወሪ ፍቓዶም ክንደይ እዩ ሀ) ፍቓድ የብለይን ለ) ፍሉይ ፍቓድ ሐ) 1ይመ) 3ይረ) 4ይ

10.ቅድሚ ምዝዋሮም ይኹን ኣብ ዝዝውርሉ እዋን ሰትዮምዶ ይፈልጡ

ሀ) እወ ለ) ኣይፈልጥን

11.ኣብ ክሊምግናሕ መኪና ካብዞም ዝስዕቡ ኣይናይ ትጥቀም

ሀ) ጫት ለ) ሽጋራ ሐ)ሸሻ መ)ማሪዋና ረ) ካልእ ይጠቀስ

12.ኣብ ደረቶም ዝግበር ዕጥቂ ይጥቀሙዶ ሀ) እወ ለ) ኣይጥቀምን

13.ኣብ መዓልቲ ክንደይ ኪሎሜትር ትጓዓዝ _____

14) ሓደጋ መኪና በዚሑካዶ ይፈልጥ ሀ) እወ ለ) ኣይፈልጥን

15) መልሶም እወ እንተኮይኑ ኣበይናይ መዓልቲ ነይሩ_____

16) ኩነታት መብራህቲ እንታይ ነይሩ ሀ) ድሁር ቀትሪ ለ) ኣጋማዘ

ሐ) ምብራህቲ ኣብ ዘለዎ ምሸት መ) ምሸት ኮይኑ ድኹም መብራህቲ ኣብ ዘለዎ

17.መንቀሊ እቲ ሓደጋ እንታይ እዩ ነይሩ ትብል

ሀ)ሓፈሻዊ ንቐሓት ተጉዓዝቲ ዘይምህላው ለ) ሕጊ ትራፊክ ዋጋ ዘይምሃብ ሐ) እቲ ዋና መንገዲ ንእንስሳት መጎዓዚ ምውዓል

መ) ፍጥነት መኪና ዘይምሕላው ረ) መኪና ዘይምዕራይ ሰ) ካሊእ

18.በቲ ሓደጋ ዝተጠቕዐ ኣካል እንታይ ነይሩ

ሀ) ብእግሩ ዝጓዓዝ ሰብ ለ) ሳይክል ዘዋሪ ሐ) ተጉዓዚ መ) ዘዋሪ መኪና

19.እቲ እትጓዓዘሉ ዝነበርካ መንገዲ እንታይ ዓይነት ነይሩ

ሀ) ፐ-ቅርፂ ዘለዎ ለ) መቋረፂ መንገዲ ሐ) ትኽ ዝበለ መንገዲ

20.ክንደይ ሓደጋታት በዚሖም ካይፈልጥ _____

21.ዝበፅሐ ዓይነት ሓደጋ እንታይ ነይሩ

ሀ)መጉዳእቲ ለ)ቅትለት እንስሳ ሐ)ሓደጋ ንብረት መ) ናይ ሰብ ሞት

22.ሓደ በዓል መኪና ከቋርፀካ እንተሎ እንታይ ትገብር

ሀ) ቅድሚ ምሕላፈን ክቐድመን ይሙክር ለ) መብዛሕትኡ ግዘ ክሓልፉኒ ይፈቕደለን

ሐ)እንተተካኢሉ ቀስ ኢሉ ንክጓዓዝ ይመክሮ ::

23.መንገዲ ኣብ ዝተጨናነቐሉ እዋን እንታይ ትገብር

ሀ)ቀስ ኢለ ክሕልፎ ይፅዕር ለ)ቀልጢፈ ክሓልፍ ይፅዕር ሐ)ዳርጋ ማዕረ

24.ካብ ናይ መዕረፊ መኪና ክፍሊ ትቅብሊት /Parking/ ወፃኢ ብናይ ትራፊክ ሕጊ ዘይምኽባር ተቐፂዕካዶ ትፈልጥ ሀ) እወ

ለ) ኣይፈልጥን

25. ኣብ እተሽከርከረሉ ግዘ ስልኪ/Mobile/ ትጥቀምዶ; ሀ) እወ ለ) ኣይጥቀምን

26. ናይ ምርኣይ ፀገም ዶ ኣለካ ሀ) እወ ኣለኒ ለ) የብለይን

27. ኣብ እትዝውረሉ እዋን ፍጥነት መኪናካ ሓሊካ ዶ ነይርካ

ሀ) እወ ለ) ኣይሓለኩን

28.ትርፊ ሰዓት ትሰርሕ ዶ; ሀ) እወ ይሰርሕ ለ) ኣይሰርሕን

29.ብዛዕባ ትራፊክ ዝምልከቱ ፈነወታት ራዲዮ ትከታተል ዶ

ሀ) እወ ይከታተል ለ) ኣይከታተልን

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

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		Reporting Item	*Page Number*
Title	*#1a*	*Indicate the study's design with a commonly used term in the title or the abstract*	*1*
Abstract	*#1b*	*Provide in the abstract an informative and balanced summary of what was done and what was found*	*2*
Background / rationale	*#2*	*Explain the scientific background and rationale for the investigation being reported*	*3*
Objectives	*#3*	*State specific objectives, including any prespecified hypotheses*	*4*
Study design	*#4*	*Present key elements of study design early in the paper*	*4*
Setting	*#5*	*Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection*	*4*
Eligibility criteria	*#6a*	*Give the eligibility criteria, and the sources and methods of selection of participants.*	*4*
	#7	*Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable*	*7*
Data sources / measurement	*#8*	*For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.*	*6*
Bias	*#9*	*Describe any efforts to address potential sources of bias*	*6*
Study size	*#10*	*Explain how the study size was arrived at*	*6*
Quantitative	*#11*	*Explain how quantitative variables were handled in the analyses. If applicable,*	*7*

variables		*describe which groupings were chosen, and why*	
Statistical methods	*#12a*	*Describe all statistical methods, including those used to control for confounding*	*7*
	#12b	*Describe any methods used to examine subgroups and interactions*	*7*
	#12c	*Explain how missing data were addressed*	*N/A*
	#12d	*If applicable, describe analytical methods taking account of sampling strategy*	*N/A*
	#12e	*Describe any sensitivity analyses*	*N/A*
Participants	*#13a*	*Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.*	*n/a there were no stages and study was not on patients*
	#13b	*Give reasons for non-participation at each stage*	*n/a*
	#13c	*Consider use of a flow diagram*	*6*
Descriptive data	*#14a*	*Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.*	*7*
	#14b	*Indicate number of participants with missing data for each variable of interest*	*N/A*
Outcome data	*#15*	*Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.*	*11*
Main results	*#16a*	*Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included*	*11*
	#16b	*Report category boundaries when continuous variables were categorized*	*N/A*
	#16c	*If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period*	*n/a estimates were for odds ratio*
Other analyses	*#17*	*Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses*	*12*
Key results	*#18*	*Summarise key results with reference to study objectives*	*7- 12*
Limitations	*#19*	*Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.*	*3*
Interpretation	*#20*	*Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.*	*13*
Generalisability	*#21*	*Discuss the generalisability (external validity) of the study results*	*15*
Funding	*#22*	*Give the source of funding and the role of the funders for the present study and, if*	*15*

applicable, for the original study on which the present article is based

BMJ Open

Magnitude and determinants of road traffic accidents in Mekelle city, Tigray, Northern Ethiopia: A cross sectional study

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Secondary Subject Heading:	Public health, Health policy
Keywords:	Road Traffic Accident, Drivers, Mekelle city, Tigray, Ethiopia

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Magnitude and determinants of road traffic accidents in Mekelle city, Tigray, Northern Ethiopia: A cross sectional study

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Abstract

Objective: This study aimed to assess the magnitude and determinants of Road Traffic Accidents (RTAs) in Mekelle City, Northern Ethiopia.

Methods: A cross-sectional study was done using a simple random sampling technique.

Setting: The study was done in Mekelle city from Feb to Jun 2015.

Participants: The study was done among drivers settled in Mekelle city.

Main outcome measures: The main outcome measure was occurrence of Road Traffic Accident within two years. A binary logistic regression was used to identify factors associated with RTA.

Results: The magnitude of RTA was found to be 23.17%. According to the drivers' perceived cause of the accident, 22 (38.60%) of the accident was due to violation of traffic rules and regulations. The majority of the victims were pedestrians, 19 (33.33%). Drivers who were driving a governmental vehicle were 4.16 (AOR=4.16; 95% CI: 1.48- 11.70) times more likely to have RTA compared to those who drive private vehicles. Drivers who used alcohol were 2.29 (AOR=2.29; 95% CI: 1.08-4.85) times more likely to have RTA compared to those drivers who did not consume alcohol.

Conclusion: Magnitude of RTA was high. Driving a governmental vehicle and alcohol use during driving were the factors associated with RTA. Monitoring blood alcohol level of drivers should be in place. Holistic study should be done to identify the causes of RTAs.

Keywords

Road Traffic Accident; Drivers; Mekelle city; Tigray; Ethiopia

Strength and Limitation

- Data quality was assured under close supervision of the principal investigators.
- Appropriate statistical methods were used to present the findings of the study.
- Cross sectional study design does not allow establishing causality.
- The analysis of this study misses some important variables like quality of the vehicles and road safety.
- There may be recall bias on the RTA occurrences.

1. Introduction

Road Traffic Accident (RTA) is an accident which occurs or originates on a way or street open to public traffic; resulting in one or more persons being killed or injured, and at least one moving vehicle is involved. RTA includes collisions between vehicles, vehicles and pedestrians and vehicles and animals or fixed obstacles [1]. RTA contributes to poverty by causing loss of productivity, material damage, injuries, disabilities, grief and deaths [2]. Deaths and injuries resulting from road traffic crashes remain a serious problem globally and current trends suggest that this will continue to be the case in the foreseeable future [3, 4].

Approximately 1.3 million people die each year in traffic-related accidents worldwide [5]. Road traffic injury is now the leading cause of death for children and young adults aged 5–29 years, signaling a need for a shift in the current child health agenda. It is the eighth leading cause of death for all age groups exceeding HIV/AIDS, tuberculosis and diarrheal diseases [6] and the deaths due to RTAs are predicted to become the 5th leading cause of death by the year 2020 [5].

The burden of road traffic injuries and deaths is disproportionately borne by vulnerable road users and those living in low- and middle-income countries, where the growing number of deaths is fuelled by transport that is increasingly motorized. Between 2013 and 2016, no reductions in the number of road traffic deaths were observed in any low-income country [2]. Although road infrastructures have a significant role in the occurrence of RTA, the human factor is the most prevalent contributing factor of RTAs. This includes both driving behavior (e.g., drinking and driving, speeding, traffic law violations) and impaired skills (e.g. lack of attention, exhaustion, physical disabilities and so on) [7]. The United Nations (UN) has planned on achieving Sustainable Development Goal (SDG) target 3.6 calls for a reduction in the number of deaths by half by 2020 [8].

Poor conditions of quality of vehicles and less road safety are determinant factors for RTA in Africa [9] including Ethiopia [10]. World Health Organization (WHO) in 2011 reported that RTA in Ethiopia reached 22,786 which accounted for 2.77% of all the deaths. The report showed that RTA is the 9th killer health problem in the country. Road traffic accident makes Ethiopia 12th and 9th in the world and in Africa respectively [11]. Mekelle is a fast growing regional city, which has a heavy traffic flow, especially during peak hours [12]. In Mekelle city, it was reported that road traffic accidents is increasing from year to year and it was shown that 96% of the causes were related to human risky behavior whereas 4% was due to vehicle related factors [13]. However, despite the growing magnitude of RTAs in the city, there is paucity of data on determinants of RTAs among drivers. Hence, this study was conducted to assess the magnitude and determinants of RTAs among drivers in Mekelle city, Tigray, Ethiopia. This study will have a significant role in supplementing and informing the current status in achieving the SDG 3.6 UN target.

2. Methods

Study setting

The study was conducted among drivers in Mekelle city, Tigray, northern Ethiopia from Feb to Jun 2015. Mekelle is the capital city of the Tigray regional state which is found at 783 Km north of the capital city of Ethiopia, Addis Ababa. Regarding road infrastructure: Mekelle city has 55 km asphalted, 23 km cobble stone and 152 km gravel road [14].

Study design

A cross-sectional study design was used.

Participants

All drivers who were based in Mekelle city with a legal driving license and who were driving taxi, Bajaj (three wheel taxi), private owned car and governmental car in Mekelle city were included in the study. Heavy truck drivers, drivers who were not working and sick during the study period, those who drive more than two vehicle types and those who came from other areas to Mekelle city were excluded from the study.

The sample size was calculated from a previous study, where the prevalence of road traffic accident was reported, p=22% in Mekelle city [13]. Using 5% marginal error and 95% confidence interval by the following formula:

$n= (Z\alpha/2)^2 P (P-1)/D^2$

Where n = Minimum sample size required

Z = Standard score corresponding to 95% confidence interval

P = Assumed proportion of drivers

D = Margin of error (precision) 5%

n = 3.84 x 0.1716/0.0025= 263

Since the source population was less than 10,000(i.e. 1500), sample size correction formula was used:

$$nf = n/1 + (n/N)$$

Where nf= desired sample size

n=calculated sample size

N=total population

nf= n/1+ (n/N) =263/1+ (263/1500)=263/1.175=223.8~224

By adding 10% contingency for non-response, the sample size was 224+22=246

Sampling procedures

A sampling frame was constructed by a vehicle plate number, which was obtained from Mekelle city transport office. The frame was sub categorized based on the type of the vehicle as a taxi, Bajaj, governmental vehicles, and private/house vehicles. Sub samples were calculated for each category of vehicles proportional to the number of vehicles in the respective categories. Then, study subjects were selected using simple random sampling method (see Figure 1).

Data collection procedures and tools

The study subjects (drivers) were traced and interviewed for data collection. The drivers were traced at their destination for taxi and Bajaj, house cars in their working area and governmental cars at their offices using the car plate number. A structured interviewer administered questionnaire, adapted from different literatures, was used. The questionnaire was initially prepared in English and was translated into the local language Tigrigna. The instrument included: socio-demographic characteristics of drivers, risky behaviors factors and other variables which has a bearing on RTA. Trained data collectors and supervisors handled the data collection process.

Patient and Public Involvement

Drivers in Mekelle city were involved in the study.

Data Quality Control

Pre-test was done on 5% of the sample at Adigrat town, Tigray region. Based on the pretest findings, necessary corrections were made to the questionnaire. Adequate supervision was undertaken by the supervisors and principal investigator during the data collection. Daily spot-checking of the filled questionnaires for errors or any incompleteness was done by the supervisors and the principal investigator.

Data management and analysis

The collected data were entered and cleaned in Microsoft excel 2007. Then, the data were exported and analyzed using STATA version 12. Values of categorical variables were presented as frequencies and percentages. All statistical tests were performed at the 5% significance level.

The dependent variable was a Road Traffic Accident (RTA) which was dichotomized into Yes (labeled "1") and No (labeled "0"). Each independent variable was cross tabulated with the outcome variable and variables which showed significant association were further entered into the bivariate binary logistic regression. Finally, variables significant in the bivariate analysis were entered into multivariable binary logistic regression analysis to identify determinants of RTA. The final model was developed using a step-wise logistic regression.

The confounding effect of the explanatory variables was checked using forward and backward elimination techniques and any variable above 20% change of coefficient was considered as a confounder. Multi-collinearity was checked using Variance Inflation Factor (VIF) at a cutoff value of 10. Variables with greater than 10 VIF value were handled by removing the most inter-

correlated variable(s) from the model and substitute their cross product as an interaction term. Final model fitness was checked using the Hosmer-Lemshew method. Receiver Operating Characteristic (ROC) curve was used to show how much the independent variables in the final model predicted the dependent variable.

3. Results

Socio-demographic characteristics of the respondents

The response rate was 100%. The median (IQR) age of the respondents was 30 (10) years. The majority of study participants (98.37%) were males. Regarding the marital status of the respondents, 102 (41.46%), 101(41.06%), 30 (12.20%) and 13 (5.28%) were divorced, married, single and widower respectively. The majority of the drivers, 170 (69.11%) were Christian Orthodox, followed by Muslims, 54 (21.95%). With regard to their educational status, 225 (91.46%) had attained at least grade 5. The median (IQR) monthly income (in Birr) of the study participants was 1000 (1200) (Table 1).

Table 1: Socio-demographic and economic characteristics of drivers in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables		Frequency	Percentage
Age in years, median (IQR)*		30 (10)	
Monthly income in Birr, median (IQR)		1000 (1200)	
Sex	Male	242	98.37
	Female	4	1.63
Marital status	Married	101	41.06
	Single	30	12.20
	Divorced	102	41.46
	Widowed	13	5.28
Religion	Orthodox	170	69.11
	Muslim	54	21.95
	Protestant	8	3.25
	Catholic	14	5.69
Educational status	Illiterate	17	6.91
	Primary (Grade 1-4)	4	1.63
	Secondary (Grade 5-10)	121	49.19
	Preparatory & above (Grade 11 & above)	104	42.28
Ethnicity	Tigraway/ti	222	90.24
	Amhara	17	6.91
	Afar	7	2.85

* IQR: Inter Quartile Range

Magnitude of RTAs

Among all the drivers, 57 (23.17%) had encountered road traffic accident in the past two years from the time of the current study. Most of the accidents happened on Monday, 22 (38.60%) and Friday, 13 (22.81%) even though accidents were reported in all the seven days. The causes of the accidents, as reported by the drivers, were mainly due to violation of traffic law in 22/57 ((38.60%) of the cases. A significant number of the accidents, 25/57 (43.86%) happened at dawn. Pedestrians and Cyclists constituted the major share of the RTA victims, 31/57 (54.40%). About two third of the accidents, 43/57 (75.44%) happened at either T-junction road or cross road (Table 2).

Table 2: Characteristics and Setting of RTA in Mekelle City, Northern Ethiopia. 2015. (n=246)

Variables		Frequency	Percentage
Accident experience in the previous 2 years	Yes	57	23.17
	No	189	76.83
Type of accident	Injury	29	50.88
	Injury and Property damage	14	24.56
	Property damage	8	14.0
	Death	6	10.5
Light Condition	At dawn	41	71.93
	Day time	16	28.07
Victim	Pedestrian	19	32.14
	Cyclist	12	21.43
	Passenger	14	25.00
	Driver	12	21.43
Accident site road	T-junction	15	26.32
	Cross Road	28	49.12
	Straight road	14	24.56
Day of accident	Monday	22	38.60
	Tuesday	4	7.02

	Wednesday	6	10.53
	Thursday	3	5.26
	Friday	13	22.81
	Saturday	9	15.79
Number of accidents (life time experience)	1	42	73.68
	2	12	21.05
	3	3	5.26
Reason for the accident	Lack of general safety awareness of pedestrians	10	18.52
	Violation of traffic rules and regulations	22	40.98
	Violation of speed Limit	9	15.73
	Lack of vehicle maintenance	13	24.77

Risky driving behaviors

Concerning risky driving behaviors, 92 (37.40) of the drivers drunk alcohol before driving. About 43 (17.48%) of the drivers were chat chewers and 30 (12.20%) were smokers. More than one third of the drivers, 96 (39.02%) ever reported that they used cell phone for communication while driving. The prevalence of RTA among drivers was 3.29%, 32.6%, 36.7%, 18.5% and 21.6% among cell phone users, alcohol consumers, chat chewers, cigarette smokers and seat belt users while driving respectively. However, the prevalence of RTA among the drivers who do not use cell phone and seat belt were 17.33% and 30.9% respectively (Table 3).

Table 3: Risky driving behaviors among drivers in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables		RTA		Frequency	Percentage	P-Value
		Yes n (%)	No n (%)			
Cell phone use while driving	Yes	31(32.29)	65(67.71)	96	39.02	0.007
	No	26(17.33)	124(82.67)	150	60.98	
Substance use	Alcohol	14(32.6)	29(67.4)	92	37.40	0.026
	Chat	11(36.7)	19(63.3)	43	17.48	
	Cigarette	32(18.5)	141(81.5)	30	12.20	
Seat belt use	Yes	44(21.6)	160(78.4)	204	82.93	0.189
	No	13(30.9)	29(69.0)	42	17.07	
What do you do when another vehicle tries to pass?	I advise him to slow down	4(12.5)	28(87.5)	32	13.01	0.028
	I give him priority	42(29.2)	102(70.8)	144	58.54	
	I speed up	11(15.71)	59(84.29)	70	28.46	
A measure taken when there is heavy traffic	Pass accordingly	49(21.59)	178(78.41)	3	1.22	0.069
	Speed up	6(37.50)	10(62.50)	16	6.50	
	Slow down	2(66.67)	1(33.33)	227	92.28	
Road Type	Gravel	5(16.7)	25(83.3)	30	12.2	0.117
	Asphalt	39(28.1)	100(71.9)	77	31.3	
	Cobble stone	13(16.9)	64(83.1)	139	56.5	

Factors associated with Road Traffic Accidents

In the bivariate analysis age, being married, being single, driving governmental vehicle, alcohol use, other substances other than alcohol use, cell phone use during driving, drivers' years of experience and vehicle service were significantly associated with RTAs at 95% CI.

Multivariable binary logistic regression analysis showed that drivers who drove after consuming alcohol were 2.29 (AOR=2. 29; 95% CI: 1.08-4.85) times more likely to have RTA compared to drivers who did not consume alcohol. Drivers who drove governmental vehicles were 4.16 (AOR=4. 16; 95% CI: 1.48- 11.70) times more likely to have RTA compared to drivers of privately owned vehicles. As the driver's experience increased by one year, the probability of RTA decreased by 26% (AOR=0. 74; 95% CI: 0.60-0.90) (Table 4).

Table 4: Multivariable regression analysis of RTA in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables		COR(95% CI)	AOR(95% CI)
Age		0.08(0.041, 0.121)*	1.05(0.98, 1.12)
Marital status	Married	0.85(0.348, 2.086)*	1.62(0.60, 4.39)
	Single	0.37 (0.141, 0.972)*	0.94(0.25, 3.45)
	Divorced	1(Ref.)	1(Ref.)
	Widower	2.72(0.711, 10.408)	
Religion	Protestant	1(Ref.)	1(Ref.)
	Orthodox	0.22(0.052, 0.940)*	0.24(0.05, 1.26)
	Muslim	0 .45(0.102, 2.059)	
	Catholic	0 .55(0.095, 3.245)	
Ethnicity	Afar	1(Ref.)	1(Ref.)
	Amhara	0 .12(0 .011, 1.195)	
	Tigraway/ti	0 .04(0.004, 0.351)*	0.04(0.005, 0.58)*
Vehicle ownership	Private (Driver is employee)	1(Ref.)	1(Ref.)

	Governmental	3.5(1.464, 8.168)*	4.16(1.48, 11.70)*
	Driver (Driver is the owner)	2.38(1.225, 4.660)*	1.64(0.71, 3.339)
License grade	1st	1(Ref.)	
	3rd	1.36(0.329, 5.632)	
	4th	0.55(0.138, 2.241)	
	Special	1.52(0.249, 9.294)	
Alcohol use	No	1(Ref.)	1(Ref.)
	Yes	1.88(1.034, 3.437)*	2.29(1.08, 4.85)*
Substance use other than alcohol	Chat	2.12.(1.010, 4.478)*	2.18(0.78, 6.05)
	Cigarette	2.55(1.105, 5.884)*	1.11(0.39, 3.18)
	I do not use	1(Ref.)	1(Ref.)
Cell phone use while driving	No	1(Ref.)	1(Ref.)
	Yes	2.27(1.246, 4.150)*	1.80(0.86, 3.74)
What do you do when another vehicle tries to pass	I advise him to slow down	1(Ref.)	
	I give him priority	2.88(0.952, 8.724)	
	I speed up	1.3(0.38, 4.463)	
Income		1.00(0.999, 1.000)	
Distance travelled		1.00(0.999, 1.005)	
Driver's experience		0.86 (0. 749, 0.999)*	0.74(0.60, 0.90)*
Vehicle service		1.24(1.103, 1.398)*	1.18(0.99, 1.40)

212 *P-value less than 0.05

The residuals were checked for influential outlier observations and the result showed that there were no suspicious influential outlier observations. Hosmer and Lemeshow test showed a chi-square value of 9.41 (p=0. 3085) which is greater than 0.05. The null hypothesis is not to be rejected, which implies that the model estimates adequately to fit the data at an acceptable level. The area under ROC curve was 0.7536 (See figure 2). The predicting power of the independent variables for the dependent variable was 75.36%. Therefore, it can be concluded that the model fits the data reasonably well. No confounding factor was found.

4. Discussion

The main aim of the study was to assess the magnitude and determinants of road traffic accidents among drivers in Mekelle city, Tigray, Northern Ethiopia. The study revealed that the magnitude of self-reported RTA in Mekelle city was 23.17%. There was a slight increment of accidents in this study compared to the previous study done in Mekelle city, which showed that the prevalence of RTA was 22% [12]. However, it is lower when compared with a similar study conducted in the same city among taxi drivers with 4 wheels, of which 26.4% of them reported RTA encounter within the past 3 years [15]. This variation might be due to the fact that the city is expanding where the population size is increasing. Or it might be due to the differences in the RTAs report period where the current study included reports of RTA in the past 2 years from the time of the study.

The study identified that ownership of the vehicles was found to be predictor of RTA. Road traffic accident was 3.78 times more likely among those who drove governmental vehicles. Though literatures did not show supportive or contradicting idea for this finding, this might be due to the fact that governmental drivers might violate the traffic rules and speed up to arrive timely at workplace especially at the peak hours.

This study revealed that driving after taking alcohol was found to be an aggravating factor for RTA. Drivers who drove after consuming alcohol were 2.29 more likely to have RTA compared to those who don't consume alcohol. This finding is similar to a similar study which showed that individuals who drank alcohol were 3.2 times more likely to encounter RTA [16]. It was also supported by the Great Britain department for Transport provisional estimates for 2013 which showed that between 230 and 290 people were killed in accidents in Great Britain where at least one driver was over the drink drive limit [17]. Another study also showed that impairments from alcohol was associated with traffic accident of crashes and deaths [18, 19]. This might be due to the nature of alcohol that has a range of psycho-motor and cognitive effects, including attitude, judgment, vigilance, perception, reaction, and controlling [20]. This can increase accident risk by lowering cognitive processing, coordination, attention, vision and hearing.

This study has also revealed that as driver's experience increases by one year, the probability of getting RTA decreased by 26 percent. This finding was similar to the finding of a study in 2003 which showed that as the drive miles and experience increases, the probability of self-reported crash decreased [21]. This might be due to the anticipation of potentially hazardous traffic situations which require years of practice.

The likelihood of RTA was 1.8 times higher among drivers who used cell phone while driving compared to these who do not use. This study is consistent with a previously done study in Mekelle city [15]. Other studies have also reported that drivers distracted by mobile devices such as smartphones and/ or other in-vehicle devices are at risk for a serious negative outcomes [22- 24]. A similar study indicated that telephone use while driving increases the likelihood of RTA/ crash by a factor of four, while texting by around 23 times [25]. This is because of loss of attention to surroundings while driving.

The findings of this study showed visual impairment was not found to be a predictor variable for RTA. But a study done in Ibadan town Nigeria showed that drivers who had visual impairment were 1.6 times more likely to encounter RTA [26]. Therefore, this needs further investigation.

The strength of this study is that data quality was assured under close supervision of the principal investigators during both data entry and data collection time. Appropriate statistical methods were used to present the findings of the study. Despite this strength, the study have certain limitations. Due to cross-sectional study design nature, establishing causality is not possible. In addition to that, there may be recall bias and the analysis of this study misses some important variables like quality of the vehicles and road safety.

Conclusion

The magnitude of RTA was high. Driving a governmental vehicle and alcohol consumption were the factors associated with RTA. Monitoring blood alcohol level of drivers should be in place. Holistic study should be done to identify the causes of RTA.

5. Disclosure section

Acknowledgments

We are glad to extend our gratitude to the data collectors and participants of the study. We would like to extend our gratitude to Mekelle University as well for funding the research.

Author contributions

AW conceptualized and designed the study, involved in data analyses, acquisition of data, tabulating the data, interpretation of data, preparing tables and figures, and critically revising the manuscript. AD and TW have involved in interpretation of data, supervision, administration, drafting the initial manuscript, and critically revising the manuscript. AD have primary responsibility for final content and involved in final review. All authors read and approved the final manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics and consent

Ethical clearance and approval was given by Mekelle University, school of public health Ethical Review Committee with the approval number of ERC 0017/2014. Written consent was taken from each participant during the interview. All authors read and approved the final manuscript.

Data availability

The data set of the study findings are available from the corresponding author upon reasonable request.

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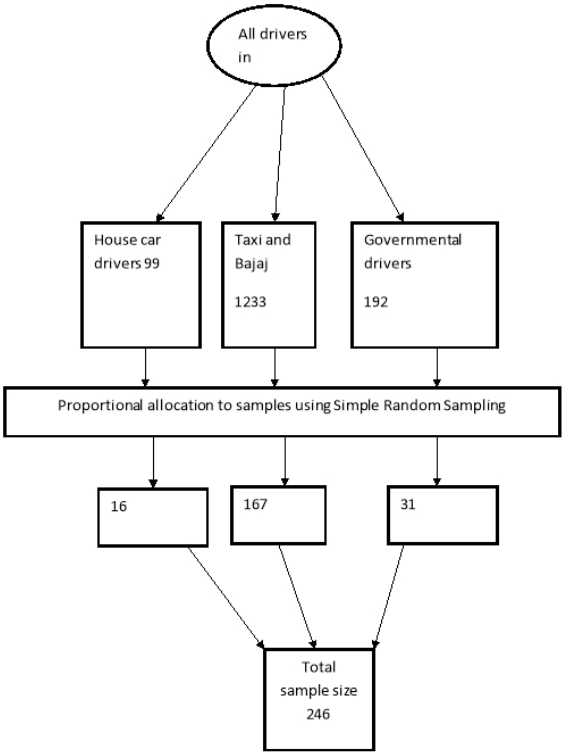

Figure 1: Sampling Procedure. Schematic presentation of the sampling technique.

Fig 1

69x89mm (300 x 300 DPI)

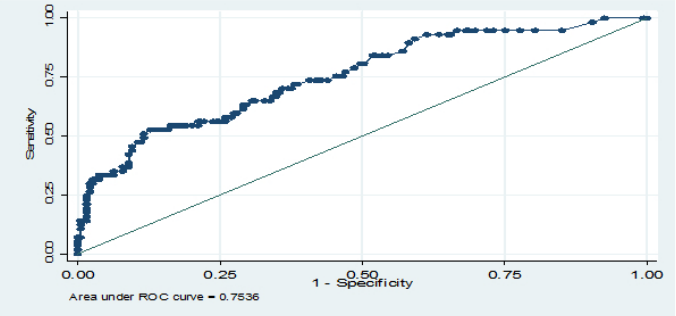

Figure 2: ROC curve. Predicting power of the independent variables for Road Traffic Accident.

Fig 2

69x89mm (300 x 300 DPI)

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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		Reporting Item	Page Number
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Study design	#4	Present key elements of study design early in the paper	5
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6

Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	6
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7
	#12b	Describe any methods used to examine subgroups and interactions	7
	#12c	Explain how missing data were addressed	N/A
	#12d	If applicable, describe analytical methods taking account of sampling strategy	N/A
	#12e	Describe any sensitivity analyses	N/A
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	n/a there were no stages and study was not on patients
	#13b	Give reasons for non-participation at each stage	n/a
	#13c	Consider use of a flow diagram	6
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	7
	#14b	Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	13
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
	#16b	Report category boundaries when continuous variables were categorized	N/A
	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a estimates were for odds ratio
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	13

Key results	#18	Summarise key results with reference to study objectives	8- 15
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	17
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	15-17
Generalisability	#21	Discuss the generalisability (external validity) of the study results	17
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	18

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Magnitude and determinants of road traffic accidents in Northern Ethiopia: A cross sectional study

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Abstract

Objective: This study aimed to assess the magnitude and determinants of Road Traffic Accidents in Mekelle City, Northern Ethiopia.

Methods: A cross-sectional study was done using a simple random sampling technique.

Setting: The study was done in Mekelle city from Feb to Jun 2015.

Participants: The study was done among drivers settled in Mekelle city.

Main outcome measures: The main outcome measure was occurrence of Road Traffic Accident within two years. A binary logistic regression was used to identify factors associated with RTA.

Results: The magnitude of RTA was found to be 23.17%. According to the drivers' perceived cause of the accident, 22 (38.60%) of the accident was due to violation of traffic rules and regulations. The majority of the victims were pedestrians, 19 (33.33%). Drivers who were driving a governmental vehicle were 4.16 (AOR=4.16; 95% CI: 1.48- 11.70) times more likely to have RTA compared to those who drive private vehicles. Drivers who used alcohol were 2.29 (AOR=2.29; 95% CI: 1.08-4.85) times more likely to have RTA compared to those drivers who did not consume alcohol.

Conclusion: Magnitude of reported Road Traffic Accident was high. Violation of traffic laws, lack of vehicle maintenance and lack of general safety awareness on pedestrians were the dominant reported causes of RTAs. Driving a governmental vehicle and alcohol consumption were the factors associated with RTA. Monitoring blood alcohol level of drivers and regular awareness to the drivers should be in place. Holistic study should be done to identify the causes of RTAs.

Keywords: Road Traffic Accident; Drivers; Mekelle city; Tigray; Ethiopia

Strength and Limitation

- Data quality was assured under close supervision of the principal investigators.
- Appropriate statistical methods were used to present the findings of the study.
- Cross sectional study design does not allow establishing causality.
- The analysis of this study misses some important variables like quality of the vehicles and road safety.
- There may be recall bias on the Road Traffic Accidents (RTAs) occurrences.

1. Introduction

Road Traffic Accident (RTA) is an accident which occurs or originates on a way or street open to public traffic; resulting in one or more persons being killed or injured, and at least one moving vehicle is involved. RTA includes collisions between vehicles, vehicles and pedestrians and vehicles and animals or fixed obstacles [1]. RTA contributes to poverty by causing loss of productivity, material damage, injuries, disabilities, grief and deaths [2]. Deaths and injuries resulting from road traffic crashes remain a serious problem globally and current trends suggest that this will continue to be the case in the foreseeable future [3, 4]. Road Traffic Accidents is the major cause of economic loss globally. The total costs to public services identified as follows: Older drivers, £63 million. (£10,000 per fatality); People driving for work, £702 million (£700,000 per fatality); Motorcyclists, £1.1 billion (£800,000 per fatality) and young drivers, £1.3 billion (£1.1 Million per fatality) [5].

Approximately 1.3 million people die each year in traffic-related accidents worldwide [6]. Road traffic injury is now the leading cause of death for children and young adults aged 5–29 years, signaling a need for a shift in the current child health agenda. It is the eighth leading cause of death

for all age groups exceeding HIV/AIDS, tuberculosis and diarrheal diseases [7] and the deaths due to RTAs are predicted to become the 5th leading cause of death by the year 2020 [6].

The burden of road traffic injuries and deaths is disproportionately borne by vulnerable road users and those living in low- and middle-income countries, where the growing number of deaths is fuelled by transport that is increasingly motorized. Between 2013 and 2016, no reductions in the number of road traffic deaths were observed in any low-income country [2]. Although road infrastructures have a significant role in the occurrence of RTA, the human factor is the most prevalent contributing factor of RTAs. This includes both driving behavior (e.g., drinking and driving, speeding, traffic law violations) and impaired skills (e.g. lack of attention, exhaustion, physical disabilities and so on) [8].

Poor conditions of quality of vehicles and less road safety are determinant factors for RTA in Africa [9] including Ethiopia [10]. World Health Organization (WHO) in 2011 reported that RTA in Ethiopia reached 22,786 which accounted for 2.77% of all the deaths. The report showed that RTA is the 9th killer health problem in the country. Road traffic accident makes Ethiopia 12th and 9th in the world and in Africa respectively [11]. Mekelle is a fast growing regional city, which has a heavy traffic flow, especially during peak hours [12]. In Mekelle city, it was reported that road traffic accidents is increasing from year to year and it was shown that 96% of the causes were related to human risky behavior whereas 4% was due to vehicle related factors [12, 13]. However, despite the growing magnitude of RTAs in the city, there is paucity of data on determinants of RTAs among drivers. In addition, to that the study can have significant role to fill the lack of data as there is lack of reliable data although it is a serious problem in most of the developing countries [14]. Hence, this study was conducted to assess the magnitude and determinants of RTAs among drivers in Mekelle city, Tigray, Ethiopia. This study can have a significant role in supplementing

and informing the current status in achieving the United Nations (UN) SDG 3.6 for a reduction in the number of deaths by half by 2020 [15].

2. Methods

Study setting

The study was conducted among drivers in Mekelle city, Tigray, northern Ethiopia from Feb to Jun 2015. Mekelle is the capital city of the Tigray regional state which is found at 783 Km north of the capital city of Ethiopia, Addis Ababa. Regarding road infrastructure: Mekelle city has 55 km asphalted, 23 km cobble stone and 152 km gravel road [16].

Study design

A cross-sectional study design was used.

Participants

All drivers who were based in Mekelle city with a legal driving license and who were driving taxi, Bajaj (three wheel taxi), private owned car and governmental car in Mekelle city were included in the study. Heavy truck drivers, drivers who were not working and sick during the study period, those who drive more than two vehicle types and those who came from other areas to Mekelle city were excluded from the study.

The sample size was calculated from a previous study, where the prevalence of road traffic accident was reported, p=22% in Mekelle city [12]. Using 5% marginal error and 95% confidence interval by the following formula:

$n= (Z\alpha/2)^2 P (P-1)/D^2$

Where n = Minimum sample size required

Z = Standard score corresponding to 95% confidence interval

P = Assumed proportion of drivers

D = Margin of error (precision) 5%

n = 3.84 x 0.1716/0.0025= 263

Since the source population was less than 10,000(i.e. 1500), sample size correction formula was used:

nf= n/1+ (n/N)

Where nf= desired sample size

n=calculated sample size

N=total population

nf= n/1+ (n/N) =263/1+ (263/1500)=263/1.175=223.8~224

By adding 10% contingency for non-response, the sample size was 224+22=246

Sampling procedures

A sampling frame was constructed by a vehicle plate number, which was obtained from Mekelle city transport office. The frame was sub categorized based on the type of the vehicle as a taxi, Bajaj, governmental vehicles, and private/house vehicles. Sub samples were calculated for each category of vehicles proportional to the number of vehicles in the respective categories. Then, study subjects were selected using simple random sampling method (see Figure 1).

Data collection procedures and tools

The study subjects (drivers) were traced and interviewed for data collection. The drivers were traced at their destination for taxi and Bajaj, house cars in their working area and governmental cars at their offices using the car plate number. A structured interviewer administered questionnaire, adapted from different literatures, was used. The questionnaire was initially prepared in English and was translated into the local language Tigrigna. The instrument included:

socio-demographic characteristics of drivers, risky behaviors factors and other variables which has a bearing on RTA. Trained data collectors and supervisors handled the data collection process.

Patient and Public Involvement

Drivers in Mekelle city were involved in the study.

Data Quality Control

Pre-test was done on 5% of the sample at Adigrat town, Tigray region. Based on the pretest findings, necessary corrections were made to the questionnaire. Adequate supervision was undertaken by the supervisors and principal investigator during the data collection. Daily spot-checking of the filled questionnaires for errors or any incompleteness was done by the supervisors and the principal investigator.

Data management and analysis

The collected data were entered and cleaned in Microsoft excel 2007. Then, the data were exported and analyzed using STATA version 12. Values of categorical variables were presented as frequencies and percentages. All statistical tests were performed at the 5% significance level.

The dependent variable was a occurrence Road Traffic Accident (RTA) within two years which was dichotomized into Yes (labeled "1") and No (labeled "0"). To prevent recall bias respondents were reinforced to remember the occurrence of RTA in the previous two years. Each independent variable was cross tabulated and further evaluated for association in the bivariate binary logistic regression. Finally, variables significant in the bivariate analysis were entered into multivariable binary logistic regression analysis to identify determinants of RTA. Variables on risky behaviors, traffic safety rules and some other personal characteristics were used to interpret the Adjusted

Odds Ratio (AOR) in the multivariate analysis under the adjustment of the socio demographic variables. The final model was developed using a step-wise logistic regression.

The confounding effect of the explanatory variables was checked using forward and backward elimination techniques and any variable above 20% change of coefficient was considered as a confounder. Multi-collinearity was checked using Variance Inflation Factor (VIF) at a cutoff value of 10. Variables with greater than 10 VIF value were handled by removing the most inter-correlated variable(s) from the model and substitute their cross product as an interaction term. Final model fitness was checked using the Hosmer-Lemshew method. Receiver Operating Characteristic (ROC) curve was used to show how much the independent variables in the final model predicted the dependent variable.

3. Results

Socio-demographic characteristics of the respondents

The response rate was 100%. The median (IQR) age of the respondents was 30 (10) years. The majority of study participants (98.37%) were males. Regarding the marital status of the respondents, 102 (41.46%), 101(41.06%), 30 (12.20%) and 13 (5.28%) were divorced, married, single and widower respectively. The majority of the drivers, 170 (69.11%) were Christian Orthodox, followed by Muslims, 54 (21.95%). With regard to their educational status, 225 (91.46%) had attained at least grade 5. The median (IQR) monthly income (in Birr) of the study participants was 1000 (1200) (Table 1).

Table 1: Socio-demographic and economic characteristics of drivers in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variable	Category	RTA occurrence/s		P-value	Total n (%)/ median (IQR)
		No n (%)/median (IQR)	Yes n (%)median (IQR)		
Age in years	median (IQR)	29 (26, 34)	35 (28, 41)	___	30 (26, 36)
Monthly income in Birr	median (IQR)	1000 (700, 1800)	1500 (1000, 2300)	___	1000 (800, 2000)
Sex	Male	186 (98.41)	56 (98.25)	0.93	242 (98.37)
	Female	3 (1.59)	1 (1.75)		4 (1.63)
Marital status	Married	74 (39.15)	27 (47.37)	0.004	101 (41.06)
	Single	88 (46.56)	14 (24.56)		102 (41.46)
	Divorced	21 (11.11)	9 (15.79)		30 (12.20)
	Widowed	6 (3.17)	7 (12.28)		13 (5.28)
Religion	Orthodox	139 (73.54)	31 (54.39)	0.031	170 (69.11)
	Muslim	37 (19.58)	(17) 29.82		(54) 21.95
	Protestant	4 (2.12)	4 (7.02)		8 (3.25)
	Catholic	9 (4.76)	5 (8.77)		14 (5.69)
Educational status	Illiterate	13 (6.88)	4 (7.02)	0.644	17 (6.91)
	Primary (Grade 1-4)	2 (1.06)	2 (3.51)		4 (1.63)
	Secondary (Grade 5-10)	94 (49.74)	27 (47.37)		121 (49.19)
	Above 10	80 (42.33)	24 (42.11)		104 (42.28)
Ethnicity	Tigray	178 (94.18)	44 (77.19)	0.000	222 (90.24)
	Amhara	10 (5.29)	7 (12.28)		17 (6.91)
	Afar	1 (0.53)	6 (10.53)		7 (2.85)

Abbreviations: IQR; Inter Quartile Range, P-value; Precision Value

Magnitude of RTAs

Among all the drivers, 57 (23.17%) had encountered road traffic accident in the past two years from the time of the current study. Most of the accidents happened on Monday, 22 (38.60%) and Friday, 13 (22.81%) even though accidents were reported in all the seven days. About 22/57 (38.60%), 13/57 (22.81%), 10/57 (17.54%) and 9/57 (15.79%) of the reported causes of RTAs were due to violation of traffic laws, lack of vehicle maintenance, lack of general safety awareness on pedestrians and Violation of speed limit . A significant number of the accidents, 25/57 (43.86%) happened at dawn. Pedestrians and Cyclists constituted the major share of the RTA victims, 31/57 (54.40%). About three forth of the accidents, 43/57 (75.44%) happened at either T-junction road or cross road (Table 2).

Table 2: Characteristics and Setting of RTA in Mekelle City, Northern Ethiopia. 2015. (n=246)

Variables	Category	Frequency	Percentage
Accident experience in the previous 2 years	Yes	57	23.17
	No	189	76.83
Type of accident	Injury	29	50.88
	Injury and Property damage	14	24.56
	Property damage	8	14.0
	Death	6	10.5
Light Condition	At dawn	41	71.93
	Day time	16	28.07
Victim	Pedestrian	19	32.14
	Cyclist	12	21.43
	Passenger	14	25.00
	Driver	12	21.43
Accident site road	T-junction	15	26.32
	Cross Road	28	49.12

	Straight road	14	24.56
Day of accident	Monday	22	38.60
	Tuesday	4	7.02
	Wednesday	6	10.53
	Thursday	3	5.26
	Friday	13	22.81
	Saturday	9	15.79
Number of accidents (life time experience)	1	42	73.68
	2	12	21.05
	3	3	5.26
Reason for the accident	Lack of general safety awareness of pedestrians	10	17.54
	Violation of traffic rules and regulations	22	38.60
	Violation of speed limit	9	15.79
	Lack of vehicle maintenance	13	22.81
	Did not remember	3	5.26

Risky driving behaviors, infrastructure setup and practices

Concerning risky driving behaviors, 92 (37.40) of the drivers drunk alcohol before driving. About 43 (17.48%) of the drivers were chat chewers and 30 (12.20%) were smokers. More than one third of the drivers, 96 (39.02%) ever reported that they used cell phone for communication while driving. The prevalence of RTA among drivers was 3.29%, 32.6%, 36.7%, 18.5% and 21.6% among cell phone users, alcohol consumers, chat chewers, cigarette smokers and seat belt users while driving respectively. However, the prevalence of RTA among the drivers who do not use cell phone and seat belt were 17.33% and 30.9% respectively (Table 3).

Table 3: Risky driving behaviors, infrastructure setup and practices among drivers in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables	Category	RTA		Total (%)	P-Value
		Yes n (%)	No n (%)		
Cell phone use while driving	Yes	31(32.29)	65(67.71)	96 (39.02)	0.007
	No	26(17.33)	124(82.67)	150 (60.98)	
Substance use	Alcohol	14(32.6)	29(67.4)	92 (37.40)	0.026
	Chat	11(36.7)	19(63.3)	43 (17.48)	
	Cigarette	32(18.5)	141(81.5)	30 (12.20)	
Seat belt use	Yes	44(21.6)	160(78.4)	204 (82.93)	0.189
	No	13(30.9)	29(69.0)	42 (17.07)	
What do you do when another vehicle tries to pass you?	I advise him to slow down	4(12.5)	28(87.5)	32 (13.01)	0.028
	I give him priority	42(29.2)	102(70.8)	144 (58.54)	
	I speed up	11(15.71)	59(84.29)	70 (28.46)	
Road infrastructure	Gravel	5(16.7)	25(83.3)	30 (12.2)	0.117
	Asphalt	39(28.1)	100(71.9)	77 (31.3)	
	Cobble stone	13(16.9)	64(83.1)	139 (56.5)	
Service provision of the vehicle as per the manufacturer recommendation	No	3 (5.26)	6 (3.17)	9 (3.66)	0.462
	Yes	54 (94.74)	183 (96.83)	237 (96.34)	
Visual impairment	No	180 (95.24)	53 (92.980	233 (94.72)	0.505
	Yes	9 (4.76)	4 (7.02)	13 (5.28)	
No violation rule for the speed limit	No	7 (3.70)	5 (8.770	12 (4.880	0.119
	Yes	182 (96.30)	52 (91.23)	234 (95.12)	
Listen radio while driving	No	47 (22.81)	13 (24.87)	60 (24.39)	0.751
	Yes	142 (75.13)	44 (77.19)	186 (75.61)	

What did you do in heavy traffic?	Either pass or stay	1 (0.53)	2 (3.51)	3 (1.22)	0.069
	Pass fast	10 (5.29)	6 (10.53)	16 (6.50)	
	Slow speed	178 (94.18)	49 (85.96)	227 (92.28)	
Ever received a ticket, citation, or warning for any traffic violation	No	113 (59.79)	27 (47.37)	140 (56.91)	0.097
	Yes	76 (40.21)	30 (52.63)	106 (43.09)	

Factors associated with Road Traffic Accidents

In the bivariate analysis age, being married, being single, driving governmental vehicle, alcohol use, other substances other than alcohol use, cell phone use during driving, drivers' years of experience and vehicle service were significantly associated with RTAs at 95% CI. Multivariable binary logistic regression analysis showed that drivers who drove after consuming alcohol were 2.29 (AOR=2. 29; 95% CI: 1.08-4.85) times more likely to have RTA compared to drivers who did not consume alcohol. Drivers who drove governmental vehicles were 4.16 (AOR=4. 16; 95% CI: 1.48- 11.70) times more likely to have RTA compared to drivers of privately owned vehicles. As the driver's experience increased by one year, the probability of RTA decreased by 26% (AOR=0. 74; 95% CI: 0.60-0.90) (Table 4).

Table 4: Bivariate and Multivariable regression analysis of RTA with the predictors in Mekelle city, Northern Ethiopia, 2015. (n=246)

Variables	Category	COR(95% CI)	AOR(95% CI)
Age		0.08(0.041, 0.121)*	1.05(0.98, 1.12)
Marital status	Married	0.85(0.348, 2.086)*	1.62(0.60, 4.39)
	Single	0.37 (0.141, 0.972)*	0.94(0.25, 3.45)
	Divorced	1(Ref.)	1(Ref.)
	Widower	2.72(0.711, 10.408)	
Religion	Protestant	1(Ref.)	1(Ref.)
	Orthodox	0.22(0.052, 0.940)*	0.24(0.05, 1.26)
	Muslim	0 .45(0.102, 2.059)	
	Catholic	0 .55(0.095, 3.245)	
Ethnicity	Afar	1(Ref.)	1(Ref.)
	Amhara	0 .12(0 .011, 1.195)	
	Tigray	0 .04(0.004, 0.351)*	0.04(0.005, 0.58)*
Vehicle ownership	Private (Driver is employee)	1(Ref.)	1(Ref.)
	Governmental	3.5(1.464, 8.168)*	4.16(1.48, 11.70)*
	Driver (Driver is the owner)	2.38(1.225, 4.660)*	1.64(0.71, 3.339)
License grade	1st	1(Ref.)	
	3rd	1.36(0.329, 5.632)	
	4th	0.55(0.138, 2.241)	
	Special	1.52(0.249, 9.294)	
Alcohol use	No	1(Ref.)	1(Ref.)
	Yes	1.88(1.034, 3.437)*	2.29(1.08, 4.85)*
Substance use other than alcohol	Chat	2.12.(1.010, 4.478)*	2.18(0.78, 6.05)
	Cigarette	2.55(1.105, 5.884)*	1.11(0.39, 3.18)
	I do not use	1(Ref.)	1(Ref.)
Cell phone use while driving	No	1(Ref.)	1(Ref.)
	Yes	2.27(1.246, 4.150)*	1.80(0.86, 3.74)
Use seat belt while driving	No	1(Ref.)	
	Yes	0.61 (0.29, 1.28)	
Income		1.00(0.999, 1.000)	

Distance travelled		1.00(0.999, 1.005)	
Driver's experience		0.86 (0. 749, 0.999)*	0.74(0.60, 0.90)*
Number of vehicle service since the date of the vehicle manufactured		1.24(1.103, 1.398)*	1.18(0.99, 1.40)
Road infrastructure	Gravel	1 (Ref.)	
	Cobble stone	1.02 (0.33, 3.14)	
	Asphalt	1.95 (0.70, 5.46)	
Service provision of the vehicle as per the manufacturer recommendation	No	1 (Ref.)	
	Yes	0.59 (0.14, 2.44)	
Visual impairment	No	1 (Ref.)	
	Yes	1.51 (0.45, 5.10)	
No violation rule for the speed	No	1 (Ref.)	
	Yes	0.40 (0.12, 1.31)	
Listen radio while driving	No	1 (Ref.)	
	Yes	1.12 (0.56, 2.26)	
What did you do in heavy traffic?	Either pass or stay	1 (Ref.)	
	Pass fast	0.30 (0.02, 4.06)	
	Slow speed	0.14 (0.01, 1.55)	
Ever received a ticket, citation, or warning for any traffic violation	No	1 (Ref.)	
	Yes	1.65 (0.91, 3.00)	

Note: * = P-value less than 0.05

The residuals were checked for influential outlier observations and the result showed that there were no suspicious influential outlier observations. Hosmer and Lemeshow test showed a chi-square value of 9.41 (p=0. 3085) which is greater than 0.05. The null hypothesis is not to be rejected, which implies that the model estimates adequately to fit the data at an acceptable

level. The area under ROC curve was 0.7536 (See figure 2). The predicting power of the independent variables for the dependent variable was 75.36%. Therefore, it can be concluded that the model fits the data reasonably well. No confounding factor was found.

4. Discussion

The main aim of the study was to assess the magnitude and determinants of road traffic accidents among drivers in Mekelle city, Tigray, Northern Ethiopia. This study showed 23.17% of the drivers have reported having RTA in the previous two years. Ownership of the vehicles, driving after taking alcohol, driver's experience, used cell phone while driving were the determinants for RTAs among the drivers.

The study revealed that the magnitude of self-reported RTA in Mekelle city was 23.17%. There was a slight increment of accidents in this study compared to the previous study done in Mekelle city, which showed that the prevalence of RTA was 22% [12]. However, it is lower when compared with a similar study conducted in the same city among taxi drivers with 4 wheels, of which 26.4% of them reported RTA encounter within the past 3 years [17]. This variation might be due to the fact that the city is expanding where the population size is increasing. Or it might be due to the differences in the RTAs report period where the current study included reports of RTA in the past 2 years from the time of the study. About three forth (75.44%) of the accidents of this study, happened at either T-junction or cross roads. The findings of this study is higher as compared to recent statistics from USA and India which showed, approximately 55% of the total traffic crashes and 23% of crashes with fatalities in urban areas in the USA occur at intersections and approximately 32% of urban traffic crashes take place at intersections in India. [18]. This difference might be due to infrastructure differences like traffic lights in the intersections of the

roads. Because traffic signals do help to prevent collisions if obeying for traffic rules by the drivers [19]. In this study about 22/57 (38.60%), 13/57 (22.81%), 10/57 (17.54%) and 9/57 (15.79%) of the reported causes of RTAs were due to violation of traffic laws, lack of vehicle maintenance, lack of general safety awareness on pedestrians and violation of speed limit. This finding is similar with the study on the comparative analysis of literature concerning road safety, which showed that, the causes include: lack of control and enforcement concerning implementation of traffic regulation (primarily driving at excessive speed, driving under the influence of alcohol, and not respecting the rights of other road users (mainly pedestrians and cyclists), lack of appropriate infrastructure and unroadworthy vehicles [20]. This is because, obeying traffic laws are designed to protect the drivers and other people, animals or from destruction of properties around the road and it self the road. In other words by knowing the rules of the road, practicing good driving skills and generally taking care as a road user can help a vital role in preventing a crash.

This study identified that ownership of the vehicles was found to be predictor of RTA. Road traffic accident was 3.78 times more likely among those who drove governmental vehicles. A study on Arab gulf countries as compared to other countries showed that vehicle ownership levels and safety parameters in both developed and developing countries is presented to highlight the relative seriousness of the road safety situation in different countries. [21]. The possible justification for this to be happen might be due to the fact that governmental drivers might violate the traffic rules and speed up to arrive timely at workplace especially at the peak hours.

This study revealed that driving after taking alcohol was found to be an aggravating factor for RTA. Drivers who drove after consuming alcohol were 2.29 more likely to have RTA compared to those who don't consume alcohol. This finding is similar to a similar study which showed that individuals who drank alcohol were 3.2 times more likely to encounter RTA [22]. It was also

supported by the Great Britain department for Transport provisional estimates for 2013 which showed that between 230 and 290 people were killed in accidents in Great Britain where at least one driver was over the drink drive limit [23]. Another study also showed that impairments from alcohol was associated with traffic accident of crashes and deaths [24, 25]. This might be due to the nature of alcohol that has a range of psycho-motor and cognitive effects, including attitude, judgment, vigilance, perception, reaction, and controlling [26]. This can increase accident risk by lowering cognitive processing, coordination, attention, vision and hearing.

This study has also revealed that as driver's experience increases by one year, the probability of getting RTA decreased by 26 percent. This finding was similar to the finding of a study in 2003 which showed that as the drive miles and experience increases, the probability of self-reported crash decreased [27]. This might be due to the anticipation of potentially hazardous traffic situations which require years of practice.

The likelihood of RTA was 1.8 times higher among drivers who used cell phone while driving compared to these who do not use. This study is consistent with a previously done study in Mekelle city [17]. Other studies have also reported that drivers distracted by mobile devices such as smartphones and/ or other in-vehicle devices are at risk for a serious negative outcomes [28- 30]. A similar study indicated that telephone use while driving increases the likelihood of RTA/ crash by a factor of four, while texting by around 23 times [31]. This is because of loss of attention to surroundings while driving.

The findings of this study showed visual impairment was not found to be a predictor variable for RTA. But a study done in Ibadan town Nigeria showed that drivers who had visual impairment were 1.6 times more likely to encounter RTA [32]. Therefore, this needs further investigation.

The strength of this study is that data quality was assured under close supervision of the principal investigators during both data entry and data collection time. Appropriate statistical methods were used to present the findings of the study. Despite this strength, the study have certain limitations. Due to cross-sectional study design nature, establishing causality is not possible. In addition to that, there may be recall bias and the analysis of this study misses some important variables like quality of the vehicles and road safety.

5. Conclusion

The magnitude of RTA was high. The intersections of the roads were the main cause of RTAs. Violation of traffic laws, lack of vehicle maintenance and lack of general safety awareness on pedestrians were the dominant reported causes of RTAs. Driving a governmental vehicle and alcohol consumption were the factors associated with RTA. Monitoring blood alcohol level of drivers should be in place. Education on traffic laws and regulations should be given to drivers on regular basis. In addition to that a holistic study should be done to identify the causes of RTA. Due to the similarities of the cities in North Ethiopia, this study can represent to other cities in Northern Ethiopia.

6. Disclosure section

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Author contributions

AW conceptualized and designed the study, involved in data analyses, acquisition of data, tabulating the data, interpretation of data, preparing tables and figures, and critically revising the manuscript. AD and TW have involved in interpretation of data, supervision, administration, drafting the initial manuscript, and critically revising the manuscript. AD have primary responsibility for final content and involved in final review. All authors read and approved the final manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics and consent

Ethical clearance and approval was given by Mekelle University, school of public health Ethical Review Committee with the approval number of ERC 0017/2014. Written consent was taken from each participant during the interview. All authors read and approved the final manuscript.

Data availability

The data set of the study findings are available from the corresponding author upon reasonable request.

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Figures

Figure 1: Sampling Procedure. Schematic presentation of the sampling procedure.

Figure 2: ROC curve. Predicting power of the independent variables for the dependent variable.

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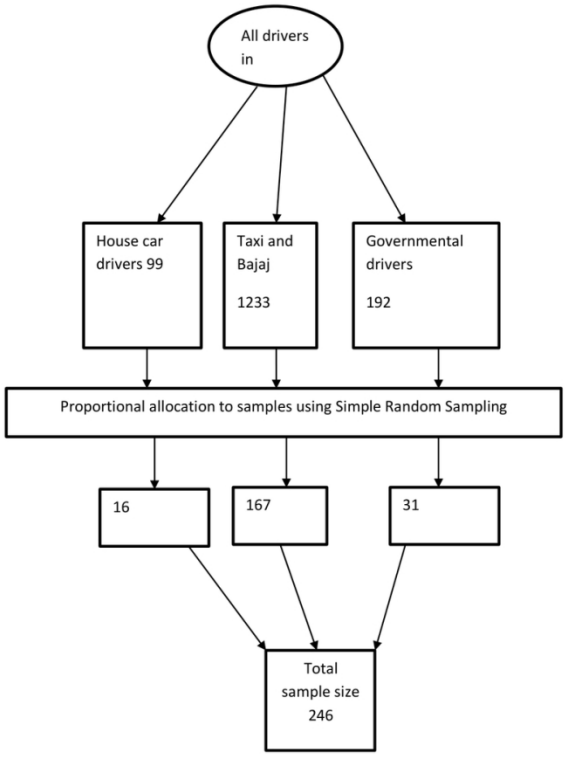

Figure 1: Schematic presentation of the sampling procedure.

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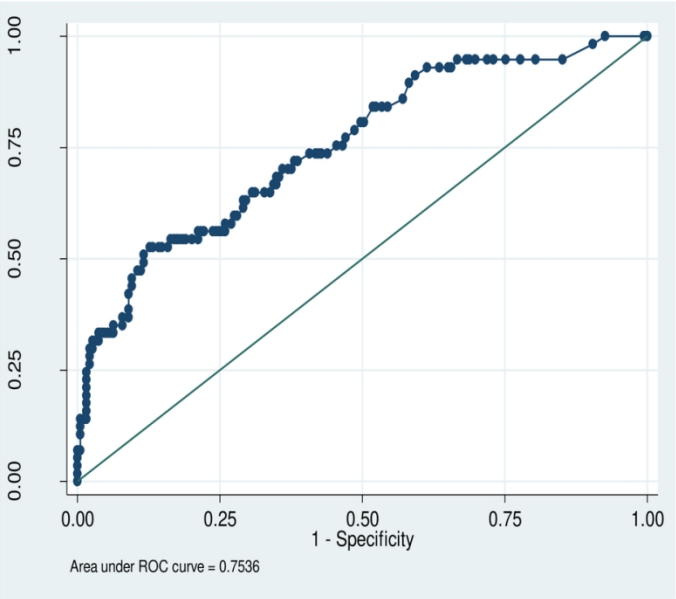

Figure 2: ROC curve, predicting power of the independent variables for the dependent variable.

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectional reporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4- 5
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Study design	#4	Present key elements of study design early in the paper	5
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5- 6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7- 8
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6

Bias	#9	Describe any efforts to address potential sources of bias	7
Study size	#10	Explain how the study size was arrived at	6
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7- 8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7- 8
	#12b	Describe any methods used to examine subgroups and interactions	8
	#12c	Explain how missing data were addressed	N/A
	#12d	If applicable, describe analytical methods taking account of sampling strategy	N/A
	#12e	Describe any sensitivity analyses	N/A
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	n/a there were no stages and study was not on patients
	#13b	Give reasons for non-participation at each stage	n/a
	#13c	Consider use of a flow diagram	6
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	7
	#14b	Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	7
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
	#16b	Report category boundaries when continuous variables were categorized	N/A
	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a estimates were for odds ratio
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	15- 16

Key results	#18	Summarise key results with reference to study objectives	16
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	19
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	16-19
Generalisability	#21	Discuss the generalisability (external validity) of the study results	19
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20