JIMMA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
JIMMA INSTITUTE OF TECHNOLOGY
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
HIGHWAY ENGINEERING STREAM

EVALUATION OF MOTORIZED VEHICLE CRASHES WITH PEDESTRIAN IN MEKELLE CITY ROAD

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF JIMMA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER'S OF SCIENCE (MSc) IN CIVIL ENGINEERING (HIGHWAY ENGINEERING STREAM)

By

Binyam Hagos

April, 2019

Jimma, Ethiopia

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By

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Co-Advisor: Engr. Teyba Wedajo

April, 2019

Jimma, Ethiopia

DECLARATION

I certify that this thesis work titled "**Evaluation of Motorized Vehicle Crashes with Pedestrian in Mekelle City Road**" is my original work. The work has not been presented elsewhere for assessment and award of any degree or diploma. Where a material has been used from other sources, it has been properly acknowledged/referred.

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ABSTRACT

In recent years, there has been increased interest in measuring pedestrian exposure to risk in transportation research in order to understand the risk and propose remedial measures. Despite this, little has been done to understand pedestrian exposure and risk factors of crashes with pedestrians in developing countries, particularly in Ethiopia. In mekelle city from the year 2007-2015 over 1,675 road traffic accidents were occurred. Out of which, over 315 people were died, over 780 people were suffered with easy and series non-fatal accidents.

The general objective of this paper was to Evaluate Motorized Vehicle Crashes with Pedestrian in Mekelle City Road. *The target population considered was* all motor vehicle accidents exposed to pedestrian crashes and recorded in Mekelle city of all sub cities, during the period from 2006 to 2010 E.C were included. In addition to this questionnaire to pedestrian and drivers of the city which accounts a total of 785 were distributed to them. Data for the study were collected both from primary and secondary sources, the study uses simple random sampling for driver and pedestrians and purposive sampling method for those information collected from different concerned office and stakeholders in the form of interview.

Data analysis was made using descriptive statistics, the results were presented in the form of crosstab's, pie charts and figures. Not giving priority to pedestrian, over speed, Failure to respect right hand drive, not giving priority to vehicle were the major causes of crashes attributed by traffic police. With regard to movement of the pedestrian during the accident, pedestrian got accident while crossing illegally: using left side with no pedestrian facility and using right side with no pedestrian facility were the leading risk factors for road crashes in the city.

It was concluded that majority of the crashes occur in daytime than night and most of the time involve the cities active workforce. *Finally it recommended that* Training and awareness campaigns are vital countermeasures which should be supplemented by engineering and enforcement that could be used to make citizens aware of the injury.

Keywords: - Motorized vehicle, Pedestrian crash, Traffic safety.

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ACRONYMS

AIB	Accident Investigation Board
BAC	Blood Alcohol Content
CI	Confidence Interval
DALYs	Injury Disability-Adjusted Life Years
DC's	Developing Countries
ERA	Ethiopian Roads Authority
et al.	"et alii", and others
ETB	Ethiopian Birr
FWD	Four Wheel Drive
HTTP	Hypertext Transfer Protocol
IRAP	International Road Assessment Programme
Km^2	Kilo Meter Square
Km/hr.	Kilo meter per Hour
LTVs	Light Truck Vehicles
MCTP	Mekelle City Traffic Police
RTA	Road Traffic Accident
SPSS	Statistical Package for Social Science
TRPC	Tigray Region Police Commission
WHO	World Health Organization
WWW	World Wide Web

CHAPTER ONE

INTRODUCTION

1.1 Background

Walking is the oldest, most basic, and possibly the most beneficial form of human transportation. Walking provides many important personal and societal benefits, including reduced air pollutant emissions when people choose to walk instead of driving cars, and health benefits from physical activity. Walking is becoming an increasingly popular mode of transportation (Retting, n.d.).Road traffic Accident (RTA) represent a leading and increasing contributor to regional and global disease burden. It is estimated that in 2002 road crashes killed over one million people worldwide and injured a further 20-50 million. They are projected to become the 3rd largest contributor to global disease burden by 2020 & Most of the projected increase in RTA will occur in low- and middle-income regions of the world, due to the rapid growth in motor vehicle numbers increasing exposure to risk factors such as speed and alcohol, and worsened by inadequate enforcement of traffic safety regulations and public health infrastructure (WHO 2004).

(Chisholm & Naci, December 2008) States the distribution of road traffic deaths by road user group varies dramatically across epidemiological sub regions. In the very low-mortality sub-regions of the Americas and Europe, the majority of road traffic deaths occur among motorized four-wheeler occupants. In the South-East Asian region, by contrast, motorcyclists contribute by far the largest to road traffic fatalities, with motorized four-wheeler occupants constituting less than 20% of total fatalities. The vulnerability of pedestrians during crashes causes a higher rate of severe injuries and fatalities. The magnitude of pedestrian fatalities also varies considerably across sub-regions, from more than half in African sub-regions to as little as 10%-15% in high-income sub regions. Currently, developing countries contribute to over 90% of the world's road traffic fatalities (WHO, 2009) and overall road injury disability-adjusted life years (DALYs) increased by 2.5% between 1990 and 2010, with pedestrian injury DALYs increasing by 12.9%, which is more than any other category (Christopher, Murray et al., 2012). This finding implies that pedestrian injury on the road is a problem that has increased at a global level and is disproportionately attributable to developing countries.

Eliminating traffic fatalities by 2024 is the goal of San Francisco's Vision Zero policy. A standardized case definition across city agencies ensures consistency of fatality counting and reporting. A clear case definition for traffic fatalities is critical for data collection, data analysis, and evaluation of the burden of traffic mortality in the City and County of San Francisco, and tracking progress towards the Vision Zero goal (Anon., July 2016).

In case of Ethiopia, pedestrian accounts for 55% of fatal crashes per year. (Tulu, Washington, & King, 2013; WHO, 2009).The Federal Police of Ethiopia crash report, which provides a breakdown by region, the regions of Oromia, Addis Ababa City, and Amhara had the highest numbers of injury crashes contributing 25.3%, 23.4%, and 22.2% of injury crashes, thus Tigray Region takes the 5th rank next to Debub people with percentage of 10.2% and 8.7% respectively.

Table 1.1 Pedestrian Injury Crash Distribution of regional states of Ethiopia (Federal Police Commission of Ethiopia, 2013).

Regional States	Fatality		Serious Injury		Slight Injury		Total Injury		Total	%
	Male	Female	Male	Female	Male	Female	Male	Female		
Tigray	189	11	189	144	201	160	662	418	1080	8.7
Afar	48	7	77	25	51	9	176	41	217	1.8
Amhara	531	157	535	222	1043	261	2109	640	2749	22.2
Oromia	856	374	633	216	889	171	2378	761	3139	25.3
Somali	58	14	81	23	50	14	189	240	240	1.9
Benishangul	11	13	49	32	81	24	141	69	210	1.7
Debub People	225	53	314	89	471	116	1010	258	1268	10.2
Gambela	14	10	27	25	35	27	76	62	138	1.1
Harar	23	3	22	12	66	10	111	25	136	1.1
Addis Ababa	333	78	1030	406	773	275	2136	759	2895	23.4
Dire Dawa	17	4	63	36	126	79	206	119	325	2.6
Total	2,305	827	3103	1230	3786	1146	9194	3203	12397	100

According to Tigray Region Police Commission (TRPC) between the years 2003-2010 E.C 10,078 total number of road traffic accidents were occurred. Thus 2530 traffic accident were fatalities, 4435 serious injuries and 3113 slight injuries. In addition to this a property damage have been lost which accounts about 300,003.134 birr.

A recent study conducted in the southern region of Tigray (Wedajo, et al., January-2017) describe the major causes of traffic accident were directly linked with road defects which includes alignment effect, cross-sectional effect and construction of roads which accounts (47.4%) followed by driver(18%) & pedestrian(16%) errors, and concludes the primary causes of road traffic accidents are road design problems over speeding, failure to give way to vehicles and pedestrians, over taking in winding horizontal curves. Improper turning movements and in ability to respect the right hand rule.

A study conducted in Mekelle city describes from the year 2007-2015 over 1,675 road traffic accidents occurred. Out of which, over 315 people were died, over 780 people were suffered with easy and series non-fatal accidents and a property damage which accounts over 10,876,512 ETB & concludes The traffic unit should implement standard traffic accident investigation to reduce doubts and improve future road safeties (Meresa, et al., 2016).

Though different researcher have conducted on the analysis of traffic accidents related to pedestrians in our country in general and in case of Northern part of our country, Mekelle city in particular this study is unique in case where non-motorized vehicles are excluded. Therefore; the study focused on Current issue of Evaluation of Motorized Vehicle Crashes with Pedestrian in Mekelle City Road.

1.2 Statement of the Problem

Each year, more than 270 000 pedestrians lose their lives on the world's roads. Many leave their homes as they would on any given day to: - school, work, places of worship, and homes of friends never to return. Globally, pedestrians constitute 22% of all road deaths, and in some countries this proportion is as high as two thirds. Millions more people are injured in traffic-related crashes while walking, some of whom become permanently disabled. These incidents cause much suffering and grief as well as economic hardship for families and loved ones (www.who.int/roadsafety/en/).

Despite having a very low road network density and vehicle ownership level, Ethiopia has a relatively high pedestrian accident record (Yismaw, 2015). An important and glaring trend that emerges is that more than half of the fatalities in Ethiopia involve pedestrians. For instance a study conducted by (Abdi, et al., APRIL, 2017) showed most affected road users were pedestrians which accounts about (79%) followed by passengers (17%), while crashes on drivers only constituted (4%).

Mekelle, one of the cities of Ethiopia and is the capital city of the Tigray Regional State, its location along the main roads, the expansion of governmental and private industry, Parking, educational colleges and institutions are main factors for the growth of the city. Interconnected to other cities of the country through a very long asphalt roads; which runs people's socio-economic activities using different motorized and non-motorized modes of transport such as taxis, privately owned cars, governmental cars, bus (city and intercity), Bajaj, and cycling (both motor & bicycle) as well as walking. The city is characterized by high rate of accidents in relation to the number of vehicles on the road (Meresa, et al., 2016).

Therefore, the study focused scientifically on evaluation of motorized vehicle crashes with pedestrian occurred in the city.

1.3. Research Questions

1. What are the general characteristics of Motorized Vehicle Crashes with Pedestrians' in Mekelle City Roads?
2. What are the major causes and contributory factors for the occurrence of Road Traffic Accident?
3. What appropriate counter measure could be used to minimize the pedestrian crashes?

1.4. Objective of the Study

1.4.1. General Objective

The main objective of the research was to Evaluate Motorized Vehicle Crashes with Pedestrian in Mekele City Road.

1.4.2. Specific Objective

- To describe the general characteristics of Motorized Vehicle Crashes with Pedestrian in Mekelle City Roads.
- To identify major causes and contributing factor for the occurrence of road traffic accident between motorized vehicles and pedestrians.
- To describe the appropriate counter measure for the occurrence of pedestrian crashes.

1.5. Significance of the study

Hence, the current study has the importance of:-

- To give awareness for those pedestrian and drivers found in the city that might make mistake in their daily life by giving possible recommendation.
- Offering information regarding the basic cause of motorized vehicle crashes with pedestrian in the City.
- Signaling and motivating the various stakeholders to take appropriate actions by incorporating the issue in their policies and strategies;
- Providing policy makers, researchers, institutions etc. with adequate, and reliable data so as to implement feasible and appropriate engineering solutions to reduce the accident.
- Adding knowledge on the gap created around the issues related with pedestrian crashes.
- To separate pedestrians from motorized vehicle in areas of high pedestrian if possible.

1.6. Scope of the study

This research has been focused on the evaluation of motorized vehicle crashes with pedestrian in Mekelle city road. However, secondary data of pedestrian crash consists overall crash occurred due to motorized and non-motorized vehicles having their percentages of (78.38%) & (21.62%) respectively. This study lucks to obtain fully completed data related to RTA especially pedestrian related data However, several data was obtained from Mekelle City Traffic Office, Tigray region police commission, Mekelle City road transport and construction office and Tigray region bureau of finance and economic development. Some irregularities exist in the data. Especially the RTA data of Mekelle City contain a number of missing and incomplete data elements. The main sources of inconsistence in the RTA data of the city were due to limitations and erratic reporting made by the traffic polices and RTA investigating officers at the data gathering and recording level mainly due to lack of knowhow. But to resolve the lack of clear pedestrian crash data with

motorized vehicle the study uses response of driver as well as pedestrian of the city in addition to this interview with traffic officers and observation have also been conducted. The number of passenger and driver accident are neglected even if they might occurred between pedestrian and motorized vehicles. Finally the data are analyzed using Chi-square method.

1.7. Limitation of the study

- Since Traffic Police Officers were engaged in many tasks and were usually out of their offices, it was difficult to get them.
- The data on RTA of the offices were not available in electronic data base and had to be collected manually from handwritten day registration books. This took more time than is needed and cost more than expected.

1.8. Organization of the study

This research work has been classified into five chapters. The chapter hierarchy is aimed at making the paper to have scientific format. The general description of each chapter is summarized as follows.

The first chapter is related with the study on general introduction starts by discussion from global perspective to local scenario related with the research title (i.e. evaluation of motorized vehicle crashes with pedestrian), statement of the problem, objective of the study, Basic research questions, Significance of the study, Scope of the study and limitation of the study. The chapter closes its discussion by stating the objectives of the study and how the paper is organized.

The second chapter discusses about the review of related literatures. The discussion of this chapter mainly focused on the over view of road traffic accident related pedestrian and concepts of accident occurrence with pedestrians, causes of road traffic crashes related with pedestrian, road safety engineering and possible counter measure of road traffic accident.in general this chapter gives large coverage for the detailed explanation of various road crashes between motorized vehicles and pedestrians.

The third chapter comprises methods applied in steering the entire work. It describes in detail how the selected methodology is adopted to come up with, In addition to methodology the chapter also explains about the data type, data source, from where the data obtained and required what for what purpose data use, and finally how it is collected method of analysis.

The fourth chapter presents detailed results and discussions of the study. Finally the conclusion and recommendations In brief the chapter presents what conclusions can be drawn from this study and what lessons can be gained from the study for different stakeholders who directly or indirectly are affected by road accident.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The (WHO, 2004) cited in http://www.roadpeace.org/articles/WorldFirstDeath.html, accessed 17 November 2003) states about the historical occurrence of road traffic injury and it was began before the introduction of motorized vehicles (car). However, it was with the car and subsequently buses, trucks and vehicles that the problem worsened rapidly.by various accounts, the first injury crash was supposedly suffered by a cyclist in new York city on 30 may 1896,followed a few months later by the first fatality, a pedestrian in London.

(Farmer & Williams, 2005) Showed average motor vehicle crashes in the United States during the years of 1986-2002 more than 117 deaths per day and concludes every day of the year results in many crash deaths, but certain days stand out as particularly risky. The temporal and geographic spread of crash deaths, as well as the view of driving as a routine task, injuries the public to this continuing problem. Innovative strategies are needed both to raise awareness and to work toward a solution.

Worldwide, Pedestrians are among the most vulnerable victims of road traffic accidents. Unprotected by vehicle body, safety belts or helmets, they are especially exposed to risk of serious injury and have a smaller chance of surviving an accident. In the year 2012 some 5784 pedestrians were killed in the European Union, comprising 21% of all road fatalities. (Olszewski, et al., August 2015)**.**

The capacity to respond to pedestrian safety is an important component of efforts to prevent road traffic injuries. Pedestrian collisions, like other road traffic crashes, should not be accepted as inevitable because they are in fact, both predictable and preventable thus successful interventions to protect pedestrians and promote safe walking requires an understanding of the nature of risk factors for pedestrian crashes (www.who.int/roadsafety/en/). (Crandall, et al., 15 April 2008) States Energy absorbing components such as compliant bumpers, dynamically raised bonnets, and windscreen airbags are being developed for improved pedestrian protection and Lower limb trauma is the commonest pedestrian injury, while head injury is responsible for most pedestrian fatalities.

(Hausmann, 20th of July 2006) Clarify the majority of pedestrians involved in road accidents get harmed in collisions with motorized vehicles, especially with passenger cars. A report conducted in Danish (AIB, 2013) presents Pedestrians usually choose to use the most direct route in order to save time and to move quickly. This is probably the reason why such a large proportion of the pedestrians crossed mid-block or outside a pedestrian facility; in fact, 2/3 of crossing accidents typically occurred on the road and outside a crossing facility furthermore, driver behavior appeared to have contributed to several of the accidents taking place in that the drivers were not sufficiently aware of the hazards presented by the pedestrians, and the possible justification of this was that they were either risk-averse, risk-blind or simply careless.

(Kuehn, et al., n.d.) States Component tests are designed to reproduce just the critical part of the whole accident event. Head impact by far results in the most severe accident consequences representing almost all fatal injuries in a pedestrian-car-collision.

Pedestrians were more likely to be killed in crashes occurring in the regional(13.3%) and remote(17.4%) areas compared with the metropolitan area(7.4%).this may be due to a higher proportion of pedestrian crashes occurring in high speed zones(≥80km/hr) in the regional and remote areas (Palamara, et al., January 2013). A study conducted among children in Addis Ababa City (berhe, et al., January 2014) shows almost all children affected by road traffic accidents were pedestrians 994(95.7%), followed by passengers 22(2.3%) and bicyclist 2(0.2%).

(Sabbou & Ibrahim, September 2010) Recommends Traffic awareness in the community should be raised through the mass media.

2.2. Conceptualizing pedestrian and road traffic safety

We are all pedestrians. Walking is a basic and common mode of transport in all societies around the world. Virtually every trip begins and ends with walking. Walking comprises the sole means of travel on some journeys, whether a long trip or a short stroll to a shop. In other journeys, a person may walk for one or more portion of the trip, for example, walking to and from bus stops, with a bus trip in between. A pedestrian is any person who is travelling by walking for at least part of his or her journey. In addition to the ordinary form of walking, a pedestrian may be using various modifications and aids to walking such as wheelchairs, motorized scooters, walkers, canes, skateboards, and roller blades. The person may carry items of varying quantities, held in

hands, strapped on the back, placed on the head, balanced on shoulders, or pushed/pulled along. A person is also considered a pedestrian when running, jogging, hiking, or when sitting down in roadway *(www.who.int/roadsafety/en/)*.

In Ethiopia, road traffic crashes result in the loss of more than 3,132 lives and more than 9,265 are injured in 2013 (Federal Police Commission of Ethiopia, 2013). It is notable that even though fast economic growth has been recorded in recent years the level of motorization and road density remain low. Nowadays, transportation is key to the development of the country's economy. As a result, road safety is a growing challenge from the perspective of socioeconomic pressures and health/medical issues, especially the stresses on crash and emergency services. This is because the need for mobility comes with attendant risks, particularly those such as human fatalities and injury, damage to property and, on occasion, livestock, arising from road crashes.

Amongst professionals, there is no consensus on the best safety performance measurement method for estimating safety performance of roadways (Harwood, Council, Hauer, Hughes, & Vogt, 2000). Therefore, the following questions are a platform to measure and quantify road crashes.

- What type of metrics should be used when measuring road traffic safety?
- How can we best measure road traffic safety in order to target and identify the parameters of a safe road environment?

Numerous measures of road safety have been utilized. Some of them rely on the number of crashes per specific population cohort (per 100,000 population), the incidence of crashes per a specific number of motorized vehicles (usually 10,000 vehicles) and the number of crashes per kilometer travelled. These metrics are inconsistently utilized throughout the world due to the unavailability of standardized metrics. Despite this, the expected number of crashes can be used as a measurement of safety performance of existing infrastructure within the parameters of a given road condition when other things are kept constant. Traditionally, a crash prediction model has been framed in terms of the expected number of crashes relative to the distance travelled.

Safety of some sites has gradually and/or suddenly deteriorated with time due to a rise in the complexity of exposure to risk of crashes. Except for the expected crash count per specified

period, the other methods mentioned previously do not take into account the time series effect or complexity of exposure on crash counts. The safety problem of sites with time in developing countries is challenging to look for improved metrics to estimate crash count by considering the simple to complex exposure model needed with the refinements of the tools over time, it has been becoming possible to quantify the safety performance of a road nowadays.

The Haddon matrix gives researchers the opportunity to examine the relationships between risk factors with crashes at pre-crash stages. It also allows the performance of road to monitored and evaluated. (WHO, 2004) recommended the Haddon matrix as a dynamic systems approach to the prevention of injuries. From the preceding analysis it can be gauged that the Haddon matrix is a dynamic system with each cell of the matrix giving the opportunity for early intervention, thus enabling the prevention of injuries in the three phases of a crash event: pre-crash, during-crash and post-crash summarized as below (see Table 2.1).The research focuses primarily on pre-crash factors with respect to drivers and pedestrians, roadway features, and environmental. Thus, the Haddon matrix is used as a conceptual framework to assist the identification, in the Ethiopian context, of possible factors contributing to crashes involving pedestrians.

Table 2.1 Haddon matrix applied to pedestrian safety

Phase	Driver Factors	Pedestrian Factors	Vehicle	Road Environment	Operating Environment
Pre event(before crash occurred	• Alcohol and drug impaired driving • Driver Vision problems • Licensing • Capacity/experience of driver • Distance travelled (fatigue) • Unsafe driving behavior	• Alcohol and drug impaired walking • Pedestrian behavior • Pedestrian volume and mix • Mobility issues for, or awareness of road safety by	• Vehicle design standard • Vehicle types • Vehicle height, volume and speed • Large truck factor (mass) • Vehicle noise	• Midblock pedestrian crossing • Standard of roads and design • Intersection types and geometry • Urban planning (mixed use urban planning and	• Demographic (age, sex, education background, and ethnicity) • Land use and zoning (built up or non-built up, commercial or residential

		child pedestrians • Mobility, Sight or Hearing issues for Older pedestrians • Pedestrian distraction • Pedestrian disability • Visibility or conspicuousness of pedestrians (ease with which they can be seen)	• Proportion of heavy vehicles • Maintenance of brakes/tyres • Vehicle weight/power ratio • Vehicle movement	design) • Traffic control devices • Illumination • Vehicle volume and speed • Bus stop design • Weather • Road width, median, footpath, shoulder, fence • Maintenance • Friction of road pavement • Sight distance	, alcohol bars' density • Population density and housing development practice • On-road and off-road parking design and operational practice • Financing scheme • Climate change • Cultural safety practices for proper use of road facilities
Event (during the crash	• Knowledge • Use of restraints fitted and worn	• Pedestrian knowledge of self-protection strategies (has been taught methods to reduce the severity of	• Vehicle size • Vehicle Crashworthiness • Protection kits	• Highway design (footpath, shoulder, road width, etc.) • Placement of road furniture • Street lighting	• Enforcement of traffic regulation for pedestrian • Duties and tax incentive for imported crash worthiness cars

		injuries)			
Post event (after the crash	• Driver knowledge of first aid (has been taught • emergency response procedures) • Driver knowledge of emergency drills (has been taught • how to respond when incidents occur (phone emergency) • Prevention of delay in detecting crash	• Pedestrian crash victims' health status • Age and sex of victims	• Prevention of fire risk • Avoid leakage of hazardous materials	• Rehabilitation of the road • Furnish traffic control device • Traffic congestion prior it	• Public participation in injury rehabilitation • Laws and regulation of transportation system regarding the injury • Technology (medical, road construction)

2.3 Variables influencing pedestrian

2.3.1 Exposure

According to (Fitzpatrick, et al., April 2018) context, exposure is a measure of the number of potential opportunities for a crash to occur. For pedestrians, facility-specific exposure has been quantified in many ways, including the following:-

- Average pedestrian volume
- Sum of entering flows (pedestrian and motor vehicle) at intersection
- Product of pedestrian volume and motor vehicle volume
- Estimated number of street crossings
- Estimated total travel distance, in person-miles of travel
- Estimated total travel time, in person-hours of travel

Exposure data, and particularly pedestrian exposure data, are not readily available in most road department around the world; however some of these data are collected for infrastructure related purposes, such as Annual Average Daily Traffic which is usually gathered for asset management purposes. Exposure can also be expressed as number of units involved; time spent interacting

with a contact of motorized vehicles, kilometers travelled in the road environment or number of trips. A European study (Fridstrom, Ifver, Ingebrigtsen, Kulmala, & Thomson, 1995) found that 50% of fatal pedestrian crashes and 70% of pedestrian injury crashes were explained by traffic flow that traffic volume and pedestrian volume are the principal variables that explain the variation of pedestrian crashes.

2.3.2 Risk

Risk may be defined as by three elements (Austrods, 2009):

a) Exposure: the number of vehicles or pedestrians travelling through a particular road environment such as traffic volume.

b) Probability: the likelihood that any time or point on road initially loss control.

c) Outcome: An array of possibilities arising from an initial loss of control, can range from a null outcome where a driver regains control to serious injury or death outcome.

2.3.3 Crash

According To (Mohammed, 2017)crash is defined as a set of events that result in injury or property damage, due to the collision of at least one motorized vehicle and may involve collision with another motorized vehicle, a bicyclist, a pedestrian or an object. A Study conducted by (Anon., September 30, 2016) shows For pedestrian crashes, the top three crash types were pedestrian “angle crashes” at intersections, “angle crashes” at midblock, and “left hooks Combined, pedestrian “angle crashes” at midblock and at intersections were over 43% of all pedestrian crashes. These three crash types made up the highest percentage of total and severe crashes.

Each crash has unintentional event expressed in terms of the number of deaths and the severity of injuries inflicted. This can be measured either as a percentage or as a specific number of injuries per designed unit of crashes example percentage of injuries per 1,000 pedestrian vehicle collisions.it provides a quantifiable magnitude of crashes, or a measure of the degree of severity of injuries sustained (Hakkert & Braimaister, 2002).

2.4 What are the pedestrian injury crash risk factors?

2.4.1 Driver factor

2.4.1.1 Speed of Driving

High speed increases the chance of death or severe injury among all road users-drivers, pedestrians, passengers, young and old alike. Excess or inappropriate speed is a major risk factor for road traffic crashes. The higher the speed the shorter time a driver has to stop and avoid a crash. Vulnerable road users are at particularly high risk of injury from speeding vehicles. For instance, pedestrians have a 90% chance of surviving car crashes at 30 km/h or below, but less than a 50% chance of surviving impacts at 45 km/h (WHO, 2004).

It is well documented that vehicle speed affects a driver's stopping distance. If the vehicle travels with a higher speed the vehicle will require a longer distance before coming to a stop. For instance, the Ethiopian Geometric Design Guide provides both recommended stopping and recommended passing sight distances with the change in the designated traffic speed for design of new or upgrading road project (see Table 2.2 below)

Table 2.2: Stopping and Passing Sight Distance in Relation to Design Speed (Ethiopian Roads Authority, 2002)

Design Speed (Km/hr.)	**Coefficient of Friction (f)**	**Stopping Sight Distance (m)**	**Passing Sight Distance (m)**
20	0.42	20	160
30	0.40	30	217
40	0.38	45	285
50	0.35	55	345
60	0.33	85	407
70	0.31	110	482
85	0.30	155	573
100	0.29	205	670
120	0.28	285	792

Analysis of countermeasures to address pedestrian safety on high-speed roadways suggests that some countermeasures are promising but may require improvements to be effective, such as

designing overpasses or underpasses that are easily accessible and inviting for pedestrians (Hudson, et al., n.d.).

2.4.1.2. Drink Driving

Drinking and driving is a hazardous combination; One third of the fatalities in New York State involve impaired or intoxicated drivers and pedestrians. With increased Blood Alcohol Content (BAC), crash risk increases sharply. A driver with a BAC of 0.08 is four times more likely to cause a crash as a driver who has not been drinking, while a driver with a BAC of 0.16 is 25 times more likely to do so. Young drinking drivers are at the highest risk of all. Drivers 20 years old or younger are almost three times more likely to be involved in alcohol related fatal crashes than other drivers (Anon., n.d.).

(Silcock, et al., 2007) Describes In most high-income countries about 20% of fatally injured drivers have excess alcohol in their blood *i.e.* blood alcohol concentration (BAC) in excess of the legal limit. In contrast, studies in low- and middle-income countries have shown that between 33% and 69% of fatally injured drivers and between 8% and 29% of non-fatally injured drivers had consumed alcohol before their crash. For example In Sweden, the Netherlands and the United Kingdom, the proportion of fatally injured drivers with excess alcohol is around 20%, although the legal limits in these countries differ considerably, being 0.02 g/100 ml, 0.05 g/100 ml and 0.08 g/100 ml, respectively. In South Africa Tests for BAC level were conducted on 2372 (or 34.6%) of the 6859 transport-related deaths. More than half (51.9%) of all transport-related deaths had elevated levels of BAC, and of these positive cases, 91% recorded BAC levels of 0.05 g/100 ml or higher. Pedestrians, followed by drivers, were most likely to be BAC-positive (see table 2.3 below).

Table 2.3 Blood alcohol concentration (in g/100 ml)

	Zero %	0.01–0.04 %	0.05–0.14%	0.15–0.24 %	≥ 0.25 %
Pedestrians	37.5	5.4	12.0	20.5	24.7
Passengers	62.6	4.7	14.0	13.7	5.0
Drivers	48.2	5.3	18.2	18.8	9.5
Cyclists	61.3	3.2	15.1	14.0	6.5

(Zhao, et al., Published 23 February 2014) Shows the effect process of alcohol on drivers is that it firstly affects drivers' physiological characteristics and then affects external performances. It matches the statement that the decline on drivers' bodily functions is the fundamental reason of the impairment of driving skill.

According to (Anon., April 05)Alcohol is a depressant drug that affects most areas of the brain which:-

- Slows brain functions so that you can't respond to situations, make decisions or react quickly.
- Reduces your ability to judge how fast you are moving or your distance from other cars, people or objects.
- Gives you false confidence you may take greater risks because you think your driving is better than it really is.
- Makes it harder to do more than one thing at a time while you concentrate on steering, you could miss seeing a red light, cars entering from side streets or pedestrians.
- Makes you feel sleepy or fatigued.

(Calinescu & Adminaite, February 2018) Recommends to allow for the testing of drink driving in all police roadside checks and introduce roadside evidential breath testing procedure by Consider adopting a zero tolerance level for drunk driving (i.e. a maximum BAC of 0.2g/l)

2.4.1.3. Non-use of helmets and seat belts

The use of seat-belts and child restraints is one of the most important actions that can be taken to prevent injury in a motor vehicle crash. While seat-belts and child restraints do not prevent crashes from taking place, they play a major role in reducing the severity of injury to vehicle occupants involved in a collision. An occupant's chance of survival increases dramatically when appropriately restrained (Anon., 2009).

(Briggs, et al., September 2008) Shows Overall, 59.0% of students reported always wearing a seatbelt when driving a car, but only 41.9% always buckled up as passengers. A study conducted in Florida (Spainhour, et al., April 30,2005)states Not wearing a seat belt is the most common cause of fatality and among drivers wearing seat belts, the most common contributing factor to the fatality were age and nearside impacts.

2.4.1.4. Fatigue

A study conducted by (Anon., 2011) among professional drivers revealed the following:

- Seventy-six percent of drivers consider fatigue to be a major highway safety issue;
- Fifty-three percent of drivers believe fatigue is an issue that the industry does not manage well;
- Twenty-one percent of drivers have experienced at least one fatigue-related incident, such as drowsiness, involuntary lane changes, and steering problems.
- Twelve percent of drivers have had an accident within the last twelve months; 20% of whom believe fatigue was a deciding factor;
- Fatigue is generally experienced after 10 hours of driving

2.4.1.5. Aggressive driving

The behavior of the individual in any place of the world is sometimes affected by the culture and characteristics of the society in which they lives.

(Rowden, et al., 20 November 2015) Concludes Aggression was found to be lower when riding a motorcycle than when driving a car and this finding was robust across all except the most extreme behavioral items.

2.4.1.6 The Use of Hand-Held Mobile Telephones

Mobile phone use while driving is increasing among road users. Although the most of countries made illegal the cell phone use while driving, the drivers still use it both for calling and texting. The main findings of these studies generally demonstrated an increasing of reaction time and decreasing of driving performance especially during not critical driving conditions, while the evaluation of the effects of mobile use during critical driving conditions is not so much investigates (Benedetto, et al., April 2012).

A Study showed the frequency of drivers using a mobile phone while driving was significantly higher among less educated, manual laborers and army and police employees living in semi-urban areas, driving a 4WD and having had a driving experience of more than 5 years. Drivers who used mobile phones while driving were less likely to wear a seat belt (49.9% used a seat belt on most of the trips) than drivers who did not use a phone while driving (57.7% used a seat belt

on most of the trips). In addition, red light violations were more common among the group who reported using a mobile phone while driving (Bener, et al., 22 July 2009).

(Bendak, et al., 2018)Discusses Out of the 12,160 drivers observed in the observational study, a staggering 11.3% were texting and another 13.6% were talking while driving. This gives an overall 24.9% mobile phone use rate while driving among observed drivers. This alarming result goes along the 77% of questionnaire respondents who admitted using their mobile phones while driving. Such a high rate of mobile phone use while driving is considered very high and imposes a high-risk level on all road users.

A study conducted in Texas by (Sun & Jia, 2016) with no regulations against using cell phone while driving; Based on careful comparison of the three prevalent approaches(interview survey , driving simulation, and on-road experiment) personal interview is selected as the best data collection method. The driving simulation and on-road experiment are not suitable for evaluating the accident risk of cell phone use due to its experimental nature and unrepresentative sample and concludes The more frequently the drivers use their cell phone, the more likely they have experience hazard situations. For instance, the drivers who spend more than 60 % of driving time on cell phone use reported the hazard experience about 2.5 times more than the ones who only spend 20 %. The drivers who use the service of text message reported the hazard situation three times more than the ones who do not use the service but use cell phone while driving.

2.4.1.7. Socioeconomic factors

According to the (Central Intelligence Agency, 2013), Ethiopian age structure exhibits a high number of children and young adults. The report reveals that the median age of Ethiopians is 17.5 years. This means that major proportions of the population consist of younger people or teenagers. Children and young adults are more vulnerable to road crashes. The education level of a society is also one of the factors that influence the level of pedestrian involvement in traffic crashes. The level of literacy in Ethiopia is 39% (Central Intelligence Agency, 2013). Therefore, the majority of the population are illiterate and it implies that road safety education and promotion are difficult due to the communication barriers. Gender is also an influential factor on exposure of risk of crashes. For instance, in Ethiopia, male pedestrians are over-represented in crashes (Tulu, Washington, & King, 2013). This is because the national trend is for males to have a higher level of mobility compared to females (Aregu, Bishop-Sambrook, Puskur, &

Tesema, 2010). This differential mobility is the natural corollary of higher male employment and a greater reliance on vehicles to seek work. This accounts for national cross-gender variations in vehicular usage and travel by foot. Therefore, the problem of road safety is Complicated, and holistic approaches are required to resolve the country's poverty and gender difference in mobility in order to reverse the current high rate of pedestrian-vehicle crashes.

2.4.2. Pedestrian factor

2.4.2.1. Alcohol and drug impaired walking

Alcohol and drug intoxicated pedestrians and driving are at heightened risk for crashes, as has been widely demonstrated in developed countries (Haque et al., 2012; Ostro¨m & Eriksson, 2001). Pedestrian crashes involving alcohol are likely to be higher at night for two main reasons. First, alcohol consumption is higher at night relative to the day. Second, reduced visibility at night coupled with poor perception and reaction of drivers and/or pedestrians due to alcohol increases the crash risk (WHO, 2013). A study carried out by Boni et al., (2011) in southern Brazil showed that positive alcohol breath-tests were found in 9.2% of pedestrians who had been involved in crashes.

2.4.2.2. The Use of Hand-Held Mobile Telephones

People watching smartphones while walking causes a significant impact to their safety. Pedestrians staring at smartphone screens while walking along the sidewalk are generally more at risk than other pedestrians not engaged in smartphone usage. More specifically, *Safe Walking* first exploits a pedestrian speed calculation algorithm by sampling acceleration data via the accelerometer and calculating gravity components via the gravity sensor. Then, this system utilizes a greyscale image detection algorithm to detect the face and eye movement modes based on OpenCV4Android to determine if pedestrians are staring at the screens. Finally, *Safe Walking* generates a vibration by a vibrator on smartphones to alert pedestrians to pay attention to road conditions (Li, et al., 12th January 2018).

A Study (HAGA, et al., 2015) discusses about Cell phone use negatively affected walking itself explained as below These results showed that mean reaction times to both visual and auditory targets were significantly longer under cell phone-use conditions than the control condition, with the game condition worst among cell phone-use conditions. The number of missed visual targets was significantly higher in the game condition than the control and movie conditions. The

number of missed steps on the walking route was greater under cell phone-use conditions than under the control condition with the game condition worst among cell phone-use conditions. In summary, these results suggest a higher risk of accidents for pedestrians who are using cell phones, especially for those who are playing games with their smart phone.

(Wang, et al., 2012)Presented the design and initial prototyping and evaluation of the Walk Safe App for people that walk and talk and cross roads. To the best of our knowledge walk Safe achieved through the first smartphone app that uses the camera and accelerometer sensors and classification pipeline to alert users of unsafe cars approaching them.

2.4.3.3. Walking along roads

The International Road Assessment Programme (IRAP) pointed out that 84% of roads with pedestrians in DCs had no footpaths (WHO, 2013). Pedestrians often tend to walk along roads due to the absence of footpaths or shoulders. The lack of separation between vulnerable road users and motorized traffic leads to a considerably larger set of potential crash risk opportunities for pedestrians compared to separated facilities encountered in developed countries. Due to financial constraints, most DCs' road networks in built-up areas are constructed without the provision of footpaths. Even when footpaths are present, they may be occupied by roadside vendors/hawkers and bars (Damsere-Derry, et al., 2010), or pedestrian facilities may be constructed without adequately accommodating the volume of pedestrians.

Pedestrians walking along an edge or shoulder of a roadway with their backs to traffic - which typically occurs less frequently in locations lacking sidewalks (Thomas, et al., January 2018).

2.4.3.4. Illegal crossing behavior

There are three scenarios when a pedestrian attempts to cross. If a pedestrian crosses when there are no vehicles around, then he/she will be definitely safe If the pedestrian wishes to cross a street when there are vehicles passing by, he/she can either wait for a safe'gap to occur, for a vehicle to slow down or stop for him/her, or just walk out into traffic and make the traffic flow stop. In the case of the pedestrian jumps in road, the driver has two choices; he/she will stop or he/she will not brake. Sometimes driver will even accelerate to show that he will not give way to the pedestrian. (Björklund and Aberg, 2005) In this case probably both driver and pedestrian give themselves a safety gap in case of emergency. The third option is jumping in to the road without

considering any safe gap. This third option is primarily chosen by intoxicated people and possibly by people in great stress or with mental handicaps or definitely by mistake. Sometimes children may even do this because they do not realize dangers. Measures to provide safety for people walking straight out into traffic may be different than measures aiming at providing safety for people choosing either of the other two strategies. But there is no chance of separating these groups from each other.

(Rothman, et al., December 13, 2012) Analyzed a population based police-reported pedestrian collision data consisted 9575 pedestrian motor vehicle crashes, of which 7325 occurred at signalized intersections when crossing and 2230 occurred at uncontrolled mid-block locations when crossing without right of way. Uncontrolled mid-block collisions resulted in greater injury severity when controlling for road type. The odds of severe injury were 1.75(95% CI 1.07 to 2.86) for children, 2.55(95% CI 2.13 to 3.05) for adults and 1.68(95% CI 1.23 to 2.28) for older adults. The odds of death at uncontrolled mid-block crossing were 4.97(95% CI 3.11 to 7.94) in adults and 3.49(95% CI 2.07 to 5.89) in older adults. Generally concludes that crossing at uncontrolled mid-block locations resulted in greater injury severity compared with crossing at signalized intersections.

On roads with > 2 lanes and > 15 000 vehicles per day, pedestrian crash rate(per million crossings) at marked crossings with raised medians was approximately half that of locations without raised medians; crash rate at unmarked crossings with raised medians was approximately 60% that of unmarked crossings without raised medians (Retting, et al., September 2003).

The major findings of (Sankaran & PERUMAL, 2014) are: pedestrian crossing speed of a male is more than that of a female. Pedestrian age and departure signal phase had high effects on crossing speed variations. Gender and group size of pedestrians were significant factors affecting the pedestrian compliance behavior. Approaching vehicle type and suitable gap between the pedestrian and the vehicle were identified as the influencing parameters in pedestrian-vehicular interactions.

2.4.3.5. Fatigue

Most people in DCs use walking as a principal mode of transportation for short and long distance travel. Long distance walking (Ipingbemi & Aiworo, 2013) may cause physical fatigue in pedestrians, who, as a consequence, may lack proper judgement in the traffic system and be

exposed to crash risks. Pedestrian fatigue may also result when pedestrians are walking when exhausted from other activities (such as extended physical work), and walking after taking heavy medication, walking carrying loads, fasting (Al-Khateeb, Obaidat, & Khedaywi, 2008) or under the influence of alcohol or other drugs (addressed below). However, there appear to be few studies addressing pedestrian fatigue in pedestrian crashes. In Ethiopia, police records of crashes do not provide details about the causes of pedestrian crashes, such as fatigue or other pedestrian faults

2.4.3. Road environment

Although most pedestrian crashes occur in urban environments, severe pedestrian crashes also are experienced in rural parts of Ethiopia (Tulu, 2007). Similarly, other studies have found that pedestrian crashes in rural areas are more severe than those in urban road environments (Lee & Abdel-Aty, 2005; Zajac & Ivan, 2003). One possible reason is that drivers navigate with a higher operating speed in rural road environments than urban environments. The other is that there might be more underreporting of less severe injury in rural areas. Other road environment factors that affect the severity injury of pedestrians include inadequate lighting, school zone, and types of road pavement.

(ZEGEER, et al., n.d.) Revealed pedestrians 65 or older experienced 17.2 percent of their fatalities on wet roads, which is higher than the percentages of persons 15 through 44 (13.9 percent) or 14 years or younger (7.5 percent). However, in terms of all pedestrian crashes (fatal and nonfatal) on North Carolina roads, older adult crashes were not overrepresented on wet roads.

2.4.4. Vehicle factors

Different Vehicles can be designed to protect or reduce the injury severity of pedestrians when they come into contact. There was little attention paid to the exterior parts of vehicles to improve safety for pedestrians (Crandall, Bhalla, & Madeley, 2002). When a pedestrian is struck by a car the sequential events that follow are influenced by the exterior design of the vehicle. As most pedestrian crashes occur at the front of the car (Crandall, et al., 2002), pedestrian friendly fittings are critical to reduce pedestrian injury severity. These include elements such as bluntness and hardness of the impact points, and pedestrian safety technologies such as pop-up bonnets or energy absorbers.

A study Conducted by (Roudsari, et al., 2004) shows Sixty nine percent of pedestrian collisions were related to passenger vehicles, 18% to light truck vehicles (LTVs) and 13% to vans and therefore concludes Vehicle type strongly influences risk of severe injury and death to pedestrian. This may be due in part to the front end design of the vehicle. Hence vehicle front end design, especially for LTVs, should be considered in future motor vehicle safety standards.

2.5. Pedestrian Travel

Pedestrian trips are made for a variety of reasons; commuting to work, commuting to transit, performing neighborhood errands, or for leisure and recreation. 3% of the nation's employment population walks as their primary mode of commuting. This number increases significantly for more urban areas, 22% of New York City's and almost 12% of Washington, DC's employees walk to work. But, not all urban areas see this kind of trend; Los Angles reports only 3% of employees walking to work and Dallas less than two percent (Fults, 2005).

(Yi, et al., n.d.) Observe that the proposed feature set achieves much better performance than the baseline features. This is because the baseline features simply count the number of persons along the walking routes, but the different roles and influences of these persons are not modeled. Moreover, the estimation errors increase when using the subsets of the proposed features, it demonstrates the effectiveness of each of the proposed features, including the location features, influence features, moving features, and stationary features.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

The chapter mainly explains how the study was conducted, the applied methods and techniques in review previous research, define problem, data collection, the reasons for which they were used according to the research aims and objectives this study was divided into three stages. There were preliminary stage, analysis stage and result and discussion stage.in order to analysis the study used to statistical tools.

3.2. Description of the study area

Mekelle is a city found in the Northern part of Ethiopia and is serving as the capital of Tigray Regional State. Mekelle is one of the seven zones of Tigray Region. It is located some 783 kilometers north of the capital Addis Ababa, at $13^{0}26'$ to $13^{0}36'$ North latitudes and $39^{0}25'$ to $39^{0}33'$ East longitudes with an average elevation of 2084 meters above mean sea level. The total area of the city by the year 2011 was about 135.21 km^2. Its municipality is believed to have been established in the early 1940s.

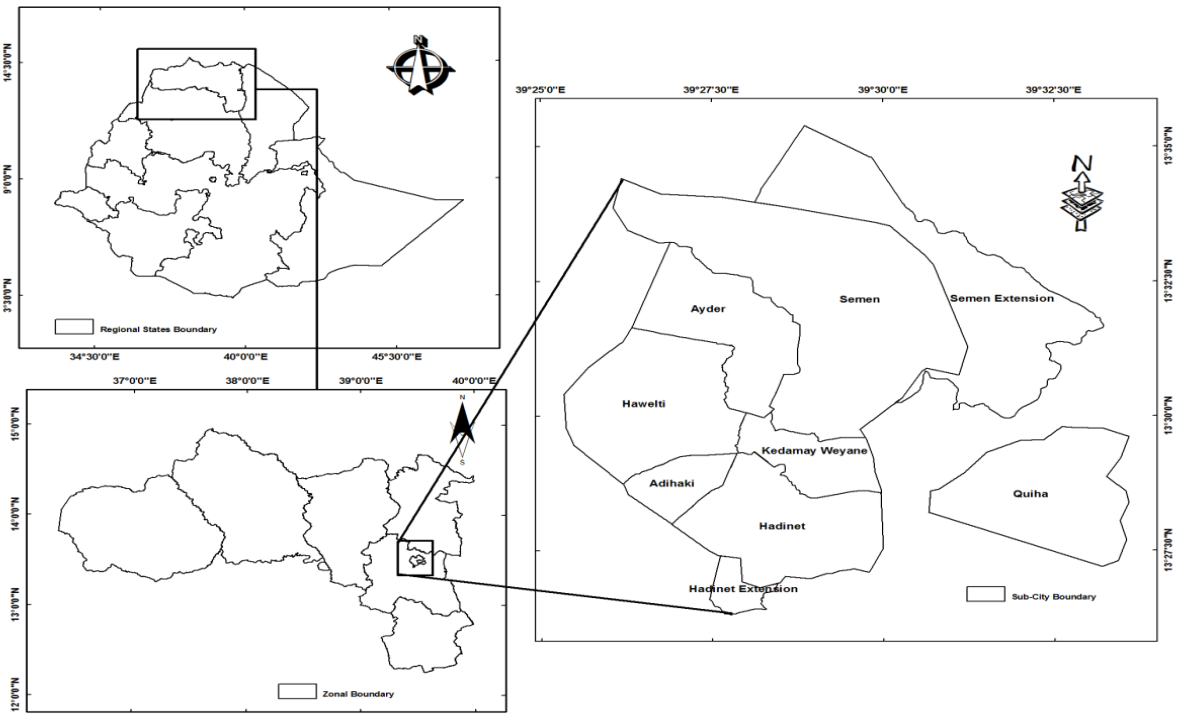

Figure 3.1 study Area

3.3. Research design

Qualitative and quantitative (mixed method) was used to evaluate the crash between motor vehicles and pedestrian in Mekelle city road. The research was conduct based on secondary & primary data like surveys, observation, interview and questionnaires design method. The figure below shows the research design flow diagram.

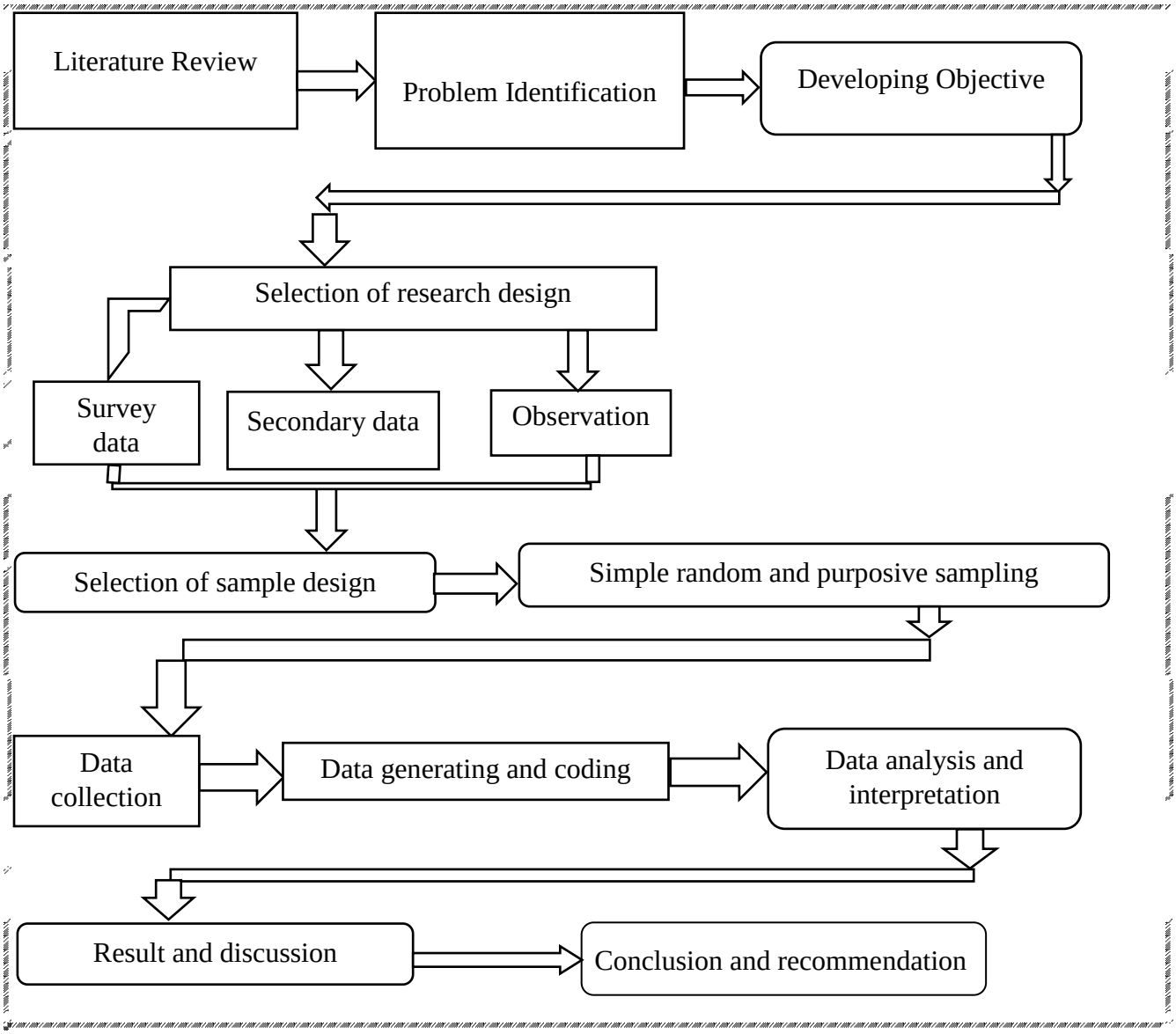

Figure 3.2 Research study design flow chart

3.4. Population

All motor vehicle accidents exposed to pedestrian crashes and recorded in Mekelle city of all sub cities, during the period from 2006 to 2010 E.C were included. In addition to this questionnaire to pedestrian and drivers of the city which accounts a total of 785 and interview with trained and experienced stakeholder are included.

3.5. Sample size and sampling technique

3.5.1. Sample size

The secondary data consists of All registered pedestrian crashes covering the period of five year from 2006 to 2010 E.C police stations of all sub cities. Whereas the primary data mainly covers the skill and experience of different stake holders, interview and questioner to pedestrian and drivers of the city respondent.

Thus, if the population size is known, (Yamane, 1967) formula for determining the sample size is given by: $n=N/(1+Ne^2)$

Where: -

n= corrected sample size

e = Margin of error (MoE), e = 0.05

N = population size, and

The total population of mekelle city were 358,528 using the above general formula we obtained sample size of 400 pedestrian. Similarly (Anon., January 2018) shows the total motorized vehicle of the city are estimated to be 10,997 therefore, sample size needed to drivers were 385. But in case of drivers the main consideration was total number of motorized vehicle rather than license because all drivers those have license might not have the opportunity of driving.

3.5.2. Sampling technique/procedure

This study uses simple random sampling for drivers and pedestrians, and purposive sampling method for those other necessary information that collected from different concerned office and stakeholders as well as pedestrian accident areas.

3.6. Study variables

3.6.1. Dependent variable

Outcome of pedestrian crash

3.6.2. Independent variable

- Pedestrian behavior
- Driver behavior
- Vehicle related factors
- Road related factors

3.7. Nature and source of data

3.7.1. Primary data collection

The major primary data collection was site visit, observation, survey, through interviews and questioner (with pedestrian, driver and traffic police officer of the city) interview part is made with key informants from Tigray Region Police Commission and Traffic police officers of mekelle city.

3.7.2. Secondary data collection

Secondary data for pedestrian accident were obtained from the daily RTA police accident files of Tigray Regional Government Traffic office, and Mekelle city traffic office of all sub city. Moreover, different books, proceedings, reports, international organization publications, and internet waves have been consulted to fill lack of pedestrian crash data's.

3.8. Data collection methods

Data were collected using a structured checklist which was developed based on daily RTA registration book format .The accident data provided by the Police Agency, consists of the data happening on the road from 2002-2009 E.C were collected from Tigray region traffic police, as well as, from Mekelle city traffic office between the years of 2006 -2010 E.C.

3.9. Methods of data analysis

Data were entered, cleaned and analyzed using SPSS version 20 software. First Descriptive statistics of count and expected count distribution using crosstabs and figures were carried out to explore the socio demographic characteristics related to the pedestrian and driver characteristics related to cause of pedestrian accident occurrence .

The crosstab was used to assess the association between the dependent and independent variables, outcome of pedestrian crash with socio demographic characteristics related to pedestrian and driver (age, sex, educational background, driving experience and driver vehicle relationship, health status, monthly income and characteristics related to cause of the accident (movement of driver & pedestrian during the accident, road condition, road surface type, vehicle service years, causes of accident, day of accident, week of accident, location of accident, type of vehicle involved, vehicle years of service and cause of injury). Data interpretation was done using Chi–square test for goodness of fit and P values were calculated. $P< 0.05$ was considered statistically significant.

3.10. Ethical considerations

The data was collected after ethical permission is given from Jimma University. Jimma Institute of Technology before continuing the study acceptance should be given from different responsible organs and local authorities in order to follow the research. Make sure the confidentiality of data, Approve of research by an ethics review committee to make sure the study is not contradicting any of the above considerations; follow the procedure that is required with the concerned organization. This study was conducted in a manner that was consistent with ethical issues that need to be considered in conducting a research. Hence, most individuals the researcher visited for interview accepted and cooperated with the researcher willingly. Moreover, a prior consent of the participants was requested before conducting the interview.

3.11. Data quality assurance

In my study the data was collected in two ways of data collections from primary source of data collection (the first witness of a fact) and secondary source of data collection (record of an event, books or circumstance). Therefore; the assurance of those data to be highly recognized and those data are true. In order to obtain quality of data researcher would be to be assured by giving attention to the following points:-

- Before collecting data, all the source of population availability has to be checked and respondents' daily work schedules have to be respected.
- All the questions has to be put in simple & clear ways.
- Willingness of the respondents to answer the questions and collaboration with the study will be tested out.
- All necessary schedules are going to be worked out need to be administered the questionnaire; conducted observations or group interviews.
- All the system for quality control /assurance of data collection has to be worked out effectively.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. General Characteristics of pedestrian crashes in Mekelle City

4.*1.1.* Temporal Variation of pedestrian crashes

The occurrence of RTA can vary within the 24 hours of a day. With maximum crashes when mobility of pedestrians, passengers, and drivers frequency increases.

Since traffic officers uses uniform format that consists summary of overall accidents it is difficult to precisely know the frequency of pedestrian crash occurred in different time intervals to resolve this I have used the response of pedestrians' as follow.

Table 4.1 Temporal variation of pedestrian crashes by time of a day in Mekelle City from pedestrian respondent.

Time of accident			level of injury			Total
			Fatality	serious	Slight	
Time of accident	Morning	Count	56	55	22	133
		Expected Count	56.1	59.4	17.5	133.0
	After noon	Count	17	24	1	42
		Expected Count	17.7	18.8	5.5	42.0
	Evening	Count	19	17	5	41
		Expected Count	17.3	18.3	5.4	41.0
	Night	Count	43	47	14	104
		Expected Count	43.9	46.5	13.7	104.0
Total		Count	135	143	42	320
		Expected Count	135.0	143.0	42.0	320.0

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.017[a]	6	0.319

Since the p-value is 0.319 thus, the accident level were not significantly associated with time of the day. The result contradicts most researchers out put this indicates the data lacks reality because it is an opinion of individuals. Pedestrian accident in Mekelle City are commonly observed in the morning time than others which accounts 41.56%. In the afternoon the expected count in case of slight injury level is higher than the observed one the reason might be because the movement of vehicle and pedestrian increases at this time so that the probability of accident occurrence will also become higher.

Table 4.2. Temporal variation of pedestrian crashes by day of week in Mekelle City from pedestrian respondent.

			level of injury			Total
			Fatality	Serious	Slight	
Day of accident occurred	Monday	Count	102	122	22	246
		Expected Count	103.8	109.9	32.3	246.0
	Tuesday	Count	8	10	2	20
		Expected Count	8.4	8.9	2.6	20.0
	Wednesday	Count	7	0	7	14
		Expected Count	5.9	6.3	1.8	14.0
	Thursday	Count	6	0	7	13
		Expected Count	5.5	5.8	1.7	13.0
	Friday	Count	7	7	0	14
		Expected Count	5.9	6.3	1.8	14.0
	Saturday	Count	2	4	2	8
		Expected Count	3.4	3.6	1.1	8.0
	Sunday	Count	3	0	2	5
		Expected Count	2.1	2.2	.7	5.0
Total		Count	135	143	42	320
		Expected Count	135.0	143.0	42.0	320.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	57.137[a]	12	0.000

According to the pedestrian response Monday and Tuesday had the highest number of accidents with 246 and 20 respectively, followed by Wednesday , Friday and Thursday having their value 14,14(similar data) & 13 respectively. Sunday and Saturday had relatively small accident number

5&8 respectively. The main reason for Monday to occur high accident is because the exchange of different goods is conducted at this time so the number of pedestrians' are very high similarly the accident is too. The reason why Sunday and Saturday to occur less accident is because the movement of vehicle decreases especially public buses so this helps to move freely. Finally as you can see from the above table 4.2 the p-value is 0.000 this indicates the accident level is highly associated with the day of accident. A study done in Addis Ababa by (berhe, A. January 2014) shows more accident were registered on Friday.

The report of road traffic accident show the occurrence of accident frequency on Mekelle city is higher than other zones .out of all traffic accident occurred in tigray regional state in the recent years between 2002 E.C and 2009 E.C 28.36 percent occurred in mekelle city and then followed by southern, southeast, and eastern regions having percentages of 16.17%, 13.93% and 13.37% respectively. Here is the summarized data as shown in Fig 4.1 below.

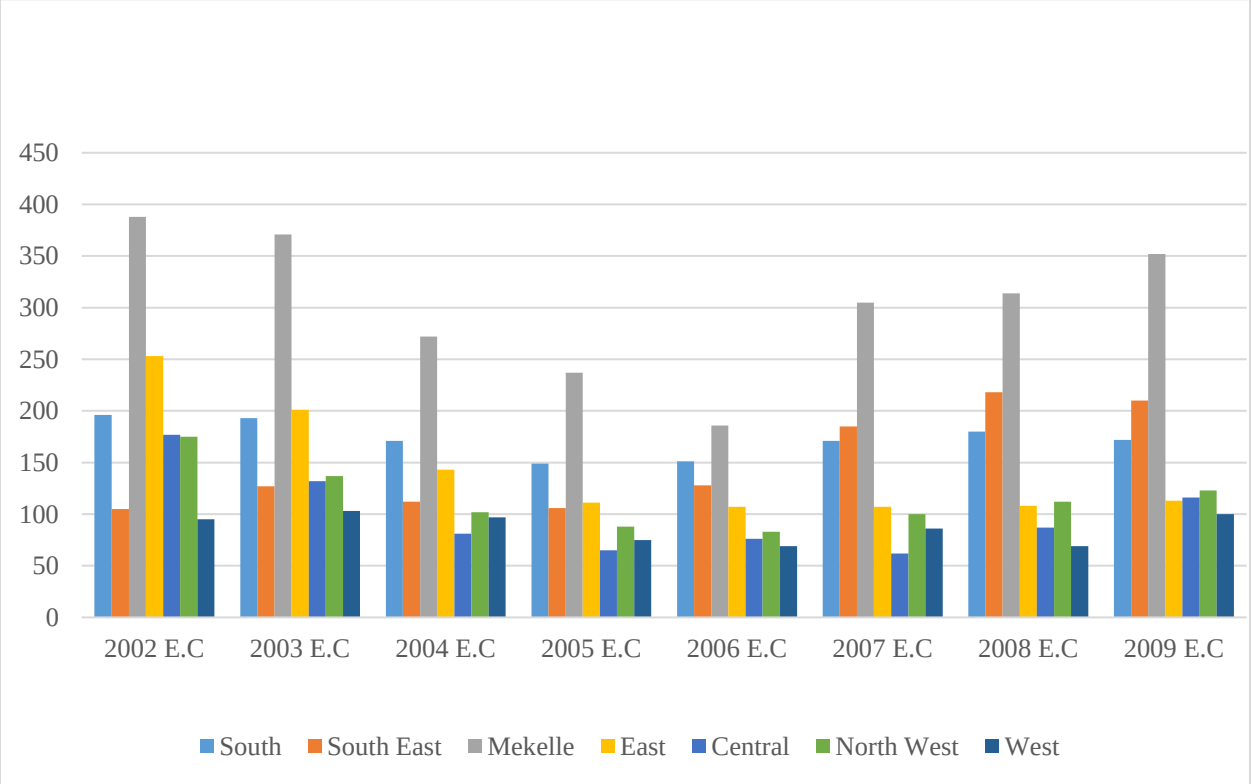

Figure 4.1. Traffic Accident of The seven Zones of Tigray Region From 2002-2009 E.C

Generally, the trends of pedestrian accidents from 2006 to 2010 have shown as figure 4.2 below

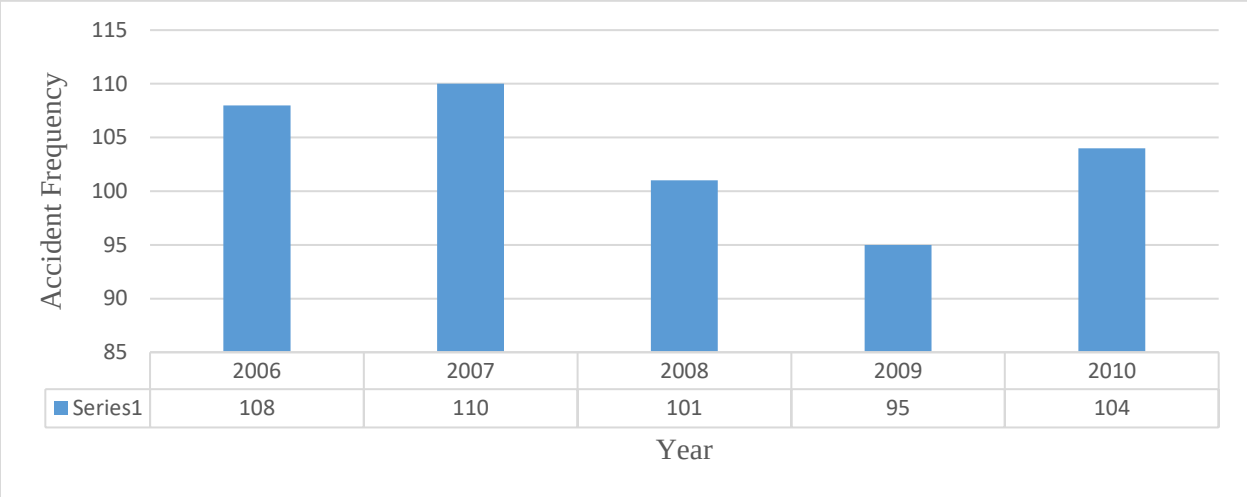

Figure 4.2. Comparison of pedestrian accident from 2006-2010 E.C

4.1.2. Socio-demographic Characteristics of pedestrians

4.1.2.1. Pedestrians' Age

Table 4.3. Chi-square test result of age of pedestrian accident and expected frequency of accident during 2006-2010 E.C.

age of pedestrian * level of injury Cross tabulation						
			level of injury			Total
			fatality	serious	slight	
age of pedestrian	<7	Count	9	23	1	33
		Expected Count	9.3	22.2	1.5	33.0
	7-13	Count	13	31	0	44
		Expected Count	12.4	29.6	2.0	44.0
	14-17	Count	3	25	1	29
		Expected Count	8.2	19.5	1.3	29.0
	18-30	Count	41	112	15	168
		Expected Count	47.4	113.2	7.5	168.0
	31-50	Count	38	77	3	118
		Expected Count	33.3	79.5	5.2	118.0
	>51	Count	42	81	3	126
		Expected Count	35.5	84.9	5.6	126.0
Total		Count	146	349	23	518
		Expected Count	146.0	349.0	23.0	518.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.859[a]	10	0.031

From the Slight injures perspectives, pedestrians whose ages' between18-30, the observed crashes are twice the expected one similarly between the ages of 7-13 the amount of crash is zero whereas the expected crashes are two. Moreover, the serious injures highly affect the pedestrians whose age is between 18-30 years old than any other age categories. Pedestrians whose age is less than 7 were the least victims of road traffic accidents next to 14-17 ages. The age category is significantly associated with the occurrence of pedestrian crashes because the p-value is 0.031.

4.1.2.2. Pedestrians' Gender

Table 4.4. Chi-square test result of gender of pedestrian accident and expected frequency of accident during 2006-2010 E.C.

Gender of pedestrian * level of injury Cross tabulation						
			level of injury			Total
			fatality	serious	slight	
Gender of pedestrian	Male	Count	100	229	16	345
		Expected Count	97.2	232.4	15.3	345.0
	female	Count	46	120	7	173
		Expected Count	48.8	116.6	7.7	173.0
Total		Count	146	349	23	518
		Expected Count	146.0	349.0	23.0	518.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.478[a]	2	.787

The general observation was that males were more involved in road accidents because they travel more in their daily duties when compared with many females who usually stay at home doing domestic duties. The result of mekelle city agrees with (Tulu, Washington, & King, 2013), in Ethiopia, male pedestrians are over-represented in crashes.

4.1.2.3. Educational back ground of pedestrian

The pedestrian those who completed high school are highly affected (38.13%) followed by less than high school (29.38%). The accident level for under graduate degree, post graduate degree,

& those who have no qualification were (20.00%), (8.75%) and 3.75% respectively. Thus the result shows no significant relationship between educational back ground and the level of injury. In addition to this table 4.5 below shows there was statistically significance association between them (p-value =0.0131 >0.05). Under graduate degrees in case of serious and slight injury perspective they have similar character i.e. the expected crash is higher than the given crash data.

Table 4.5. Chi-square test result of educational background of pedestrian accident and expected frequency of accident from pedestrian respondent

Educational back ground * level of injury Cross tabulation

Educational back ground			level of injury			Total
			fatality	serious	slight	
	No qualification	Count	12	14	2	28
		Expected Count	11.8	12.5	3.7	28.0
	Less than high school	Count	39	45	10	94
		Expected Count	39.7	42.0	12.3	94.0
	High school	Count	46	51	25	122
		Expected Count	51.5	54.5	16.0	122.0
	Under graduate degree	Count	33	26	5	64
		Expected Count	27.0	28.6	8.4	64.0
	Post graduate degree	Count	5	7	0	12
		Expected Count	5.1	5.4	1.6	12.0
Total		Count	135	143	42	320
		Expected Count	135.0	143.0	42.0	320.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.485[a]	8	0.131

4.1.2.4. Health Status

Almost all pedestrians affected regarding health status are registered by healthy (96.91%), followed by disable (1.54%), about (1.5%) is covered by Deaf, Blind. Drunk and Unknown categories (see figure 4.3. below for detailed information)

Table 4.6. Chi-square test result of pedestrian health status crash frequency and expected in mekelle city (2006-2010 E.C)

pedestrian health status * level of injury Cross tabulation						
			level of injury			Total
			fatality	serious	slight	
pedestrian health status	Deaf	Count	1	0	0	1
		Expected Count	.3	.7	.0	1.0
	Blind	Count	0	1	0	1
		Expected Count	.3	.7	.0	1.0
	Disable	Count	2	5	1	8
		Expected Count	2.3	5.4	.4	8.0
	Healthy	Count	141	340	21	502
		Expected Count	141.5	338.2	22.3	502.0
	Drunk	Count	2	1	0	3
		Expected Count	.8	2.0	.1	3.0
	Unknown	Count	0	2	1	3
		Expected Count	.8	2.0	.1	3.0
Total		Count	146	349	23	518
		Expected Count	146.0	349.0	23.0	518.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.057[a]	10	0.221

The deaf category under fatality perspective have registered count greater than expected while in the serious injury observed crash count is lesser than the expected count and in the slight injury level observed count and expected crash count remains same. Healthy pedestrian shows count data higher than expected count in fatality &serious levels but slight injury contradicts this value. Unknown category characterizes in fatality injury level the expected count is higher than the observed count and in serious and slight injury the expected count is similar to the observed count. Finally we can conclude from the above table 4.6. Statistically there was no association between the health status of pedestrian and accident level occurrence (p=0.221).

Zero percent does not mean no accident frequency rather few in number that approximates to zero. Thus those who have problems physically or any other are less victims of the accident.

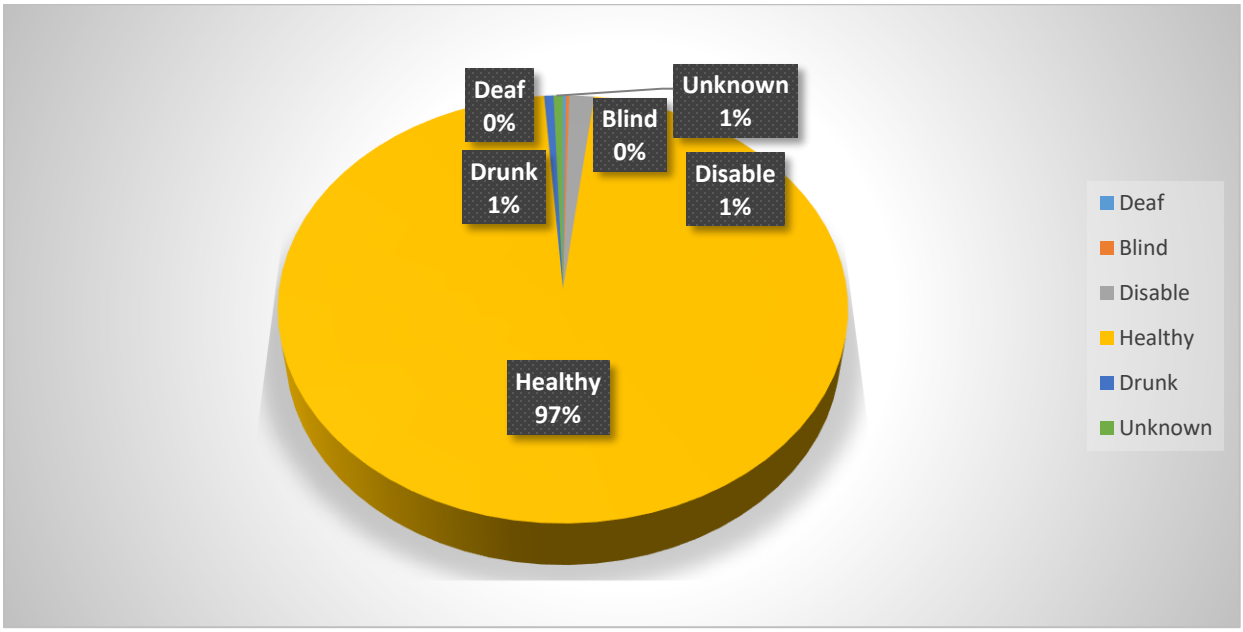

Figure 4.3. Health status of pedestrian and total accident occurred (2006-2010 E.C)

4.1.2.5. Pedestrian work

Regarding to the work type pedestrians that work daily work were mostly affected 194 (37.45%) followed by students 153(29.54%) and farmers 126(24.32%). The least affected were found under unknown category which accounts 2(0.39%), unemployed 16(3.09%) and Idle 27 (5.21%) the reason for daily workers to be most victims was they have low income their choice is walking than any other mode of transport. In case of workers the probability of injury occurred in fatality & slight accident level perspective is less than the observed crash data while in serious injury the reverse is true. There was statistically significant association between pedestrian work type and accident occurrence.

Table 4.7. Chi-square result test of pedestrian work type with level of injury (2006-2010 E.C)

pedestrian work * level of injury Cross tabulation						
			level of injury			Total
			fatality	serious	slight	
pedestrian work	Student	Count	32	116	5	153
		Expected Count	43.1	103.1	6.8	153.0
	Worker	Count	64	117	13	194
		Expected Count	54.7	130.7	8.6	194.0
	Farmer	Count	32	92	2	126
		Expected Count	35.5	84.9	5.6	126.0
	Unemployed	Count	5	8	3	16
		Expected Count	4.5	10.8	.7	16.0
	Idle	Count	13	14	0	27
		Expected Count	7.6	18.2	1.2	27.0
	Unknown	Count	0	2	0	2
		Expected Count	.6	1.3	.1	2.0
Total		Count	146	349	23	518
		Expected Count	146.0	349.0	23.0	518.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.573[a]	10	0.001

4.1.2.6. Monthly income of pedestrian

About one hundred fifty four (48.13%) of the pedestrian were unemployed, eighty nine (27.81%) earns 2000-5000 per month, forty eight (15%) receives less than 2000, seventeen (5.31%) receives 5001-10,000 and twelve (3.75%) receives 10,001-20,000 per month. The accident occurrences is highly represented in unemployed category than other group this contradicts with the five year registered data of mekelle city that unemployed uses minimal rank. However, monthly income and accident level are statistically associated with p-value=0.000.

Table 4.8. Chi-square test result of monthly income of pedestrian and expected crash count from pedestrian respondent.

monthly income * level of injury Cross tabulation						
			level of injury			Total
			fatality	serious	slight	
monthly income	Less than 2000 ETB	Count	10	22	16	48
		Expected Count	20.3	21.5	6.3	48.0
	2,000 to 5,000 ETB	Count	37	45	7	89
		Expected Count	37.5	39.8	11.7	89.0
	5,001 to 10,000 ETB	Count	9	5	3	17
		Expected Count	7.2	7.6	2.2	17.0
	10,001 to 20,000 ETB	Count	5	7	0	12
		Expected Count	5.1	5.4	1.6	12.0
	Unemployed	Count	74	64	16	154
		Expected Count	65.0	68.8	20.2	154.0
Total		Count	135	143	42	320
		Expected Count	135.0	143.0	42.0	320.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.874[a]	8	0.000

4.1.3. Socio-demographic characteristic of drivers'

4.1.3.1. Age of drivers'

Table 4.9. Below elaborate the age distribution of the drivers and its associated effects on the levels of Traffic Accidents in mekelle city. Accordingly, about 0.98%, 49.02%, 39.06%, and 10.94% of the reported driver casualties have an age of < 18, 18-30, 31-50, and >51 years respectively. When drivers' accident victims were compared by their age category, those drivers with an age less than 18 years old are the lesser affected age category since acquiring driving license considers at minimum of 18 years. In contrary, drivers with an age greater than 18 years, but less or equal to 50 years were the most affected drivers in RTAs in all categories of RTA classifications.

In the fatality level of injury the expected crash is more than six times the observed crash in the age category of 18-30 this indicates that the probability of causing death in this group is higher. Similarly in case of slight injury in the age category >51 the expected count is 25.2 times the observed count frequency this means the age category is highly characterized by slight injury.in conclusion the age of driver have very much significantly associated with the occurrence of pedestrian accident(p-value=0.000)

Table 4.9. Chi-Square test results by age group of the drivers and frequency of accident (2006-2010 E.C)

			Level of Injury			Total
			Fatality	Serious	Slight	
	<18	Count	2	3	0	5
		Expected Count	1.4	1.3	2.2	5.0
	18-30	Count	11	72	168	251
		Expected Count	72.6	65.7	112.8	251.0
	31-50	Count	128	11	61	200
		Expected Count	57.8	52.3	89.8	200.0
	>51	Count	7	48	1	56
		Expected Count	16.2	14.7	25.2	56.0
Total		Count	148	134	230	512
		Expected Count	148.0	134.0	230.0	512.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	315.939[a]	6	0.000

4.1.3.2. Gender of drivers'

The occurrence of RTA in Mekelle City shows a greater variation in terms of drivers' Gender. Most of the drivers' of mekelle city that causes pedestrian crashes with in the five year data were males which accounts 50(97.66%), females 12(2.34%) and others 4(0.78%) .Correspondingly, the female drivers' road traffic accident casualties were minimal. In the female drivers slight injury is zero (0) but the expected crash shows eight (8). In case of male drivers the fatality and serious injury of expected crash is greater than the given data. There was statistically significant association between gender of the driver and accident level with p-value as you can see in the table 4.10 below.

Table 4.10. Chi-Square test results by Gender group of the drivers and frequency of accident (2006-2010 E.C)

			Level of Injury			Total
			Fatality	Serious	Slight	
Gender	Female	Count	8	4	0	12
		Expected Count	3.4	.6	8.0	12.0
	Male	Count	139	22	340	501
		Expected Count	143.6	25.4	332.0	501.0
Total		Count	147	26	340	513
		Expected Count	147.0	26.0	340.0	513.0

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	33.708[a]	2	0.000

4.1.3.3. Educational background of driver

One hundred seventy nine (34.56%) of accident occurs by those who completed secondary school education, one hundred fifty nine (30.69%) those who completed higher education caused the next rank, one hundred four (20.08%) accident were by those who completed primary school. The illiterates, reading and writing & Greater than higher education caused lesser accident. Thus the result shows no significant relationship between these two variables with p-value greater than the allowable value. The expected crash value is lesser than the observed data in all accident levels in the Illiterate category, whereas under secondary school in case of serious injury the expected crash frequency is higher than the recorded value.

Table 4.11. Chi-Square test results by Educational background of the drivers and frequency of accident (2006-2010 E.C)

Education Back ground			Level of injury			Total
			Fatality	Serious	Slight	
	Illiterate	Count	1	2	0	3
		Expected Count	.8	2.0	.1	3.0
	Reading and Writing	Count	0	1	0	1
		Expected Count	.3	.7	.0	1.0
	Primary School	Count	30	71	3	104
		Expected Count	28.7	70.6	4.7	104.0
	Secondary School	Count	54	114	11	179
		Expected Count	49.4	121.6	8.1	179.0
	Higher Education	Count	42	111	6	159
		Expected Count	43.9	108.0	7.2	159.0
	above higher education	Count	14	48	3	65
		Expected Count	17.9	44.1	2.9	65.0
Total		Count	141	347	23	511
		Expected Count	141.0	347.0	23.0	511.0

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.838[a]	10	0.902

4.1.3.4. Driving experience

It is believed that the experience of drivers play a paramount role in road crashes. The distributions of road crashes in Mekelle City are also affected by the driving experience.

150 (28.96%) incidences have been exhibited by drivers whose driving experience is between 2 to 5 years. The drivers with driving experience between 5 and 10 years have caused 121 (23.36%) road crashes in the study period. In addition to this drivers whose driving experience between 1-2 years accounts 85(16.41%), those who have no license 81(15.64%),greater than 10 years 47(9.07%), less than one year 29(5.60),and unknown 5(0.97%) respectively. This result in Mekelle City is found highly experienced drivers are not engaged in frequent traffic accident scenarios than the least experienced. Generally the driving experience have statistically associated with the accident level with (p-value 0.012).

Table 4.12. Chi-Square test results by driving experience and frequency of accident from 2006-2010 E.C

driving experience * level injury Cross tabulation						
			Level injury			Total
			fatality	serious	slight	
Driving experience	no license	Count	25	54	2	81
		Expected Count	22.4	54.9	3.6	81.0
	<1 year	Count	15	13	1	29
		Expected Count	8.0	19.7	1.3	29.0
	1-2 year	Count	21	62	2	85
		Expected Count	23.5	57.7	3.8	85.0
	2-5 year	Count	41	98	11	150
		Expected Count	41.5	101.8	6.7	150.0
	5-10 year	Count	34	80	7	121
		Expected Count	33.5	82.1	5.4	121.0
	>10 year	Count	6	41	0	47
		Expected Count	13.0	31.9	2.1	47.0
Total		Count	142	348	23	513
		Expected Count	142.0	348.0	23.0	513.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.765[a]	10	0.012

4.1.3.5. Driver vehicle relationship

The incident of pedestrian accident was evaluated against driver and vehicle ownership. Table 4.13. Below illustrates how far the drivers' vehicle ownership relationship contributes to accident occurrences in Mekelle City. About 397(76.64%) of accidents are recorded from hired drivers. Whereas, 99(19.11%), 18(3.47%) and 4(0.77%) were accompanied by owners of vehicle while driving their own vehicle, others and unknown category respectively.in addition to this driver vehicle relationship is significantly associated with the level of injury in the given year.

Table 4.13. Chi-square test result of driver vehicle relationship and frequency of accident (2006-2010 E.C)

relationship * level injury Cross tabulation						
			Level injury			Total
			fatality	serious	slight	
relationship	owner	Count	22	70	7	99
		Expected Count	27.5	67.0	4.4	99.0
	hired	Count	115	269	13	397
		Expected Count	110.4	268.8	17.8	397.0
	others	Count	6	9	3	18
		Expected Count	5.0	12.2	.8	18.0
Total		Count	143	348	23	514
		Expected Count	143.0	348.0	23.0	514.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.213[a]	4	0.024

4.1.3.6. Monthly income of driver

About ninety six (50.53%) of the drivers respondent were earned 2000-5000 ETB per month's thirty seven (19.47%) earns less than 2000 ETB per month, about fifty three (27.89%) received from 10,001 to 20.000 ETB and four (2.11%) were unemployed. The data shows the drivers' belongs to the low monthly income (up to 5000 ETB causes about 72.11% of the accident, where as those who received from 5001-20,000) contributes about 27.89% of accident. In the slight injury perspective under the monthly income of 2000-5000 the recorded data & expected crash data remains same. . The minimum expected count is 0.17.However, monthly income and level of accident are not statistically significant since the p-value is=0.240.

Table 4.14. Chi-square test result of monthly income profile and accident frequency from driver respondent

monthly income * level of injury Cross tabulation						
			level of injury			Total
			fatality	serious	slight	
monthly income	Less than 2000 ETB	Count	15	22	0	37
		Expected Count	16.6	18.9	1.6	37.0
	2,000 to 5,000 ETB	Count	42	50	4	96
		Expected Count	42.9	49.0	4.0	96.0
	5,001 to 10,000 ETB	Count	13	11	1	25
		Expected Count	11.2	12.8	1.1	25.0
	10,001 to 20,000 ETB	Count	12	14	2	28
		Expected Count	12.5	14.3	1.2	28.0
	Unemployed	Count	3	0	1	4
		Expected Count	1.8	2.0	.2	4.0
Total		Count	85	97	8	190
		Expected Count	85.0	97.0	8.0	190.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.365[a]	8	0.240

4.1.4. Vehicle characteristics

4.1.4.1. Vehicle type

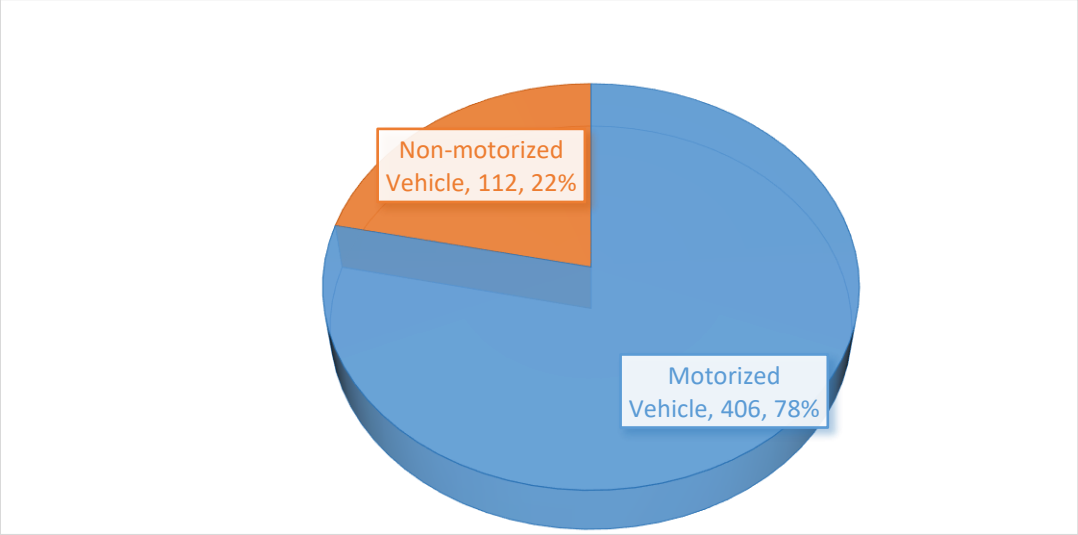

Figure 4.4. Vehicle type and total pedestrian accident (2006-2010 E.C)

The entire types of vehicles in the city in relation to their contribution to road crashes in the last five years are summarized in the table below. Vehicles more frequently involved in RTAs than other vehicle categories are taxi ,Cart and Isuzu type which accounts 87(16.80%), 84(16.22%) & 68(13.13%) respectively. Lory, bus and other (Bajaj's) category contributes lesser value i,e 11(2.12%,20(3.56%) &25(4.83%) respectively. the expected crash frequency of cycle under serious injury is lesser than the recorded once and the expected crash is higher under slight injury. Finally the association between vehicle type and accident level is statistically significant having p-value of 0.029 which is lesser than 0.05.

Table 4.15. Chi-square test result of vehicle type and frequency of accident (2006-2010 E.C)

vehicle type * level injury Cross tabulation						
			level injury			Total
			fatality	serious	slight	
	cycle	Count	7	20	1	28
		Expected Count	7.9	18.9	1.2	28.0
	motor cycle	Count	8	18	3	29
		Expected Count	8.2	19.5	1.3	29.0
	automobile	Count	4	19	3	26
		Expected Count	7.3	17.5	1.2	26.0
	land cruiser	Count	14	28	4	46
		Expected Count	13.0	31.0	2.0	46.0
	pick up	Count	21	32	0	53
		Expected Count	14.9	35.7	2.4	53.0
	Isuzu type (1 - 10 Tone)	Count	28	38	2	68
		Expected Count	19.2	45.8	3.0	68.0
	lorry	Count	3	8	0	11
		Expected Count	3.1	7.4	.5	11.0
	taxi	Count	20	62	5	87
		Expected Count	24.5	58.6	3.9	87.0
	minibuses(15)	Count	16	25	0	41
		Expected Count	11.6	27.6	1.8	41.0
	bus (> 15 Passengers)	Count	6	12	2	20
		Expected Count	5.6	13.5	.9	20.0
	cart	Count	13	69	2	84
		Expected Count	23.7	56.6	3.7	84.0
	other	Count	6	18	1	25
		Expected Count	7.0	16.8	1.1	25.0
Total		Count	146	349	23	518
		Expected Count	146.0	349.0	23.0	518.0

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	36.240[a]	22	0.029

4.1.4.2. Vehicle service year

The vehicle service age determines the fate of the vehicle to be engaged in RTA Crashes. The RTA data collected from Mekelle City Traffic office, as shown in figure 4.9. below reveals that the vehicle service age determines the variation in the distribution of RTA throughout the study period.

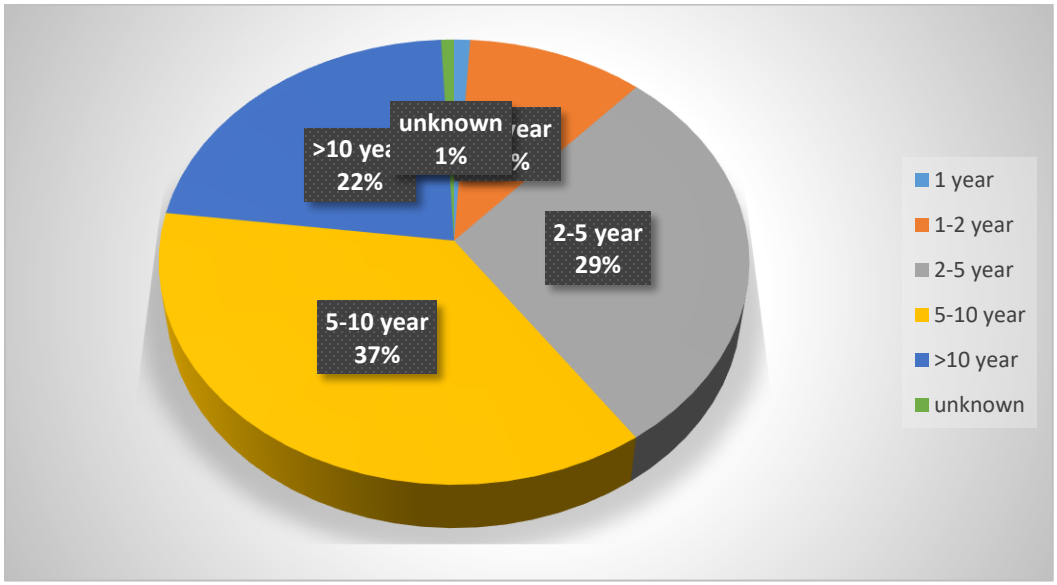

Figure 4.5. Vehicle service year and pedestrian accident (2006-2010 E.C)

Vehicles with service age between 5 and 10, and 2 to 5 years caused total crash of 190 (36.68%) and 149 (28.76%) respectively. Generally as the service year increases the accident level also increases except for the service year categories >10 years and unknown.

4.1.5. Road Characteristics

4.1.5.1. Road surface type with pedestrian crash

Highest accidents were recorded in good asphalt and cobblestone with percentage of 86%, 11% respectively. Gravel and poor asphalt characteristics uses 1% & 0% respectively.

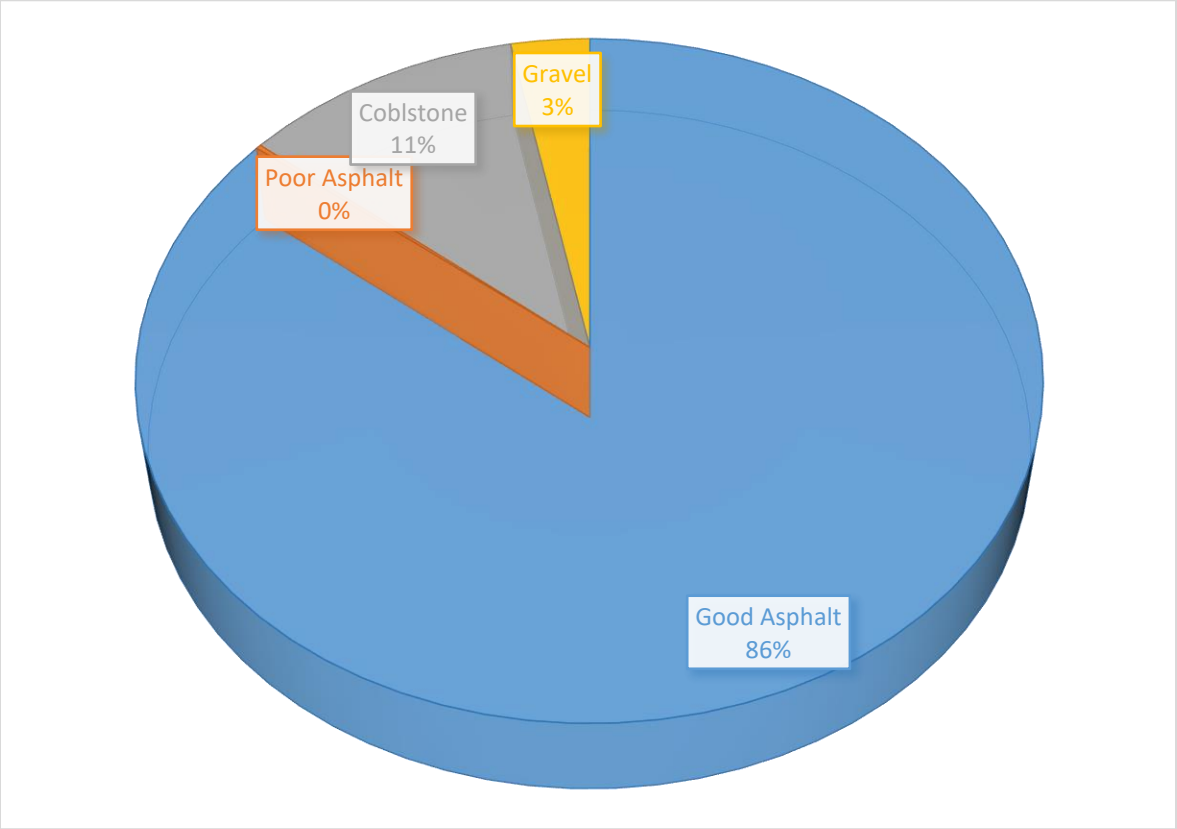

Figure 4.6. Road surface type and pedestrian accident in mekelle city (2006-2010 E.C)

4.1.5.2. Road condition and Weather Condition with pedestrian crash

Road surface condition dry, wet, mud, and unknown conditions were used to investigate the severity of accidents by road conditions in the city. Accordingly, as shown in Figure 4.7 it was revealed that about 498(96%) of the accidents occurred on dry road surface conditions; and consequently, in wet road surface conditions, about 20(4%) accidents occurred.

In contrary, no accidents occurred in mud and unknown road surface conditions. Hence, the analysis shows that almost all of the pedestrian accident happened in dry road surface conditions.

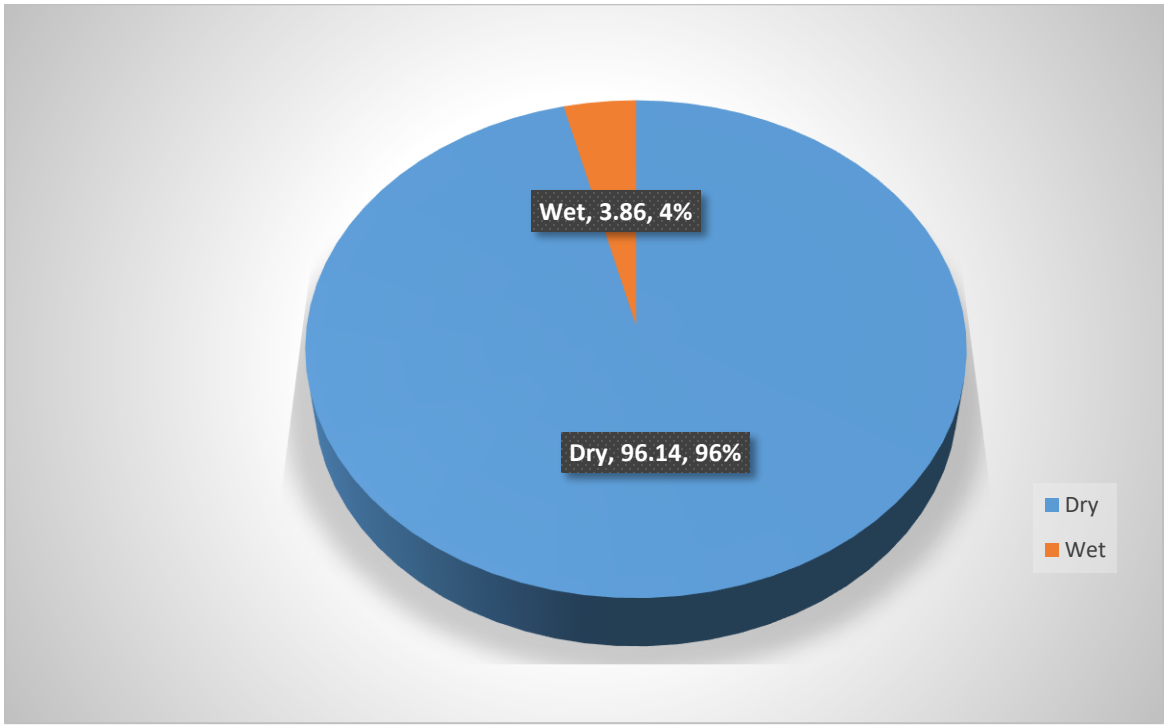

Figure 4.7. Road condition type and total pedestrian accident of mekelle city 2006-2010 E.C

4.1.5.3. Lighting condition with pedestrian crash

Even though the existence of light is very important for the reduction of RTAs significantly, the analysis shows that most of the pedestrian accident i.e. 430(83%) occurred during the day light in the years 2006-2010 E.C. The accidents in night time takes the next rank which accounts 69(13%) this the reason might be the pedestrian volume increases at this time.

Accidents those happened in sunrise and sun set were relatively very low and shares the same magnitude (see Figure 4.8. for the detail).

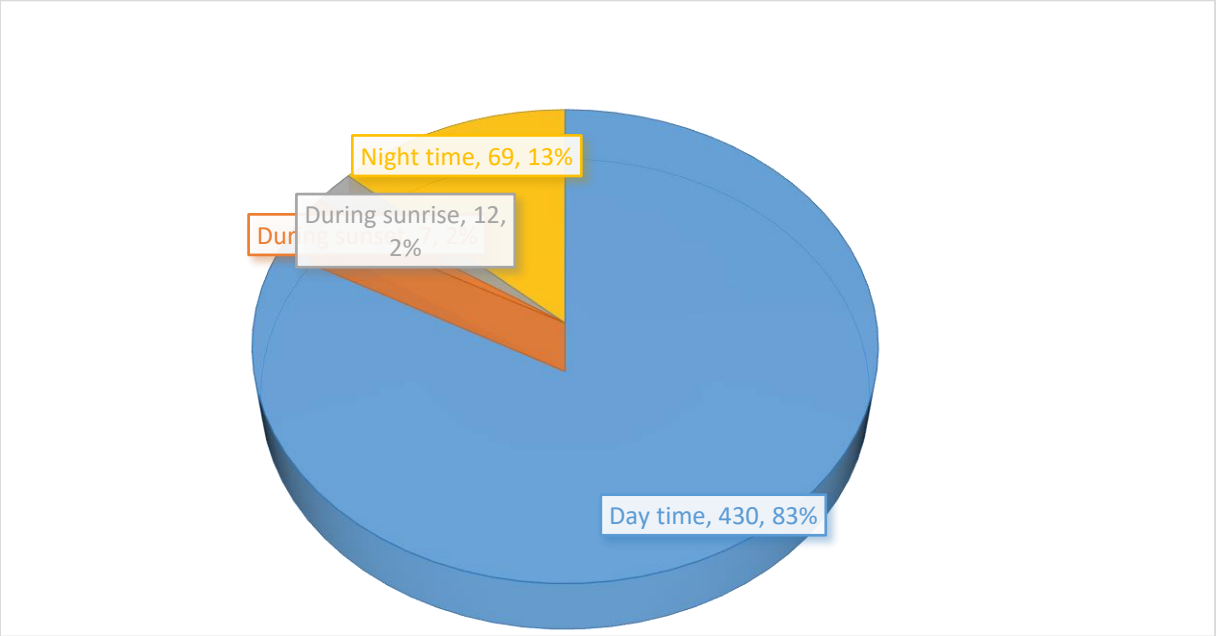

Figure 4.8. Lighting condition and total pedestrian accident in mekelle city (2006-2010 E.C)

4.1.5.4. Pedestrian crashes by land use in Mekelle city roads

Among the eight categories of places the number of accidents is higher in residential areas (38%) followed by organizations (18%) and school (15%) this result is similar with the study conducted by (berhe, A. January 2014) in Addis Ababa city related to children accident. The main reason might be because most of the time pedestrian play in their residential areas and also there are no traffic police near residential areas.

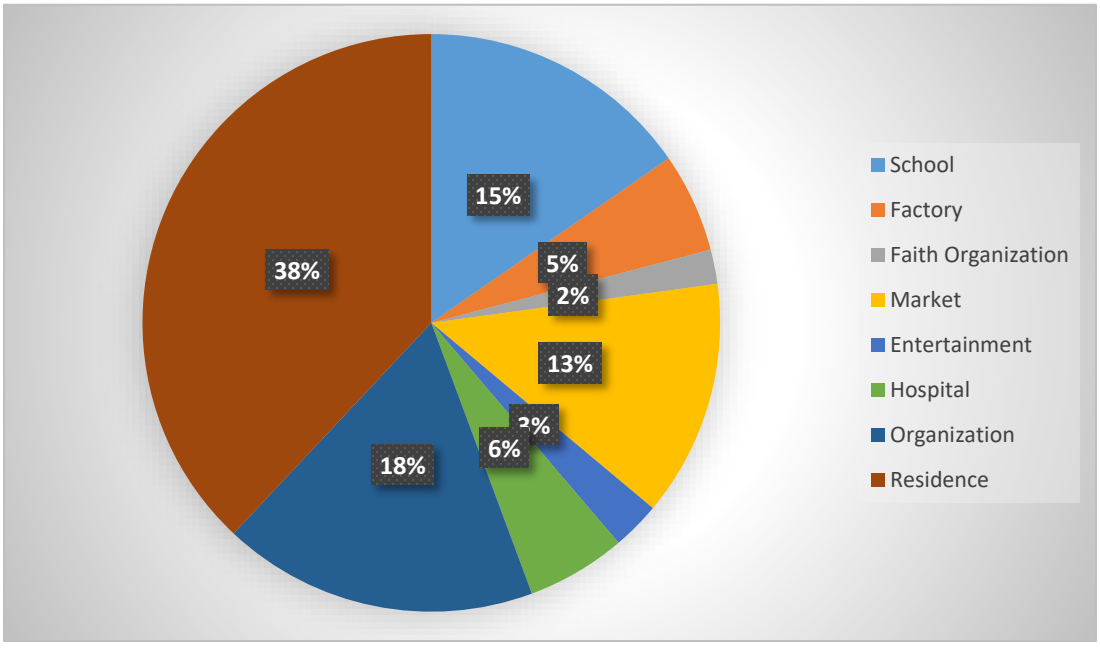

Figure 4.9. Accident location and total pedestrian accident in mekelle city (2006-2010 E.C)

4.2. Major causes and contributing to pedestrian crash in mekelle city road

4.2.1. Secondary data Survey Based Factors that Contribute to pedestrian crashes

Regarding to movement of the pedestrian during the accident, pedestrian got accident while crossing illegally (79.34%), followed by using left side with no pedestrian facility (6.95%) and using right side with no pedestrian facility (5.21%). The other accident in total of (8%) occurred shared by during crossing cross road with no traffic light, crossing cross road diagonally, using pedestrian crossing, crossing with obscuring of vehicle, walking on road way with pedestrian facility, pedestrian walking, vehicle travelling midway of road, playing on road way, neither vehicular nor pedestrian facility and unknown categories. In case of playing on road way the given data of fatality injury is lesser than the expected crash data where as in the serious injury given data is higher than the expected count data and in the slight injury the count data is lesser than the expected count. The movement of pedestrian during the accident have statistically significant association with level of accident occurrence (since p=0.000). The reason for illegal pedestrian crossing to be highly represented is because the pedestrian chooses short route, lacks knowledge of pedestrian crossing sign and signals, pedestrian facility so as to walk freely.

Again, this information alone does not provide sufficient information to determine if the pedestrian was collide with whilst obeying or disobeying the pedestrian signals. Additional information about the circumstances of the collision and the conflict with the vehicle is provided to analysis whether the cause is single parameter i.e. pedestrian, driver or any other factor.

Table 4.16. Chi-square test result of pedestrian movement during accident (2006-2010 E.C)

pedestrian movement * level of injury Cross tabulation						
pedestrian movement			level of injury			Total
			fatality	serious	slight	
	Crossing cross road with no traffic light	Count	3	3	0	6
		Expected Count	1.7	4.0	.3	6.0
	Crossing cross road diagonally	Count	0	4	0	4
		Expected Count	1.1	2.7	.2	4.0
	Using pedestrian crossing	Count	2	7	1	10
		Expected Count	2.8	6.7	.4	10.0
	illegal pedestrian crossing	Count	115	278	18	411
		Expected Count	115.8	276.9	18.2	411.0
	Crossing with obscuring of vehicle	Count	1	0	3	4
		Expected Count	1.1	2.7	.2	4.0
	Walking on roadway with pedestrian facility	Count	2	1	0	3
		Expected Count	.8	2.0	.1	3.0
	pedestrian walking(side)	Count	4	0	0	4
		Expected Count	1.1	2.7	.2	4.0
	Using Left side with no pedestrian facility	Count	11	24	1	36
		Expected Count	10.1	24.3	1.6	36.0
	Using Right side with no pedestrian facility	Count	2	25	0	27
		Expected Count	7.6	18.2	1.2	27.0
	Vehicle travelling midway of road	Count	0	1	0	1
		Expected Count	.3	.7	.0	1.0
	playing on roadway	Count	0	6	0	6
		Expected Count	1.7	4.0	.3	6.0
	Neither vehicular nor pedestrian facility	Count	2	0	0	2
		Expected Count	.6	1.3	.1	2.0
	Unknown	Count	4	0	0	4
		Expected Count	1.1	2.7	.2	4.0
Total		Count	146	349	23	518
		Expected Count	146.0	349.0	23.0	518.0

Chi-Square Tests

Value	Df	Asymp. Sig. (2-sided)
91.280[a]	24	0.000

According to the traffic office report of the five year the pedestrian crash contributing factor are summarized as follow. Three hundred thirty four (64.48%) of the accidents were due to not giving priority to pedestrian, sixty eight (13.13%) were due to over speed, forty-eight (9.27%) were by Failure to respect right hand drive, Twenty four (4.63%) due to not giving priority to vehicle. The rest percentage is covered by Illegal turning, Driving too close with another, Unsafe loading , Unknown, Pedestrian problem in Crossing, and Not obeying traffic police rule respectively.(to see the detailed value see Figure 4.10. below).

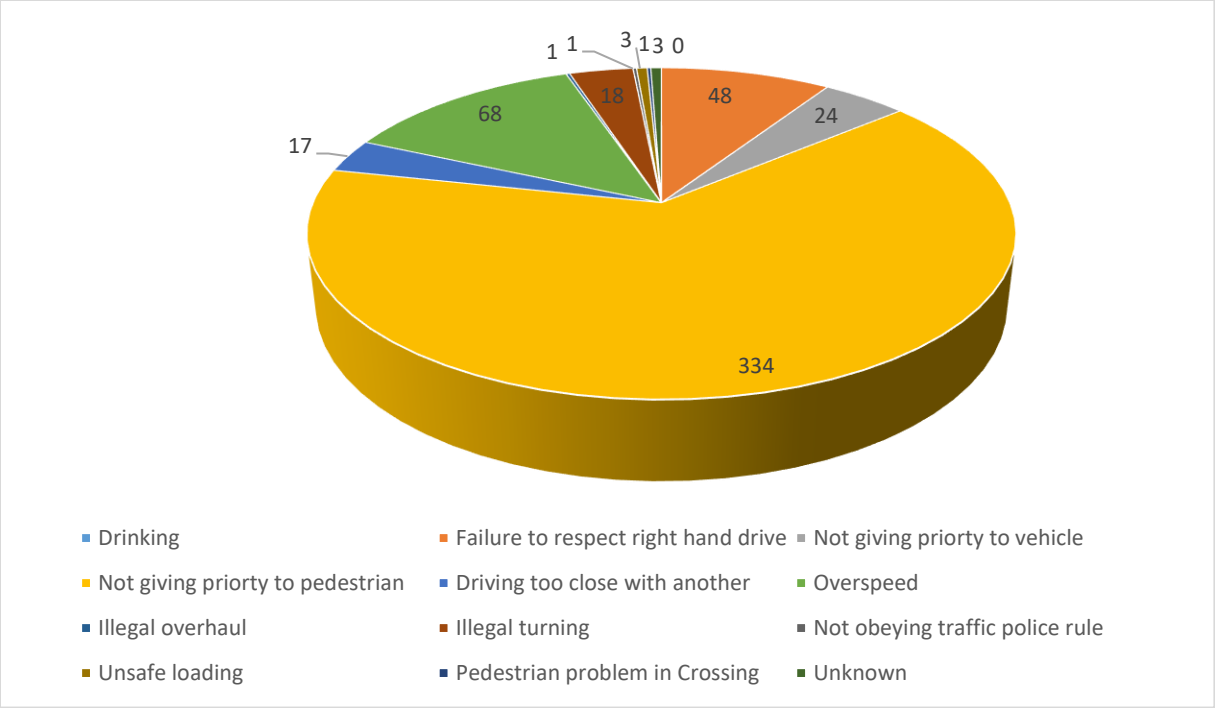

Figure 4.10. Main Causes and a Contributing to pedestrian crashes as Reported by Traffic Police in mekelle city road (2006-2010 E.C)

The result of this study shows there is no accident occurred because of drinking this contradicts most researchers output.

Regarding the movement of drivers' of (72.97%) of the victims had the accident when they were moving straight , 8.69% of the accident occurred when entering intersection , 7.92% during turning to the right side and 7.34% occurred during left turn movement. Almost 3% of the cause is represented by the other categorical variables (see in detail the figure 4.11. below).

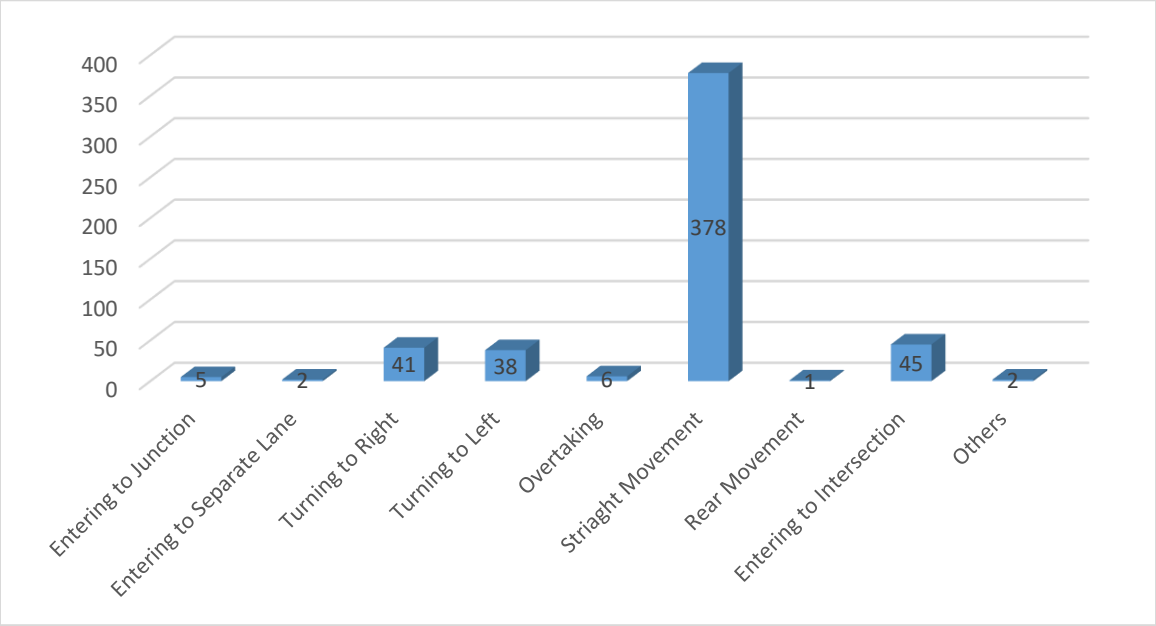

Figure 4.11. Driver movement and frequency of pedestrian accident (2006-2010 E.C)

during driver movement Even though they are not singe cause that mean related to driver the driver shares higher degree so special attention is given during driving specially while moving straight, entering to intersection, turning to the right and left sides so that the crash can be minimized.

4.2.2. Questionnaire Survey Based Factors that Contribute to pedestrian crashes

In the discussion about the causes of driver accident in case of mekelle city from the five year recorded data drinking doesn't have any contribution for the accident occurrence. The figure 4.10 above shows the magnitude of alcohol user from driver respondent which shows about 76% uses alcohol where as 24% doesn't take any alcohol. Thus the data obtained from traffic police disagrees with the questioners about the effect of alcohol on pedestrian crash in the city.

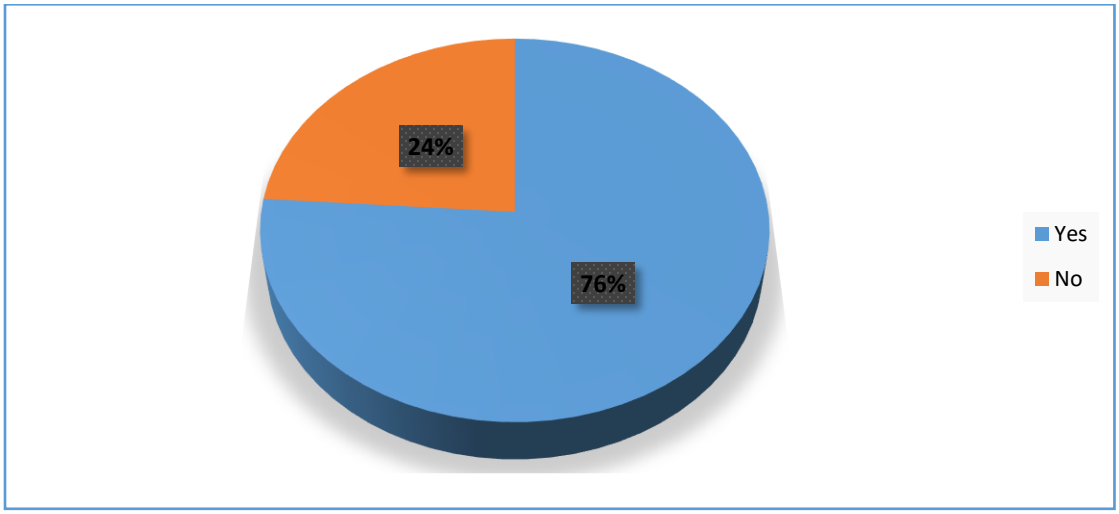

Figure 4.12. Percentage of alcohol user from drivers' perspective

Illegal crossing of the road takes the first rank whose value accounts about 46.34% and this agrees with the secondary data obtained from the traffic officers. The second common form of pedestrian behavior encountered on mekelle city road were walking along the roadway which accounts 23.67% this might be either because of no pedestrian walkway or carelessness.

Not paying attention when crossing the roadway and Pedestrian distraction such as using mobile phone while crossing consists of 15.06% and 6.74% respectively. If others category which accounts about 8.18% and this mainly includes playing along roadway.

Table 4.17. Unsafe forms of pedestrian behavior encountered on roads from pedestrian response

Which these unsafe forms of pedestrian behavior do you encounter most often on the roads?	Number	%
Walking along road way	165	23.67
Illegal crossing	323	46.34
Pedestrian distraction	47	6.74
Not paying attention when crossing the roadway	105	15.06
If others [specify]	57	8.18
Sum	697	100.00

Figure 4.13. Pedestrian walking along the roadway around kedamay weyane

Figure 4.14. Illegal pedestrian crossing around kedamay weyane

The first common form of driver behavior encountered on mekelle city road were not yielding right of way to other vehicles which accounts about 114(25.91%) followed by not yielding right of way to pedestrian 88(20%). Tailgating is also another contributing factor which consists of 73(16.59%).Alcohol consumption adversely affects judgment, reaction time and vision as well as use of seat belts/ helmets and choice of driving speed. Thus the contribution of Drinking and driving, speeding, jumping and traffic light and not using indicators as a percentage is 63(14.32%),40(9.09%),20(4.55%) and 7(1.59%) respectivelly.In addition to this lack of driving experience, driving without license also contributes almost 35(7.95%).

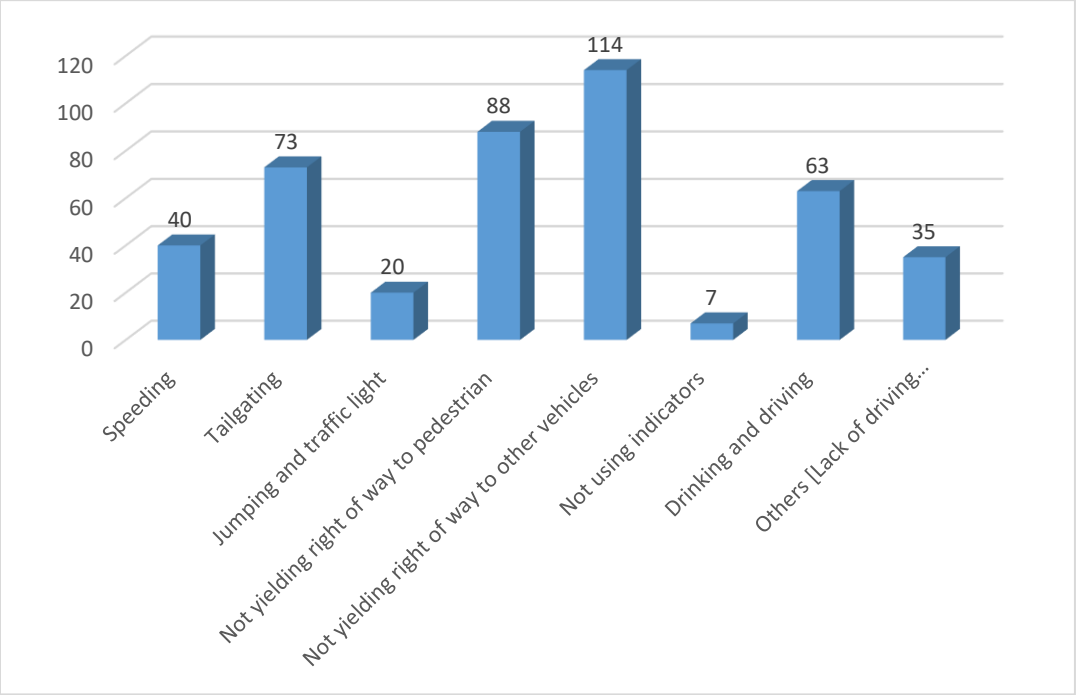

Figure 4.15. Drivers commonly encountered unsafe forms of driving behavior

4.3. General pedestrian Crash Situations and Potential Countermeasures

Table 4.18. General Crash situations and countermeasures related pedestrian

Accordingly the possible counter measure are proposed for identified pedestrian accident problems and these are strongly supported by site visit and observation during the movement of pedestrians in the city.

General pedestrian crash Situation	Potential Countermeasure
Crossing cross road with no traffic light	• installing traffic light system
Crossing cross road diagonally	• using zebra crossing
Using pedestrian crossing	• Crossing carefully • Not using mobile phone • Obeying traffic rules
illegal pedestrian crossing	• Following traffic rule regulation
Crossing with obscuring of vehicle	• Make good visibility
Walking on roadway with pedestrian facility	• Using sidewalk appropriately
pedestrian walking(side)	• Making full attention • Provide guard rail
Using Left side with no pedestrian facility	• building sidewalks on left side
Using Right side with no pedestrian facility	• building sidewalks on right side • use left side of roadway
Vehicle travelling midway of road	• pedestrian use their own way • No driver error
playing on roadway	• Do not play on roadway • Give awareness to child
Neither vehicular nor pedestrian facility	• Provide enough maintenance to these facility

The above table indicates that even though they describe mostly with pedestrian movement improvement of road infrastructure and driver behavior are also the basic elements to propose as prime counter-measure to address the identified accident situations.

Table 4.19. General Crash situations and countermeasures related driver

The counter-measure are combination of driver factor, pedestrian behavior, vehicle and road related factors to overcome the challenges.

General pedestrian crash Situation	Potential Countermeasure
Drinking	• Drink-drive legislation & enforcement
Failure to respect right hand drive	• respect right hand drive
Not giving priority to vehicle	• giving priority to vehicle
Not giving priority to pedestrian	• giving priority to pedestrian
Driving too close with another	• driving with enough gap to another vehicle
Over speed	• Use Speed limit
Illegal overhaul	• Driving with uniform speed
Illegal turning	• Turning legally
Not obeying traffic police rule	• obeying traffic police rule
Unsafe loading	• safe loading
Pedestrian problem in Crossing	• Discipline in crossing roads

The most commonly encountered unsafe forms of pedestrian and driver behaviors on the road are included and prime counter measure are also explained in the above discussion but to minimize the pedestrian crashes the above means of reduction of crash plays vital role if properly conducted. The pedestrian counter measure method used to resolve the different challenges' were related with the main causes listed previously or the input and the summery shown below explains the possible means of pedestrian crash mitigation with consideration of the magnitude caused by the main factors.

- To look as you cross the street and check every lane of traffic, and any gap, as you walk.
- Encourage relationships between traffic police and their communities in order to best understand traffic outlines.
- Give training to pedestrians about the dangers of being distracted around traffic.
- Educate pedestrians, especially children, not to use cell phones or other electronic devices while crossing the road.
- Pedestrian signs should be designed with the simplest possible messages in order that they are easily understood them.
- Improve sight distance and/or visibility between motor vehicles and pedestrians

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The result of the current study has highlighted a number of issues that required attention in order to reduce traffic accidents with pedestrians. It is hoped the information from the study will lead to developing a better understanding of issues related to traffic accidents in the city in particular and our country in general.

- Majority of the pedestrian accident in mekelle city are occurring in the morning time. Hence traffic policemen should be assigned in the major roads where motorized vehicle and pedestrian flows mostly.
- Moreover, the result confirmed that traffic accident to the level of injury in the city mostly affected age categories of between 18-30 regardless of their sex, and start declining when they are less than 17 years.
- Drivers with age group of 18-30 years: educational background those who completed secondary school and those who have driving experience of 2-5 years were highly responsible for the largest number of pedestrian accidents.
- Among the various reasons causing numerous pedestrian accidents in mekelle city not giving priority to pedestrian, over speed, Failure to respect right hand drive, not giving priority to vehicle contributed much to the misery of road crashes in the city.
- With regard to movement of the pedestrian during the accident, pedestrian got accident while crossing illegally 411(79.34%): using left side with no pedestrian facility 36(6.95%) and using right side with no pedestrian facility 27 (5.21%) were ranked from first to third respectively.
- Regarding the movement of drivers' 378 (72.97%) of the victims had the accident when they were moving straight, 45(8.69%) of the accident occurred when entering to intersection, 41(7.92%) during turning to the right side and 38 (7.34%) occurred during left turn movement.
- With regards to places of accidents: residential areas, organizations and school were ranked from first to third respectively in all the five years.

- Besides, highest accidents were recorded in good asphalt & cobblestone: in dry surface condition than wet: during day light followed by night time.
- To look as you cross the street and check every lane of traffic, and any gap, as you walk is the prime counter measure to mitigate the crash.

5.2 Recommendation

Based on understanding of the main causes of accidents, on the existing situation or identified causes, improvement was suggested. In general, the following recommendation should be implemented:-

- The traffic officer must use new separate pedestrian format only and record each carefully to examine the actual cause, count affected by road crashes and resolve the problems scientifically.
- The role of law enforcing authority is solely important. The use of safety helmet and belt must be enforced as well as strict rules regarding license issuing, ban of using mobile phone while driving, etc.
- Give Special awareness creation programs especially for the drivers who (18-30 year) age group and 2-5 driving experience so that they could develop the sense of responsibility.
- Training and awareness campaigns are vital countermeasures which should be supplemented by engineering and enforcement that could be used to make citizens aware of the increase in risk of injury or death due to night time visibility, drunk driving and walking, excessive speed and so on.
- An effort has to be made to compile and organize RTA data of the city in database software or at least in application software programs like Microsoft office Access or Microsoft office Excel for data retrieval and analysis.

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APPENDICES

Appendix A

Questionnaire survey

Appendix A Pedestrians questionnaires

JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

HIGHWAY ENGINEERING STREAM

Dear Pedestrians

This questionnaire is designed to gather data on the evaluation of motorized vehicle crashes with pedestrian in case of Mekelle city road.to achieve this purpose your response to every questions given below has a crucial value. Therefore you are kindly requested to read the questions carefully and give accurate and real data which exists on the ground. The response that you replay will not be used for any other purpose other than this research work. I would like to thank you in advance for your time and cooperation

Part 1: personal information

Please tick all appropriate boxes.

1. Gender

   □ Male □ Female

2. Age

   □ Less than 18 □ 26-35 □ 51-65

   □ 18-25 □ 36-50 □ Above 65

3. What is your current marital status?

□ Single □ Married □ Others

4. What is your highest level of education?

□ No qualification □ Under graduate degree

□ Less than high school □ Post graduate degree

□ High school

5. What is your monthly income?

□ Less than 2000 ETB □ 10,001 to 20,000 ETB

□ 2,000 to 5,000 ETB □ Unemployed

□ 5,001 to 10,000 ETB

6. To the best of your knowledge, are you in a good health?

□ Yes □ No

Part 2: Pedestrian accident

7. I am worried about the traffic accidents in Mekelle city roads?

□ Strongly disagree □ Agree

□ Disagree □ Strongly agree

□ Neither agree nor disagree

8. Have you, or one of your relatives, ever been in an accident as a pedestrian?

□ Yes □ No

9. From your point of view, who was responsible for that accident?

□ Driver □ Driver and pedestrian □ Government

□ Pedestrian □ If others specify

10. Do you think that weather is an important factors in traffic accidents?

□ Yes □ No

11. When do you think most traffic accidents take place?

□ Morning □ Evening

□ After noon □ Night

12. What day of the week do you think most traffic accidents take place

□ Monday □ Wednesday □ Friday

□ Tuesday □ Thursday □ Saturday

- Sunday

Part 3: Pedestrian behavior

13. How many years have you been living in Mekelle city?

- Less than 1 year
- 1 to three years
- 4 to six years
- More than six years

14. How often do you cross roads as a pedestrian?

- Always
- Some times
- Never

15. Do you know the places designed for pedestrian crossings?

- Yes
- No

16. Do you mostly cross from the places not designed for pedestrian crossing?

- Yes
- No

17. What is the main purpose of crossing the road?

- Going to work
- Shopping
- Social purpose
- Others

18. Do you use a mobile phone while crossing roads?

- Always
- Some times
- Never

19. Do you drink Alcohol?

- Yes
- No

20. If your answer to question number 19 is "Yes", how often do you use Alcoholic drinks?

- Very often
- Occasionally
- Seldom
- Never

21. Which these unsafe forms of pedestrian behavior do you encounter most often on the roads? Please tick all the appropriate boxes.

- Walking along road way
- Illegal crossing
- Pedestrian distraction
- Not paying attention when crossing the roadway
- If.Others[specify]

Part 4: Traffic Safety

22. What role do you think mekelle city traffic police should play in reducing pedestrian accidents?

……

Appendix B Drivers questionnaires

JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

HIGHWAY ENGINEERING STREAM

Dear Drivers

This questionnaire is designed to gather data on the evaluation of motorized vehicle crashes with pedestrian in case of Mekelle city road.to achieve this purpose your response to every questions given below has a crucial value. Therefore you are kindly requested to read the questions carefully and give accurate and real data which exists on the ground. The response that you replay will not be used for any other purpose other than this research work. I would like to thank you in advance for your time and cooperation.

Part 1: Personal Information

Please tick all appropriate boxes

1. Gender

   □ Male □ Female

2. Age

   □ Less than 18 □ 36-50

   □ 18-25 □ 51-65

   □ 26-35 □ More than 65

3. What is your current marital status?

   □ Single □ Married □ Others

4. What is your highest level of education?

- ☐ No qualification
- ☐ Less than high school
- ☐ High school
- ☐ Undergraduate degree
- ☐ Post- graduate degree

5. What is your monthly income?
   - ☐ Less than 2000 ETB
   - ☐ 2,000 to 5,000 ETB
   - ☐ 5,001 to 10,000 ETB
   - ☐ 10,001 to 20,000 ETB
   - ☐ Unemployed

6. To the best of your knowledge, are you in a good health?
   - ☐ Yes
   - ☐ No

Part 2: Traffic Accidents

7. I am worried about traffic accidents in the Mekelle City?
   - ☐ Strongly disagree
   - ☐ Disagree
   - ☐ Neither agree nor disagree
   - ☐ Agree
   - ☐ Strongly agree

8. Over the last one year, have you been in a traffic accidents?
   - ☐ YES
   - ☐ NO

9. If the answer is ‘yes’, go to question number 10 and 11; if the answer is ‘no’, go to question number 12.

10. Over the past one year, how many traffic accidents have you been involved in?
    - ☐ None
    - ☐ One
    - ☐ Two
    - ☐ Three
    - ☐ More than Three

11. What is the level of injury that you have been occurred?
    - ☐ fatality
    - ☐ slight injury
    - ☐ Serious injury
    - ☐ PDO

12. Do you think that weather is an important factors in traffic accidents?
    - ☐ Yes
    - ☐ No

13. When do you think most traffic accidents take place?
    - ☐ Morning
    - ☐ After noon
    - ☐ Evening

- ☐ Night

14. What day of the week do you think most traffic accidents take place

- ☐ Monday
- ☐ Tuesday
- ☐ Wednesday
- ☐ Thursday
- ☐ Friday
- ☐ Saturday
- ☐ Sunday

Part 3: Driver Behaviors

15. How many years have you been driving?

- ☐ 1-3 years
- ☐ 4-6 years
- ☐ 7-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ More than 20 years

16. Have you received a traffic ticket while you have been driving in the Mekelle city?

- ☐ Yes
- ☐ No

17. If your answer to question number 16 is "Yes", how many times?

- ☐ One-Two
- ☐ Three-four
- ☐ Above

18. Are you the owner of the vehicle you drive?

- ☐ Yes
- ☐ No

19. How old is the vehicle you mostly use?

- ☐ Up to 1 year old
- ☐ 1 to 3 years old
- ☐ 4 to 7 years old
- ☐ More than 7 years old

20. What is the main purpose of the vehicle?

- ☐ Commute to work
- ☐ Social purpose
- ☐ Commercial purpose
- ☐ Private business purpose

21. Do you wear a seat belt?

- ☐ Yes
- ☐ No

22. If your answer to question number 21 is YES, how often do you use your seat belt?

- ☐ Always
- ☐ Most of the Time
- ☐ Some Times

23. Do you use mobile phone while driving?

 Always Some times Never

24. Do you drink alcohol?

 Yes

 No

25. If your answer to question number 24 is “Yes”, how often do you drive after having Alcoholic drinks?

 Very often Seldom Occasionally

26. Which these unsafe forms of driving behavior do you encounter most often on the roads? Please tick all the appropriate boxes

 Speeding

 Tailgating

 Jumping and traffic light

 Not yielding right of way to pedestrian

 Not yielding right of way to other vehicles

 Not using indicators

 Drinking and driving

 Others [specify it]

27. Have you ever been subjected to aggressive behavior from other drivers?

 Yes No

Part 4: Traffic Safety

28. What role do you think Mekelle city traffic police should play to reduce pedestrian accidents?
29. What do you think about the way of traffic police enforcement of traffic laws in case of Mekelle city roads?

    □ Very good □ Poor

    □ Good □ Very poor

30. What do you think about the cost of punishments for traffic violations?

    □ Expensive □ Cheap

    □ Medium □ Unknown

Appendix C Interview Questions

JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

HIGHWAY ENGINEERING STREAM

Dear Traffic officers of Mekelle city Road

This Interview is designed to gather data on the evaluation of motorized vehicle crashes with pedestrian in case of Mekelle city road.to achieve this purpose your response to every questions given below has a crucial value. Therefore you are kindly requested to read the questions carefully and give accurate and real data which exists on the ground. The response that you replay will not be used for any other purpose other than this research work. I would like to thank you in advance for your time and cooperation

Manager's questions (traffic polices questions)

1. What are the causes of traffic accident in Mekelle city roads?
   1.1 Have you been involved in any of them?
2. How many traffic officers are working in the field of traffic law enforcement?
   2.1 How much experience do they have?
   2.2 How old are the police men?
   2.3 What type of training do they have?
3. Describe the traffic campaign carried out by Mekelle city traffic office?
   3.1 How can we create awareness programs?
   3.2 Have you been informed of the campaigns?

3.3 What is your opinion about these?

4. What are the difficulties facing when implementing traffic safety programs?

   4.1 How can we decrease the risk of traffic accidents?

5. What precaution should be taken to ensure the traffic safety in Mekelle city roads?

   5.1 What do you think of using traffic calming measure?

6. Do you have any recommendations about traffic accidents risk reduction?

   6.1 Which of these recommendations is the most important?

Appendix D: Questionnaire result of pedestrian and driver responses

Figure d-1 purpose of crossing the road from pedestrian perspective

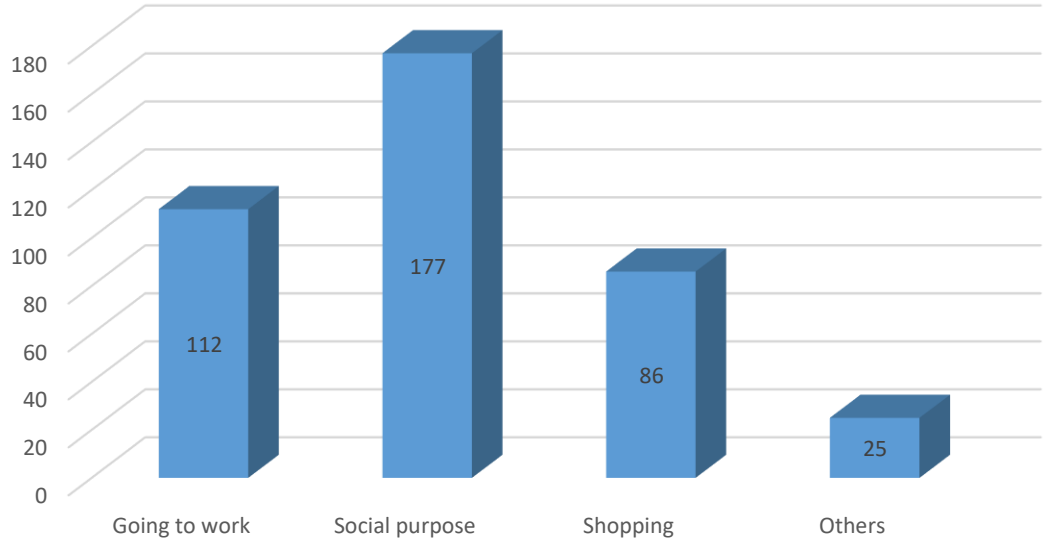


Figure d-2 do you use a mobile phone while crossing roads?

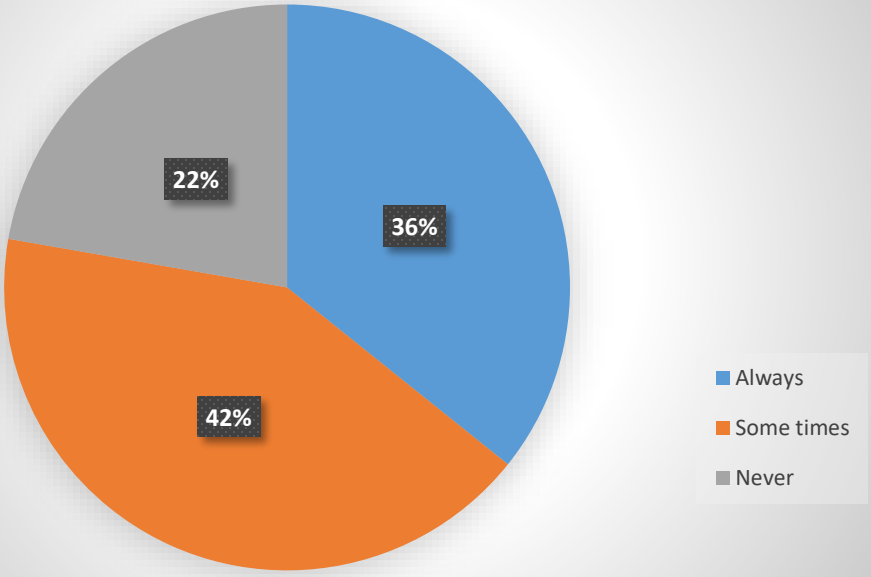


Figure d-3 do you drink alcohol?

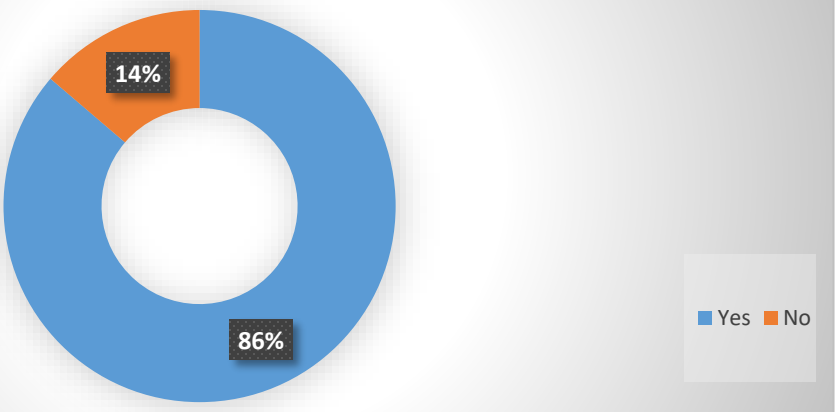
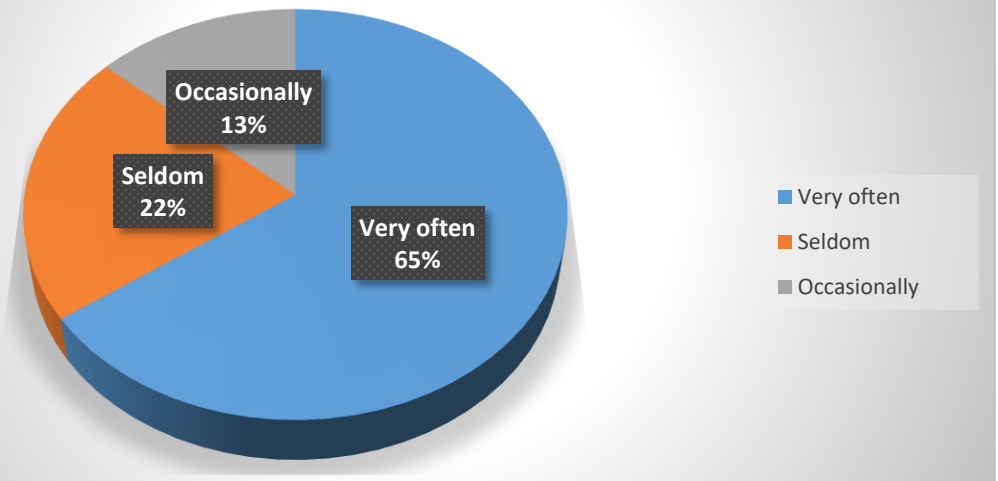


Figure d-4 how often do you use Alcohol drinks? from pedestrian perspective



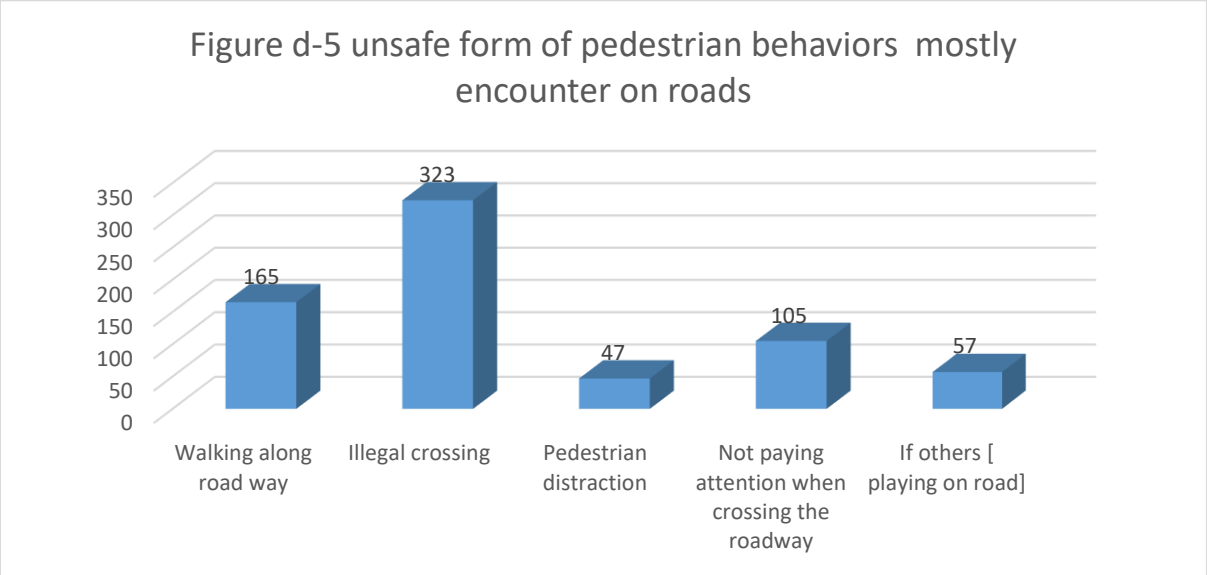


Figure d-5 unsafe form of pedestrian behaviors mostly encounter on roads
350
300
250
200
150
100
50
0
165
323
47
105
57
Walking along road way
Illegal crossing
Pedestrian distraction
Not paying attention when crossing the roadway
If others [playing on road]

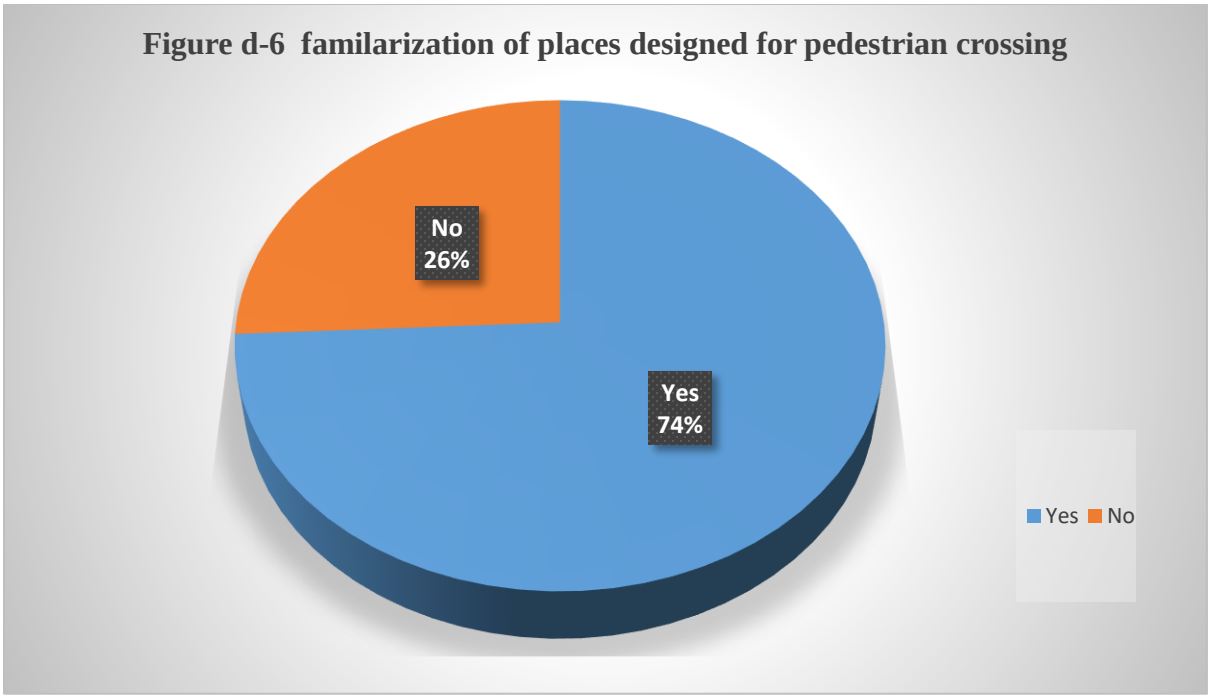


Figure d-6 familarization of places designed for pedestrian crossing
No 26%
Yes 74%
Yes
No

Figure d-7 traffic ticket received drivers' of mekelle city

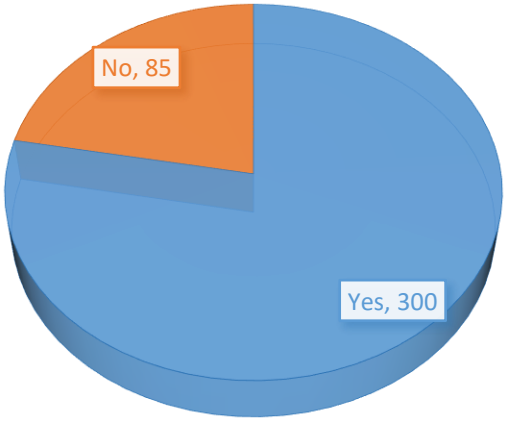


Figure d-8 commonly encountered unsafe forms of driver behaviour

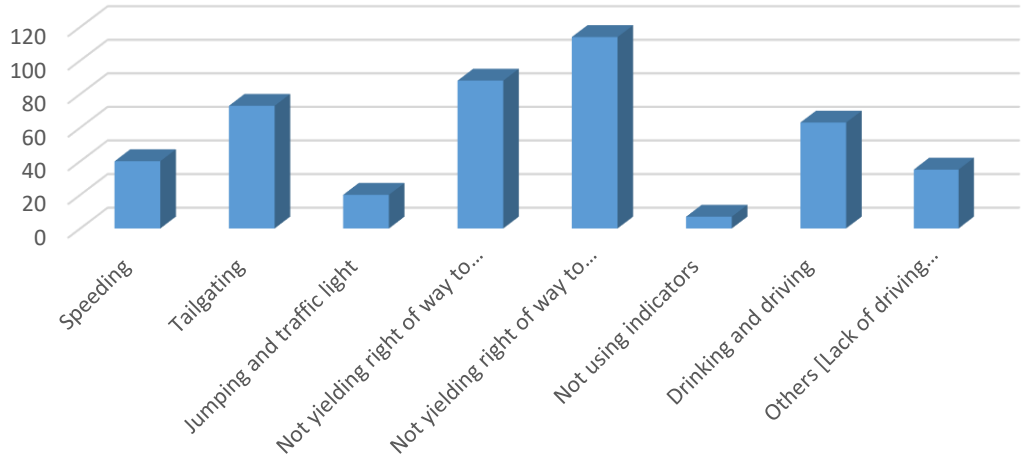


Figure d-9 degree of aggressiveness from drivers' perspective

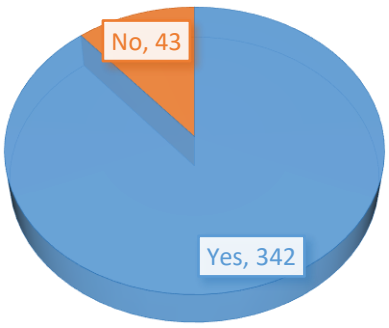


Figure d-10 way of traffic police inforcement in mekelle city road from driver perspective

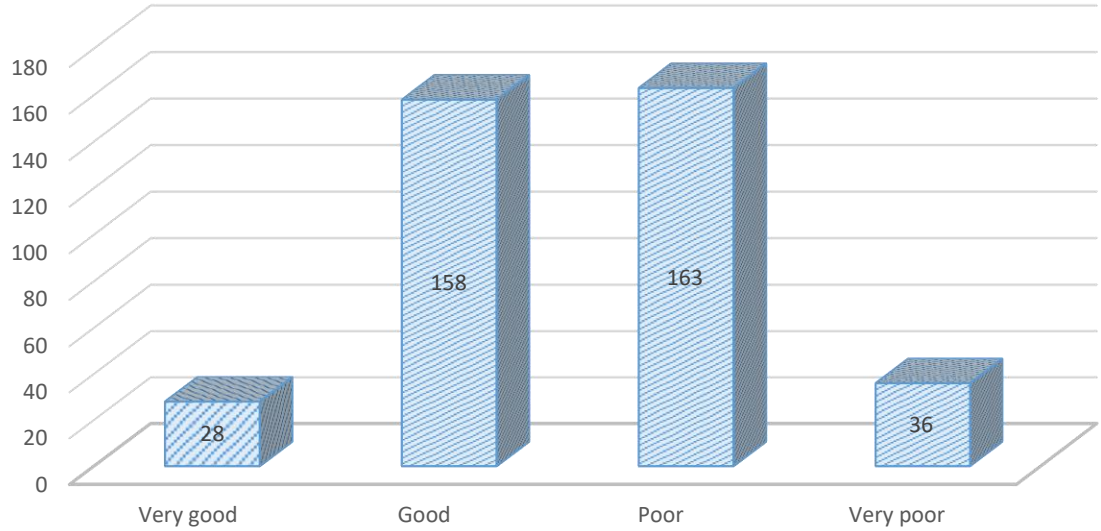


Figure d-11 purpose of the vehicle in meklle city from driver respondent

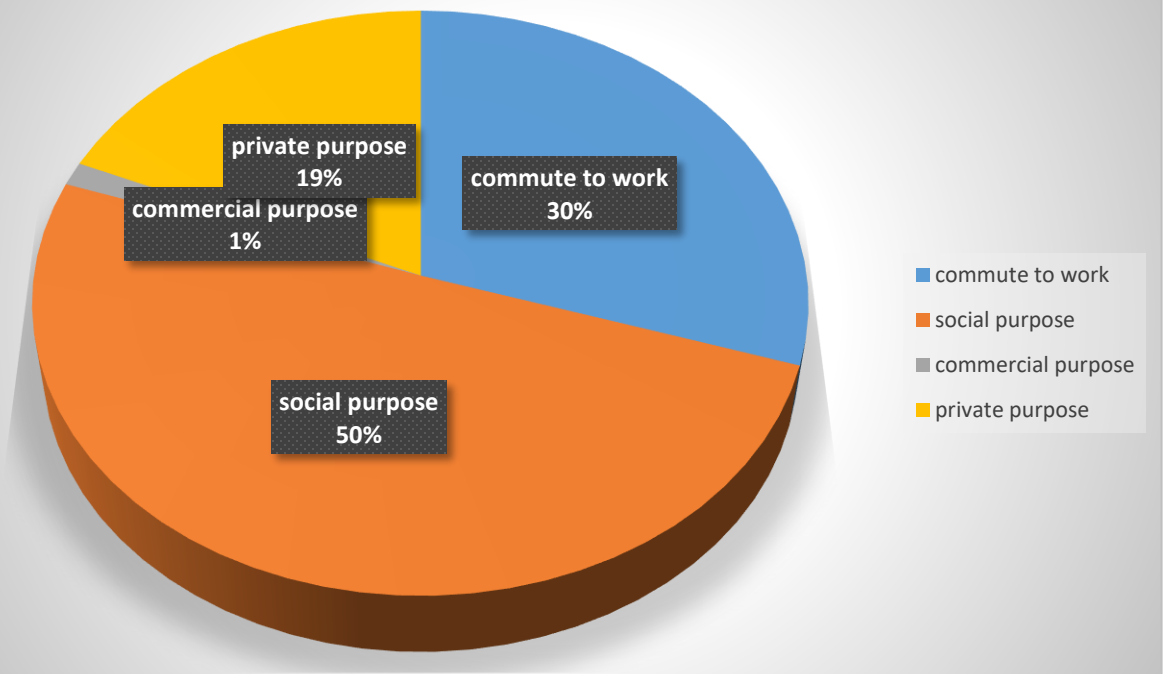


Figure d-12 distribution of seat belt user from drivers' respondent

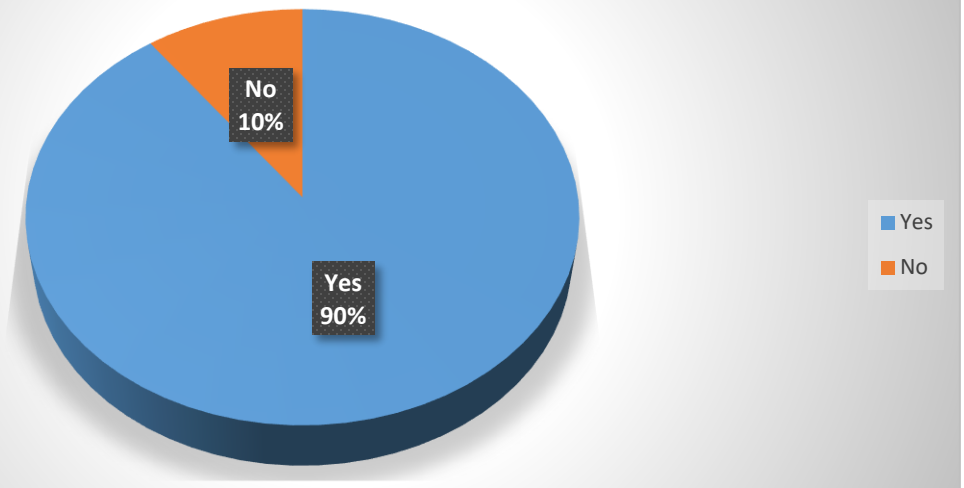
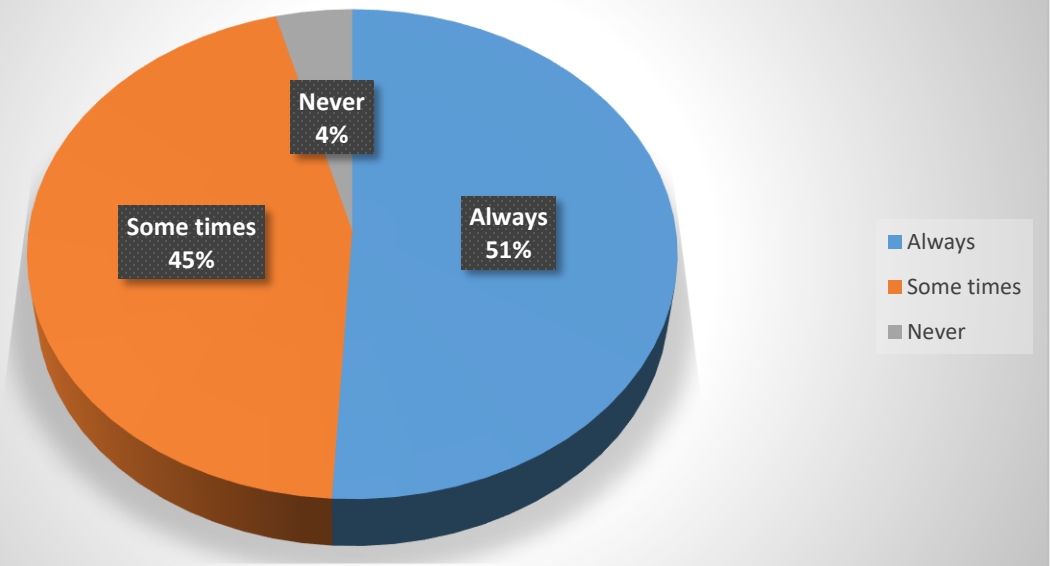


Figure d-13 use of mobile phone from driver perspective



APPENDIX –E: Photo taken during observation and previously.

Figure e-1 pedestrian fatality in mekelle city road (from TRPC 2010 E.C)

Figure e-2 illegal parking around hawelti semaetat.

Figure e-3. Seriously injured pedestrian accident in mekelle city (from MCTP 2010 E.C)

Figure e-4. Pedestrian walking along the roadway around kedamay weyane

Figure e-5. Illegal pedestrian crossing around kedamay weyane