



JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING

ENVIRONMENTAL ENGINEERING CHAIR

**RISK FACTORS FOR ROAD TRAFFIC ACCIDENTS ON THE ROAD FROM  
DURAME TO MUDULA, SNNPR, ETHIOPIA**

BY

MULUGETA AYANO AYMALO

ATHESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF JIMMA  
UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTERS OF SCIENCE IN ENVIRONMENTAL ENGINEERING

MARCH, 2018

JIMMA, ETHIOPIA

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MARCH, 2018

JIMMA, ETHIOPIA

**DECLARATION**

This thesis entitled as” ***RISK FACTORS FOR ROAD TRAFFIC ACCIDENTS ON THE ROAD FROM DURAME TO MUDULA, SNNPR, ETHIOPIA***” was my original work and has not been presented for a degree in this or any other universities.

**Mulugeta Ayano Aymalo**

Signature.....Date.....

This thesis entitled as” ***RISK FACTORS FOR ROAD TRAFFIC ACCIDENTS ON THE ROAD FROM DURAME TO MUDULA, SNNPR, ETHIOPIA***” has been submitted for examination with my approval as university supervisor.

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## ACKNOWLEDGEMENTS

First of all, I would like to thank the Almighty **God** for His mercy care and courage. I wish to express my sincere appreciation to my advisors **Prof., Dr.-Ing Esayas Alemayehu** and **Mr.Dida Aberra (PhD Candidate)** for their patience; guidance, encouragement and support in shaping the outlook of this thesis .They provided invaluable insights that have guided my thinking and understanding.

My thanks to JIT, JU and Ethiopian Roads Authority (ERA) for the financial support. Finally I would like to thanks my dear wife Hirut Bekele and all her family especiallyMs. Tesfanesh Bekele,Mr.Markos Fonkamo and his sincere wife Aster Bekele for greate suport and maneging my son Dlayehu Mulugeta as their own son. Special thanks also go to the following families and friends who were behind my study: My sons Bemblak Mulugeta and Dlayehu Mulugeta, my mother Galshawa Gadana, my brother Berhanu Ayano, my sister Mesaynesh Ayano and all other brothers, my friends Mr. Abebe Mendoye, Mr. Berhanu Yoseph, Mr. Abeta Denebo, Mr. Samuel Lambebo.

## ABSTRACT

*Road traffic accident is amongst the leading causes for the loss of lives and property damage in Ethiopia. The peoples, who are walking, perform daily activities, playing on the sides of the streets or set out on long trips, have been killed and injured. This intern exerts pressure on the economic developments of the nation. The same scenario has been reported on site under this study. Objective of the study is to investing the risk factors for the road traffic accidents in the Kambata Tambaro zone, on the road from Durame to Mudula. Cross-sectional type of the study was employed in order to investigate road traffic fatalities caused for the last five years (from September 2012 to September 20170). Necessary data were obtained from the Traffic police office, Health institutions, road transportation office, and residents living on the roadside. Survey methods such as focal group discussions, interview and questionnaires were employed besides observations and review of documents. The results were presented in the form of line graphs, tables, pie charts and figures. The finding of this study shows that the road traffic casualties have been temporary increasing from time to time, motorized vehicle more involved in traffic accident than the non motorized vehicle, loss of human life 16.7% injured (serious 31.0% slight 52.3%), property damage estimated cost 6.1 million due to the following factors: drivers' maturity, skill and experience, vehicles mechanical problem, weather condition, road type and condition, absence of speed limitation signs and bumps at the black spot increases RTAs, low awareness of pedestrians using the road, lack of pedestrians road crossing facility and fence at black spots led to traffic crash. However, the accidents were as a result of serious combination of a number of factors and it is usually difficult to single out one main cause. The interaction of human road users, the motor vehicles and the prevailing physical environmental conditions if not agreeably managed can lead to road traffic accidents which in effect contribute to road safety problems and challenges. Hence, it is recommended that, create road traffic awareness for road users, Speed limits should be restricted and place appropriate road signs Special attention should be given to the RTA black spots already identified, the stakeholders should significantly participate in road safety management.*

**Keywords:** Road traffic accidents; Risk factors; Kambata-Tambaro; Durame to Mudula Ethiopia

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## **ACRONYMS**

CSA	Census Statistically Agency
DALY	Disability Adjusted Life Years
D-M	Durame to Mudula
ERA	Ethiopia Roads Authority
ETB	Ethiopian Birr
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GNP	Gross National Product
IRTAD	International Road Traffic Accident Database
KTZ	Kambata Tambaro Zone
QA	Quality Assurance
RFs	Risk Factors
RSDP	Road Safty Development Program
RT	Road Traffic
RTABS	Road Traffic Accidents Black Spots
RTAs	Road Traffic Accidents
RTF	Road Traffic Fetality
RTI	Road Traffic Injure
SNNPR	Southren Nations, Nationality and People of Region
SPSS	Statistical Package for the Social Sciences
USA	United States of America
WHO	World Health Organization

# 1. INTRODUCTION

## 1.1 Background of the Study

People for centuries and millennium have been moving from place to place to carry out their day to-day activities. To facilitate their movement, they use different ways of transportation including land (highway and rail), air (domestic and international), water (inland and ocean). It is an accepted fact that of all modes of transportation, road transport is easily accessible and closes to people.

Road transportation provides benefits both to nations and to individuals by facilitating the movement of goods and people (WHO 2011 and Wade *et al.*, 2011). It enables people to have increased access to jobs, markets, education, recreation and health care. In Africa, over 80% of goods and people are transported by roads and in Ethiopia road transport accounts for over 90% of goods and passenger movements in the country every year. Therefore, road transportation has a direct connection with the day-to-day activities of people, especially in large cities and towns where the distance is too far to cover on foot or by bicycle within a reasonable time. However, the increase in road transportation has placed a considerable burden on the people's lives (WHO, 2009).

Motor vehicle accidents (MVA) both serious and fatal are a common problem. High speeds, road conditions, general disregard by other motorists and pedestrians for right of ways, as well as uncontrolled livestock wandering into the roadway are contributing causes for RTAs.

The road traffic crashes are the leading causes of death and disablement of people under 44 years old next to HIV/AIDS and it losses the total economy (WHO 2009). In Each year more than two thousand people die and ten thousand people are injured because of road traffic accidents (Ethiopian Federal Police 2008/09-2010/11). According to the report on Road Traffic Injury Prevention (Peden et al., 2004), traffic accidents account for about 3000 daily fatalities worldwide. Statistical projections show that during the period between 2000 and 2020, fatalities related to traffic accidents will decrease with about 30% in high income countries. The opposite pattern is expected in developing countries, where traffic accidents are expected to increase at a fast rate in the years to come. World Health Organization (WHO) strategy of 2009 reports that currently road traffic injuries are the leading cause of deaths and

injuries. The 10<sup>th</sup> leading cause of all deaths and 9<sup>th</sup> leading contributor to the burden of disease worldwide based on disability adjusted life years (DALY). The numbers of deaths resulting from RTAs have been projected to reach 8.4 million in the year 2020.

The study site shows that the accident rate is increasing from time to time as the population of the traffic intensity from Ethiopian Road Authority shows. Especially the traffic accident is very high in between the roads from Durame to Mudula because of no alternative roads that joined the zone of districts with regional town. Most of the accidents occurred were found in the analysis part is due to the drivers speed and carelessness. In most survey studies drivers have the custom of drinking alcohol, smoking, and chewing chat those leads them to committee accident unintentionally.

The problem of road network design for the roads, the vehicles failure, the speed of the drivers and other factors on the SNNPR to search the mechanisms those could break the problem of the accidents of the roads traffic. But the two mentioned difficulty which are the roads network design and the vehicle failure may not the first issue in the current situation in these roads. Therefore identifying these evils only is not enough unless and otherwise we find the rapid mechanism that solves this high rate of growth of roads accident in our country, Ethiopia.

## **1.2 Statement of the problem**

Although road traffic accidents are a major global public health problem, most of it occurs in low- and middle-income countries including Ethiopia. Pedestrians and passengers of commercial vehicles are the most vulnerable in Ethiopia, whereas in high income countries crashes involve primarily privately owned vehicles with the driver being the main car occupant injured or killed. In the United States of America, for instance, 60% of the fatalities account to car drivers, while in Ethiopia, 5% account to drivers. This implies that in one crash the number of people killed or injured in Ethiopia is about 30 times higher than in the US World Report on Road Traffic Injury Prevention (2007).

Poor road network; absence of knowledge on road traffic safety; mixed traffic flow system; poor legislation and failure of enforcement; poor conditions of vehicles; poor emergency medical services; and absence of traffic accident compulsory insurance law are key determinants of the problem.

Road traffic accidents are a huge public health and development problem in Ethiopia. Its current situation requires a high level political commitment, immediate decisions and actions in order to curb the growing problem. Otherwise, it will get worse from day-to-day as motorization and population increase rapidly. The main problems in Ethiopia, specifically, on the way from Durame to Mudula road cross areas as the police commissions of the country reported some of the biggest problems are: death of life due to carelessness of drivers, over speeding, passengers, pedestrians and crushing of other vehicles due to improper rule accepting and others problems.

The challenges of road traffic injury in different parts of Ethiopia are one of the most critical problems of Ethiopia. The most problems occur on the roads from Durame to Mudula parts as the drivers do not care for the life and properties while driving at high speed. On this ways many animals, human being can cross the roads to complete their daily activities. But the road had caused many dangers to the people and the animals as well as the properties of the region (SNNPR) 223, 230, 265, 250 deaths, injuries, slightly injuries and property damage respectively occurred per a year by environmental, human and vehicle related factors, (SNNPR Statistics Office, 2011/2012).

However, the increase in road transportation has placed a considerable burden on the people's lives (WHO, 2009). The fatality of road traffic deaths and injuries may the major one. Each year more than two thousand people die and ten thousand people have been injured because of road traffic accidents (Ethiopian Federal Police, 2008/09-2010/11). The road traffic crashes are the leading causes of death and disablement of people under 44 years next to HIV/AIDS (WHO, 2009). Road traffic crash results from a combination of factors related to the components of the system including environmental, human and vehicles related components.

Some factors contribute to the occurrence of a collision and are therefore part of crash causation. Other factors aggravate the effects of the collision and thus contribute to severity. Some factors may not appear to be directly related to road traffic injuries. Some causes are immediate, but they may be underpinned by medium-term and long-term structural causes.

As road transportation has many economical and social uses, in many cities today it is also generating significant social and economic costs. These costs arise from the external effects of traffic system, particularly accidents, overcrowding, consumption of public space, air pollution, noise, and disruption of social and economic interaction (A. Persson , 2008). These

externalities of traffic are especially pertinent in urban areas because here spatial densities are high and the infrastructure networks are most intensively used. Driving throughout Ethiopia is difficult and possesses a serious safety concern. For this alarming problem there is no any research done on the road from Durame to Mudula that could help to identifying the major causes of the road traffic accident on the road from Durame to Mudula.

The interest of this study under its objective seeks to fill the gap of knowledge which exists by identifying major factors associating to the cause of road traffic accidents so as the findings may be useful for further implementation of the road safety measures or a baseline of similar studies. Therefore, identifying the major factors that contribute to road traffic crashes is important in identifying interventions that can reduce the risks associated with those factors (Lisa, David *et al.*, 2005).

### **1.3. Research Questions**

In order to achieve the purpose of the research, the following guiding questions or lines of questions are devised.

- 1) Which category of vehicles crash Causalities seriously happened on the road from Durame to Mudula?
- 2) What are the impacts of the road traffic accidents on the socio-economic?
- 3) How the pedestrians and drivers using the road?
- 4) What are the major factors associated to the road traffic accidents on the road from Durame to Mudula?
- 5) What kinds of safety measures that taken by local authorities to prevent traffic accident on the road from Durame to Mudula?

### **1.4. Objectives of the study**

#### **A. General objective**

The general objective of the study is to investigate the risk factors for the road traffic accidents on the road from Durame to Mudula towns from Sept 2012-Sept 2017 G.C.

## **B. Specific objectives**

To- describe general characteristics of motorized and non motorized vehicles related Causalities happened on the road from Durame to Mudula

To- analyze the socio-economic impact of road traffic accident under study area

To- describe the awareness of pedestrians and drivers using the roads

To- investigate the major factors associated with for the road traffic accidents on the road from Durame to Mudula

To -assess road safety measures taken by local authorities to prevent traffic accident on the road from Durame to Mudula

### **1.5. Significance of the study**

This study was investigated the risk factors for road traffic accident in KTZ in the SNNPR, Ethiopia, emphasized is given to studying and measuring RTA causalities of pedestrians, drivers, passengers and others. In addition, factors related to the road environment, condition of vehicles and police enforcement was identified. Therefore, the significance of the study can be stated as follows

Even though the study is limited to a single road from Durame to Mudula in KTZ in the country, the results has been obtained from this research could be helpful in launching initiations in studying the complex problems of rural and urban road transport in general and RTA in particular.

The findings obtained from the study would helpful to gain information and knowledge about the patterns of road accidents in the study area, which in turn could help to develop counter measures that could reduce the number and severity of accidents.

It is important for the police for law enforcement and distribution of man power for surveillance.

It is important to the government, Ethiopian Transport Authority and Ethiopian Road Authorities to determine the need for road improvements, vehicle inspections and to initiate programs for education



The study will be used as a bench mark information to those scholars who want to conduct future detailed studies on RTA, road safety and other related issues.

### **1.6. Limitation of the Study**

Some of the police traffic offices were not willing to give the available data giving appointment and on the appointment day not responding for the appointment by putting reasons such as one of the member who is responsible went for work to the field survey. Therefore, absence of recent information and limited cooperation of the government offices such as Traffic Police Commission, were the main problems that the researcher had to face during the survey and data collection phase. The recording system of road traffic accidents at the police station in different levels were manually maintained hence it consumed time in sorting out information and some of the information was missing especially those pertaining to referred cases. Accident reports from different sources lack significant level of consistency and accuracy and the figures obtained are not enough.

In nutshell, gathering information especially through observation is not feasible; this could be taken as the limitation of this research too. To combat these constrains, the study used multiple methods to explore information for a more comprehensive picture of risk factors and road traffic accidents.

### **1.7. Delimitations/ Scope of the Study**

Among the factors that affect the precision of any study, the availability and reliability of the information employs is very important. This study mainly uses the information collected from KTZ Traffic Police, public health institutions, Road Traffic Accident Control and Inspection Office that is available for last 5 years. The study also was attempted to observe the causalities of motorize and non motorized vehicles category of road traffic accident, risk factors and assesses the safety measures taken by local authorities of road traffic accident in KT zone. Therefore, the study is restricted to investigate the risk factors of road traffic accident with exclusion of governance factors in KT zone along that the road transportation from Durame-Mudula in length of 60km. The research was not included other districts in KTzone in order to their frequently using of the road from D-M and in the other area.

## 2. LITERATURE REVIEW

### 2.1. Definition

Transportation could be divided into three main areas, the Land transportation, the water transportation and the aerial transportation. The most focus area of this thesis is on the transportation of the lands. The transportation of land to mean that it focuses on the area where there is a strong traffic intensity of the flows. As transportation is vital for the socio-economic development of one country, it needs a great emphasis on its proper management. But behind the impotency of the transportation there is high severity of road traffic accidents in the world currently as the number of motor vehicle on land increases from time to time.

Road Traffic Accident is any vehicle accident occurring in a public highway. It includes collision between vehicles and animals, vehicles and pedestrians or vehicles and stuck obstacles. Single vehicle accidents that involve a single vehicle, which means without other road user, are also enclosed (Safecarguide, 2004). In a similar manner (Ajit and Ripunjy, 2004), have mentioned that Accident is an occasion, occurring abruptly, unpredictably and inadvertently under unforeseen circumstances. (Seemingly, 2007) have also outlined that an accident is a rare, random, multi-factor event always preceded by a situation in which one or more road users have failed to cope with the road environment.

Far from the above arguments, (Alister and Simon, 2011) stated that accident involves personal injury occurring on the public highway including footways involving at least one road vehicle or a vehicle in collision with a pedestrian and which becomes known to the police within 30 days. In this regard, RTA can be defined as an accident that occurred on a way or street open to public traffic; resulted in one or more persons being killed or wounded, and at least one stirring vehicle was intricate.

Therefore, RTA is a smash between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or obstacles. The type of transport which exhibits accident that drastically affects the wellbeing of the people and economy of the nations is the one which involves the movement of people and or goods from one place to the other. Several RTA incidences occur throughout the world at every fraction of times in a day.

## **2.2. Global and Regional Trends of Road Traffic Accidents**

### **2.2.1 Globally Trends of Road Traffic Accidents**

RTA crashes which were ranked at 9th leading cause of burden of disease by 2002 could rank at the 3rd cause of burden of disease by 2020, if the current trend in motorization continues increasing in the same or similar manner for the coming decade (Penda *et al.*, 2004). An estimated 1.2 million people are killed in road crash each year, and as 50 million are injured, occupying 30 percent to 70 percent of orthopedic beds in developing countries hospitals. And if the present trends continue, road traffic injuries are predicted to be the third leading contributor to the global burden of disease and injury by 2020. Road traffic accident injuries are predictable and preventable, but good data are important to understand the ways in which road safety interventions and technology can be successful transferred from developed nations where they have proven effective.

Awareness of the consequences of road traffic injuries is lagging among policy makers and the general public. What needed is in corporation of comprehensive road safety programs in to national planning in developing countries. In developed countries, road traffic death rates have decreased since the 1960s because of successful interventions such as seat belt safety laws, enforcement of speed limits, warnings about the dangers of mixing alcohol consumption with driving, and safer design and use of roads and vehicles. For example, road traffic fatalities declined by 27 percent in the United States and by 63 percent in Canada from 1975 to 1988. But traffic fatalities increased in developing countries during the same period by 44 percent in Malaysia and 243 percent in china. More than one half of all road traffic deaths globally occur among people ages 15-44 their most productive age group accounts for 60 percent of all daily lost because of road traffic accidents (Penda *et al.*, 2004).

### **2.2.2. Africa Trends of Road Traffic Accidents**

Road traffic accidents kill more people around the world than malaria, and are the leading cause of death for young and youth aged 5 to 29 especially in developing countries (WHO, 2004). The Global Status Report Road Safety (2013) has found that the risk of dying as a

result of road traffic injury is highest in African region. The African continent recorded an average of 24.1 out of 100,000 populations dying as a result of road crash in a year.

The severity of road traffic crashes is likely to be much greater in Africa than any were else, because many vulnerable road users are involved, poor transport conditions such as lack of seat belts, mobile phoning while driving, and hazardous vehicle environments. The tendency of road traffic accident to cluster or concentrate at spots on road sections usually known as “black spots” or “accident spots” is very common on roads. These spots can be considered as source of spatial information on road accidents. Identification of such spots helps the enforcement arm of the government, in conjunction with the implementing agencies of the government to put remedial measures to alleviate the occurrences of road traffic accidents. However, more precise information needs to improve the road facility so that driving can be dining safety at these spots (Sauna *et al.*, 2006).

The poor reporting system also masked the magnitude of the problem in Africa. The lack of pre-hospital and hospital emergency care after accidents makes the outcome of car accidents in Africa road deaths (48.4 per- 100,000 people), Egypt (41.6), Libya (40.5), Ethiopia (35.0), Sudan (34.7), Guinea-Bissau (34.4), South Africa (33.2) (WHO 2009). Road traffic accidents in Africa are expected to rapidly increase over the next four decades, becoming a major public health challenge across the continent. Currently, road traffic accident worldwide is estimated to claim the lives of 1.4 million people per year and injure an additional 20-50 million. By 2050 the international futures for casting model anticipates that global traffic deaths will surpass 3 million people per year.

This forecast shows that Africa will be particularly hard hit and will account for over 1 million of these deaths, or 35 percent of the global total. To put this in perspective, by 2050, traffic accidents in Africa will kill almost the same number of people annually as now die from HIV/AIDS in east and Southern Africa combined. And, for every 20 Africans who die in 2050, one will be killed in a traffic accident. However, despite the significant numbers of Africans being injured or killed in this way, road traffic accidents do not receive the same coverage as other public health issues such as HIV/AIDS, tuberculosis and malaria. African countries experience a dramatic increase in the number of vehicles on the road.

Very often, such increases in road traffic accident are not matched by adequate improvements in infrastructure and road safety legislation. This results in lag between private expenditure on vehicles and the public expenditure necessary to accommodate increased motorization African (Futures Brief, 2012).

Exposure is any variable which relates to any activities which influence or expose road users to an increased risk of involvement in a crash. In other words, any activities which expose road users (non-human or human) to a crash risk are exposure variables. Exposure can describe the range or volume of activities which might increase the likelihood of a crash happening. In crashes involving pedestrians, exposure is expressed in terms of the specific amount of time a pedestrian spends or pedestrian volume, or number of crossing pedestrians etc. in contact with specific volume motorized traffic to travel a specified number of kilometres. The details of measurement of exposure will be discussed in the literature review section (Chapter 3).

Risk may be defined as by three elements (Austroads, 2009): 32

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

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

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

Risk may be given as (Austroads, 2009):

Risk = f (Exposure × Probability × Outcome) (1)

A reduction of risk can be achieved through reducing the exposure of people or number of vehicles. Hakkert & Braimaister (2002) defined risk in terms of road safety by quantifying the level of road safety relative to the amount of exposure to road traffic crashes. In road traffic safety, risk is the quantifiable probability of a crash occurring (Hauer, 1982).

Consequence is defined as an outcome arising from an activity, for instance for a road

### **2.2.3 Ethiopia Trends of Road Traffic Accidents**

Ethiopia is one of the worst countries in the world where road transportation kills and injuries are in large number of road users every year. In Ethiopia, traffic police reports are the official sources of data for road-related incidents. In Ethiopia, the rate of road traffic accidents is very

high; because of road transport is the major transportation mechanism along with poor road infrastructure, poor enforcement of traffic laws and other factors (WHO 2009).

In Ethiopia each year more than two thousand people die and ten thousand people injured in road traffic clashes (Ethiopian Federal Police Report, 2010/2011). Road traffic accident, the 9<sup>th</sup> most important killer globally, ranked 13<sup>th</sup> in Ethiopia (See Table1). According to a study of the Swedish medical university, fatalities related to traffic accident in the country have a proportion of 70 to 100 for every 10,000 vehicles, which means in every 5 accidents kill 1 person on average (WHO Report, 2012). Like other low income countries, the traffic controlling system is not that much supported by modern technological instruments in Ethiopia. Currently, the country is almost using relatively simple and outdated controlling methods which had been applicable before several decades. It seems that more sophisticated optimization methods are failed for networks.

According to studies most traffic accidents are the result of speed, lack of road signs and driver's impairment of judgment. Many say that speed, drunk driving and lack of enforcement are said to be the causes of the major failures of the traffic system in Ethiopia. Within a year, over 2,000 people die while over 8,000 are vulnerable to light and heavy injuries are properties worth over 500 million birr get damaged in the country because of road traffic accidents. Most importantly, Oromia regional state is one of the traffic flow is usually high because of its location obviously vehicles from the 8 states and Dire Dawa City Administration pass through this region to come to the capital city of Addis Ababa ( Samuel Taye, 2012).

Ethiopians are more likely to make use of commercial vehicles, minibuses, buses, three tire vehicles (Bajaj) to support mobility needs. Commercial vehicles have a high involvement in crashes, although there is need for exposure data to determine whether they are over-represented. It is also highly likely that these vehicles travel more kilometers per annum which contributes to both a high number of crashes and high rate. The observed trends in Ethiopia road crashes provide guidance on their current road safety problems and the challenges, and point to possible areas of counter measures, policies, and program will need to

represent low-cost solutions, green economic constraints within the country (Australian Road Safety Research, 201).

Most of the road deaths in developing countries involve vulnerable road users such as pedestrians and cyclists. In Ethiopia, pedestrian injuries account for 84% of all road traffic fatalities compared with 32% in Britain and 15% in the United States of America. In contrast, in the heavily motorized countries, drivers and passengers account for the majority of road deaths involving children (Bunn, Collier *et al*, 2003). Similarly, (Mekonnen, 2007) quoted that, RTA in Ethiopia is a serious problem. The RTA death rate is estimated to be 130 per 10,000 vehicles. Of the total victims of RTA who lost their lives, over half are pedestrians, out of whom 30% are children.

In Ethiopia, one among five people injured dies due to RTA. Based on a five-year average records, of the personal injury accidents, 81% are caused due to drivers error, 5% due to vehicle defect, 4% due to pedestrian error, 1% due to road defects and 9% due to other problems in Ethiopia. Studies further shows that the professional drivers are involved in 88% of the fatal accidents. Special purpose vehicles and motor bicycles cause 8% of such accidents. On the other hand, automobile drivers have very good safety records with only 4% of the fatal accidents, which is equivalent to a rate of 12 fatal accidents per 10,000 vehicles. According to the National Road Safety Coordination Office of Ethiopia, the main underlying reasons for the frequent RTA occurrences and severe impacts of RTA in Ethiopia are Improper behavior or lower skill of drivers, Poor vehicle technical conditions, Animals and carts using the highways, Pedestrians not taking proper precautions, Poor traffic law enforcement, Poor emergency medical services and Insufficient safety considerations given in road development.

In addition to this (Segni, 2007) added another responsible reasons of RTA occurrences in Ethiopia like driving without respecting right-hand rule, failure to give way for vehicles and pedestrians, overtaking in snaky horizontal curves, following too close to the vehicle in front, improper turning and speeding. These causes contribute to 73% of the total accident in the year 2004/05 in Ethiopia but the other possible reasons accounted for less than 27%. It would be impossible to attach a value to each case of human sacrifice and anguish, add up the values and result a figure that captures the national social cost of road crashes and wounds.

Conversely, the economic expenses of road traffic accidents are, obviously, a heavy burden for the national economy.

In addition to this UN (2009) added that the economic costs of road crashes and injuries are estimated to be 1% of Gross Domestic Product (GDP) in low-income countries such as Ethiopia. In another stance, Mohammed (2011) Put his findings of the cost of RTA in Ethiopia on the basis of the Ethiopia's data and economic figure of 2009/10, as the cost of damage only, slight, serious and fatal road traffic crashes were 327.12 million, 204.65 million, 619.38 million, and 716.02 million ETB respectively. This represents the total national economic loss resulting from road accidents to be estimated as ETB 1.867 Billion which is equivalent to 145.07 million United States Dollar (USD) considering the exchange rate of the same year, or approximately 0.49% of the GDP of the country in the same year. Another study conducted by Ethiopian Roads Authority stated that, RTA costs Ethiopian economy between 350-430 million Birr annually, and loses almost 1860 lives each year with another 8,690 people reported injured (CSA, 2007).

As stated by (UN, 2009), similar to most countries of the world, police is responsible for traffic accident investigation and reporting in Ethiopia. According to the Ethiopian transport regulation (*Negarit Gazeta*, which is still in use with amendments), a driver of a vehicle involved in a road accident shall notify the nearest police station immediately if the accident involves personal injury and within twenty-four hours if it involves property damage only. According to the regulation, all accidents are reportable. In practice, however, the police are notified only when the accident involves serious injury, agreement cannot be reached between parties involved or if police accident report is required for insurance. Because of this, the reporting of nonfatal accidents is uncertain. Thus, the under-reporting of road accidents in Ethiopia is expected to be quite considerable.

Normally, in response to notification of an accident, a traffic police investigator attends the scene of the accident. Based on the information obtained from observations, the parties involved in the accident, and other evidences, police prepares a factual report and makes the sketch of the site on a plain sheet of paper. The police, who are inadequately equipped and trained, understandably, primarily see their role to take action if the law has been broken and give much attention to get evidence for prosecution rather than to investigate the many factors



involved in the accident. On return from the accident site, an account of the accident is recorded in a daily report book at a local police station or traffic office. The accident recordings in the daily recording book form the basis of the Ethiopian road accident statistics. Periodic summaries of aggregate road accident records are made and sent to the immediate higher police department. They finally reach the Federal Police where the national road accident statistics are compiled.

The content of the road accident reporting, as it exists now, misses relevant details of an accident report required for any road safety improvement works. The reporting form, in the daily report book, is not designed to include details of each vehicle and road user involved in an accident. The report, further, does not contain details of the road section and precise location of an accident. The location of an accident is usually reported broadly by “*Kebelle and Wereda*” or the name of the surroundings. Besides, because a plain paper is used on the spot, the investigating policeman is unlikely to remember the required accident details and as a result the form available at the local traffic police office is never completely filled.

The information recorded could generally be adequate for the police work, but it is of limited use to other bodies requiring information for identifying the causes and appropriate remedial measures. It is primarily inadequate in determining the location of accidents and the factors involved. Moreover, accident reporting lacks a significant level of consistency. Terminology of accident details does not have a uniform definition even among the staff members at a police station. There also exists a significant variation in accident reporting in different regional states.

In addition to the indicated limitations of accident reporting, there is no established system of computerized accident data bank to store detailed information on individual road traffic accidents occurring in the country. This is another handicap for the efficient management of the reported traffic accident data. Moreover, there is no system of periodic road traffic accident analysis and dissemination system to give information on road traffic accident trends, specific accident problems so that stakeholders are aware and aim to improve the situation. Almost many of the author’s research source of objective, methodology and the results were similar to the study area and also as part of rationality for the study and may also show gaps of validity that makes differ from those authors could show the accident areas.

### **2.3. The Four Major causes for the Road Transport System Physical Components and their Contribution to Improper Management of Road Traffic**

The road transport system has four main physical components. These are the road user /human factors/, the vehicle factor, the road factor and environmental factors. The road user includes the driver, animals, passenger, pedestrian and bicyclist. The vehicle factor also can be further classified as motorized and non-motorized. (Hickford and Hall, 2004:87).

Some factors contribute to the occurrence of a collision and are therefore part of crash causation. Other factors aggravate the effects of the collision and thus contribute to severity. Some factors may not appear to be directly related to road traffic injuries. Some causes are immediate, but they may be underpinned by medium-term and long-term structural causes. Identifying the risk factors that contribute to road traffic crashes is important in identifying interventions that can reduce the risks associated with those factors (Lisa, David *et al*, 2005).

#### **2.3.1 Environmental related factors**

Moen *et al.*, 2005 and Lankarani *et al.*, 2014, argue that environmental parameters are important contributory factors to RTAs. For example, the physical environment, various climatic threats and geohazards like heat, fog, high winds, snow, rain, ice, flooding, tomadoes hurricanes, and avalanches have effects on roads hence on traffic accidents. The weather (e.g. heavy tropical rain) also threatens surface transport and impacts road way safety, mobility. It affects road safety through increased crash risk as well as exposure to weather related hazards. Weather impacts roadway mobility by increasing travel time delay, reducing traffic volumes and speeds and reducing road way capacity. Weather and road conditions in terms of road qualities therefore have a role in the causes of traffic accidents (Komba, 2006). Road environments have impacts on occurrences of road traffic accidents. In developed countries, there are continuous efforts to meet the safety standards of roads through safety audit during the planning, designing, and operation stage. However, (Berhanu, 2000) reports that in Ethiopia, the police have limited road and traffic engineering skill in general and thus they underestimate the contribution of roads and environments to traffic accidents and especially they lack trainings on subject area. Road Related Causes of Road Traffic Accident Since the entire process of road transport is conducted on roads, the quality, size and engineering characteristics of the roads will have considerable contribution to the increase or decrease of

RTA risks. (WHO, 2004) supports this idea by saying that, the road network has an effect on crash risk because it determines how road users perceive their environment and drivers instructions for road users, through signs and traffic panels, on what they should be doing. Many traffic management and road safety engineering measures work through their influence on human behavior. Some variables regarding the road related causes of RTA are discussed as to below.

### **2.3.1.1 Roadway characteristics**

The roadway's conditions like the quality of pavements, shoulders, traffic control devices and intersections, can be a factor in a crash. Fewer traffic control devices and complex intersections with excessive signage lead to confusion. Highways must be designed for adequate sight distance for designed speed for the drivers to have sufficient perception – reaction time. The Traffic signs and signals should provide enough time for decision sight distance when the signal changes from green to red. The super-elevation on highways and especially ramps should be carefully laid with correct radius and appropriate transition zones for the vehicle to negotiate curves safely. Another important factor is the frictional force between the pavement and tires. Road factors include, but are not limited to lighting, view obstructions, signals, surface character, dimension and shielding devices. All factors are subject to adjustments by outside influences such as road surface that become slippery from rainfall. Modifying each of the listed road factors are weather, lighting, roadside devices, activities, surface deposits, damage, deterioration and age (Lisa, David *et al.*, 2005).

### **2.3.1.2 Road Lights**

Road lights are intended to provide enough lighting for drivers to travel with comfort and safety during night periods or under low visibility conditions. This solution is commonly applied where there is the possibility of conflicts between vehicles and pedestrians or cyclists. In rural roads, the implementation of lighting on unlit roads may lead to a 64 per cent reduction in fatal accidents and 20 to 50 per cent of total accident reduction. In the other way round the absence of road lights will add up to the RTA occurrences by 20 to 50% (Sandra 2000).

### **2.3.2 Human Related Causes of Road Traffic Accident**

Human factors are without doubt the most complex and difficult to separate, as they are virtually all very momentary in nature. What existed at the time of the crash may not exist some instants later. Consider sensory capabilities, knowledge, decision making, attitude, attentiveness, fitness, health, driving skill, age, weight, strength and freedom of movement. of these, the emotional dynamics are the greatest variable attributes and the most difficult to ascertain. They are also subject to the most adjustment with the least remaining evidence (Lisa, David et al. 2005). Human factors in vehicle collisions include all factors related to drivers and other road users that may contribute to a crash. Examples include driver comportment, visual and auditory acuity, decision-making ability, and reaction speed. Some of the human related causes of RTA are discussed as follows.

#### **2.3.2.1 Drink Driving**

Drink driving is one of the most contributing factors to RTA occurrences in many countries of the world. For instance (WHO, 2009 and WHO, 2010), reveals that, drink driving is responsible for between 10 and 32 % of fatal crashes. As discussed by (WHO ,2004), drivers and motorcyclists with any blood alcohol content greater than zero are at higher risk of a crash than those whose blood alcohol content is zero. Alcohol ingestion by drivers puts pedestrians and riders of motorized two-wheelers at risk.

#### **2.3.2.2 Non-Use of Seat-Belts**

A significant number of lives could be saved every year by using seatbelts. Till these times many drivers are not realizing how much seat belts could save the lives of themselves and the life of their customers. What makes this fact more complex is that, although it is the worst in most of the developing countries of the world, it is a usual phenomenon in some most developed countries to see drivers with no use of seat belts while driving on public roads. (WHO, 2010) suggests that, In France, where the wearing rate is among the highest, it was estimated that, in 2007 if every passenger and driver had worn a seatbelt, 397 lives could have been saved (around 9% of total fatalities). Wearing a seat belt reduces the risk of a fatality by 40 – 50%.

Another study by (Lisa, David *et al.*, 2005) shows that, not wearing a seatbelt is the most common cause of fatality which contributes to fatality among 63% of all vehicle occupants. In addition to this WHO (2004) have stated that Rates of seat-belt use vary greatly among different countries, depending upon the existence of laws mandating their fitting and use and the 15 degree to which those laws are enforced. In low-income and middle-income countries, usage rates are generally much lower. Seat-belt usage is substantially lower in fatal crashes than in normal traffic. Correctly used seat-belts reduce the risk of death in a crash by approximately 60%. In absolute similarities, supporting the above studies, (WHO, 2009) added that if a seatbelt was correctly used, it would reduce the risk of fatality among front seat passengers by 40-50%.

#### **2.3.2.4 Beyond Speed**

The speed of motor vehicles is at the core of the road injury problem. Speed affects to both crash jeopardy and crash magnitude. In accordance to this, recent studies have proved that as speeds increase, so do the number and severity of injuries. For instance a study reported at WHO (2004) shows that the higher the impact speed, the greater the likelihood of serious and fatal injury. The same report WHO (2004) proved that the higher the speed of a vehicle, the shorter the time a driver has to stop and escape a crash. A car moving at 50 km/h will usually require 13 meters in which to stopover, while a car moving at 40 km/h will stop in less than 8.5 meters.

An average increase in speed of 1 km/h is associated with a 3% higher risk of a crash involving an injury. In severe crashes, the increased risk is even greater. In such cases, an average increase in speed of 1 km/h leads to a 5% higher risk of serious or fatal injury, travelling at 5 km/h above a road speed limit of 65 km/h results in an increase in the relative risk of being involved in a casualty crash. For car occupants in a crash with an impact speed of 80 km/h, the possibility of death is 20 times what it would have been at an impact speed of 30 km/h. 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 or beyond. The likelihood of a pedestrian being killed increases by a factor of as the impact speed of the car increases from 30 km/h to 50 km/h. To this end (WHO, 2009), summarized that, a 5% increase in average

speed leads to an approximately 10% increase in crashes that cause injuries, and a 20% increase in fatal crashes.

#### **2.3.2.5 Age of drivers**

The age of drivers affects to the behavior of their driving styles and to the level of Driver's attention. In similar sense (WHO, 2004; (Lisa, David *et al.*, 2005) argued that Crash rates of male drivers aged 16–20 years were at least three times the estimated crash rate of male drivers aged 25 years and above. Teenagers are significantly more likely to be involved in a fatal crash than older drivers. At almost every blood alcohol level, the risk of crash casualty declines with increasing driver age and experience. In addition to this a study on drivers killed in road crashes estimated that teenage drivers had more than five times the risk of a crash compared with drivers aged 30 and beyond, at all levels.

#### **2.3.2.6 The Use of Hand-Held Mobile Telephones**

The use of mobile telephones while driving could result in unexpected RTA risks. WHO (2004) suspects that, the use of hand-held mobile telephones can adversely affect driver behavior – as regards physical as well as perceptual and decision-making tasks. The process of dialing influences a driver's ability to keep to the course on the road.

#### **2.3.2.7 Lack of knowledge of Road User**

Road users acquire the knowledge needed to travel safely by means of formal training and their own experiences. However, insufficient knowledge of traffic regulations, traffic signs, vehicles and other elements may be some of the factors contributing to unsafe behavior and road calamities. Road user information and operations are intended to reduce accidents by promoting safer behavior in traffic, by giving road users better knowledge and more favorable attitudes towards such behavior. Another objective is increased understanding of restrictive measures which are introduced to increase safety, such as speed limits. (Elvic, Runee *et al.*, 2005), evaluated a number of studies on the effects of information campaigns on the number of accidents. They reviewed that most campaigns targeted at road accidents in general have not led to statistically significant changes in the number of accidents.

### **2.3.3 Vehicle Related Causes of Road Traffic Accident**

While vehicle design can have considerable influence on crash injuries, it must be studied in accordance to its contribution to RTA. Prior studies to this one like WHO (2004) have proved that vehicle related factors contribution to crashes, through vehicle defects, is generally around 3% in high-income countries, about 5% in Kenya and 3% in South Africa. Lisa, David et al., 2005, have argued that a small percentage of crashes are caused by mechanical failure of a vehicle, such as some form of tire failure, brake failure, or steering failure. The vehicle and roadway interaction like skid resistance play a major role in stopping the vehicle from encroaching the off road features like shoulder, median and other traffic signage. Improvements have been made in the manufacture of tires and vehicle design however defects can still occur or be the product of poor vehicle maintenance. Similarly, Ung (2007) stated that Vehicles have caused road accident because their owners did not properly maintain and regularly inspect the vehicle during the maneuver. So the road accident happened when brake failure, tire blowout, power steering failure, headlight failure. In addition to this defective or under inflated defective brakes, overloaded or poorly loaded vehicle or trailer, defective lights or indicators, defective steering or suspension and defective or missing mirrors are the major factors for the frequent occurrence of RTA.

### **2.4. Socio-Economic Impacts of Road Traffic Accident**

All countries in the world are currently affected by RTA. Although the effects of RTA vary from one country to the other, from nation to nation, it should be every body's concern. Some of the major impacts of RTA discussed by different organizations and scholars are conversed in the following sub-topics.

#### **2.4.1. Social impact**

The RTA impacts are also shown with their influence on the social aspects of the livelihood. To this regard, WHO (2004) claims that, over 50% of the global mortality due to road traffic injury occurs among young adults aged between 15 and 44 years, and the rates for this age group are higher in low-income and middle-income countries. In 2002, males accounted for 73% of all road traffic deaths, with an overall rate almost three times that for females: 27.6 per 100, 000 population and 10.4 per 100, 000 population, correspondingly. Road traffic mortality

rates are higher in men than in women in all regions regardless of income level, and also across all age groups. On average, males in the low-income and middle-income countries of the WHO Africa Region and the WHO Eastern Mediterranean Region have the highest road traffic injury mortality rates worldwide.

The gender difference in mortality rates is probably related to both exposure and risk-taking behavior. Furthermore, about 60% of the Disability Adjusted Life Year (DALY) lost globally as a result of road traffic injury occurs among adults aged between 15 and 44 years. Seemingly, WHO (2013) stipulates that, there are large disparities in road traffic death rates between regions. The risk of dying as a result of a road traffic injury is highest in the African Region (24.1 per 100, 000 population), and lowest in the European Region (10.3 per 100, 000). Young adults aged between 15 and 44 years account for 59% of global road traffic deaths. More than three-quarters (77%) of all road traffic deaths occur among men.

In an absolute similar manner (Naci, Chislom *et al.*, 2008) supports this argument by stating that, Road crashes kill and maim the most productive segments of the population; globally, in 1998, 51% of fatalities and 59% of disability-adjusted life years lost as the result of road traffic injuries occurred in the most productive age groups. The report of WHO (2004) added that people with road traffic injuries accounted for 13-31% of all injury-related attendees and 48% of bed occupancy in surgical wards and were the most frequent users of operating theatres and intensive care units. The increased work load in radiology departments and increased demand for physiotherapy and rehabilitation services were largely attributed to road traffic injuries. Regardless of the costs of healthcare and rehabilitation, injured people bear additional costs. Permanent disability, such loss of eye sight or brain damage, can deprive an individual the ability to achieve even minor goals and can result in dependence on others for financial support and routine physical care. Less serious injuries can result in chronic physical pain and limit the injured person's physical activity for lengthy periods.

WHO (2009) states that, over 90% of the world's fatalities on the roads occur in low and middle income countries, although these countries only have about 48% of the world's registered vehicles. The WHO anticipates, unless immediate action is taken, that over the next 15 years, the number of people dying annually in the road traffic crashes may rise to 2.4 million. This report also urges that, given these numbers, road traffic injuries have to be seen



in low and middle income countries as one of the most important health problems along with diseases such as diarrhea, malaria, HIV/AIDS and tuberculosis. The social and economic impact of road traffic accidents is a very sensitive issue. The impact is not only on individual life or his family but also on the government and on the society at large. When we see the specific social and economic impact of road traffic accidents we can find the following ( Alemgena, 2005:65) 37. Disability of many people, Create high dependency burden, Jobless too many people Increase in number of widows and female headed households, Unable many children to complete their, education or acquire skill for life making, Long period of hospitalization, Cost of Medical care, Hampers economic growth, Loss of household productivity, and Backwardness of the country.

#### **2.4.2. Economic impact**

Road traffic accidents are currently deteriorating the financial wealth of many nations. In this regard, (WHO, Naci Chislom *et al.*, 2008) urges that, in economic terms, the cost of road crash injuries is estimated at roughly 1% of Gross National Product (GNP) in low-income countries, 1.5% in middle-income countries and 2% in high-income countries. The direct economic costs of global road crashes have been estimated at US\$ 518 billion, with the costs in low-income countries – estimated at US\$ 65 billion – exceeding the total annual amount received in development assistance. In addition to this, in terms of regional disparities of cost of ( RTA Naci, Chislom *et al.*, 2008) indicated that, the economic cost of road crashes have been estimated to be as much as US\$ 24.5 Billion in Asia, US\$ 19 Billion in Latin America and Caribbean, US\$ 9.9 Billion in Central and East Europe, US\$ 7.4 Billion in the Middle East and US\$ 3.7 Billion in Africa. When we come to Ethiopia, RTA's economic impact is even worse. As far as the economic impact of RTA in Ethiopia is concerned (Persson, 2008) have discussed that, the economic impact of RTAs is substantial for Ethiopians as the annual cost is estimated to be around £40 million. Ethiopia losses about 700 million birr a year (Federal Police, 2003:26).

#### **2.5 Black Spots of Road Traffic Accident**

Black spot areas in RTA are defined in different ways by different scholars. From the perspective of Rokytova (2000), black spots are defined as locations that are generally classified after an assessment of the level of risk and the likelihood of a crash occurring at a

location. Black spot safety work can be designated as the task of improving road safety through variations of the geometrical and environmental characteristics of the problematic sites in the existing road network. In towns and cities, there is a tendency for traffic accidents to cluster at specific places, often at intersections. A concentration of accidents at a specific spot may partly be due to inappropriate road design or inappropriate traffic control at that place. In such cases, the clustering of accidents can be avoided or reduced by improving road design or traffic control.

In another words, accident black spot on a National Highway in Norway is defined as any place with a maximum length of 100 meters, where at least four injury accidents have been testified to the police in a four year period (Elvic, Runee *et al.*, 2005). Thus, a black spot in the UK may well have only five injury accidents in three years, whereas a city in Bangladesh may have black spot defined as having more than 10 injury accidents in a year (Geurts and Wets 2003). In most developed states, black spots are defined as the locations where there are 12 accidents in 3 years per 0.3 kilometers (Guo, GAO *et al.*, 2003). In Czech Republic, the black spot criterion is that junctions or 250m long road sections that are considered as black spots on condition that at least 3 road accidents with injuries occurred within 1 year or at least 3 road accidents with injuries of the same type occurred within 3 years or at least 5 road accidents of the same type occurred within 1 year (Rokytova 2000). Study on single carriage way trunk road (Walmsley, Summersgill *et al.*, 1998) revealed that the criterion used to delineate road sections for accident analysis are age of opening, carriageway width, curbs, hard strips, and speed of the road section.

Black spots on national highways in Norway have heavy traffic but do not have particularly high accident rates when compared with places which are not classified as accident black spots (Elvic, Runee *et al.*, 2005). Ranking of black-spots were done with various alternatives. Jonnessen and Sakshaug (2006) show three alternative methods of ranking black spots. These are number of accident with personal injury or serious personal injury, accident rates (accident per million vehicle kilometer) and potential for accident reduction. In addition to this, (Lisa, David *et al.*, 2005), stated that Black spot areas are sites that have had more than one fatal crash, sites with multiple crashes within a mile from one another.

## **2.6. Components of the Traffic System and Their Characteristics**

To understand the function and operational aspects of traffic on streets and highways it is important to understand how the various elements of a traffic system interact. Further, the characteristics of traffic streams are heavily influenced by the characteristics and limitations of each of these elements. There are five critical components that interact in a traffic system: Elizabeth Kopits and Maureen Copper, "Traffic Fatalities and Economic Growth. Road users- drivers, pedestrians, bicyclists, and passengers, Vehicles-private and commercial, Street and highway, Traffic control device and Environment.

### **a. Road users**

Human beings are complex and have a wide range of characteristics that can and do influence the driving task. In a system where the driver is in complete control of vehicle operation, good traffic engineering requires a keen understanding of driver characteristics. Much of the task of traffic engineering is to find ways to provide drivers with information in a clear, effective manner that induces safe and proper responses. Descriptive Analysis of Road Traffic Crashes in Addis Ababa Page 39 (AAU/AAiT MSc Thesis) The two driver characteristics of utmost importance are visual acuity factors and the reaction process.

### **b. Vehicles related problem**

One of the most critical safety problems in any highway and street system involves the interactions of vehicles and pedestrians. A substantial number of traffic crashes and fatalities involve pedestrians. Virtually all of the interactions between pedestrians and vehicles occur as pedestrians cross the street at intersections and mid-block locations. At signalized intersections, safe accommodation of pedestrian crossing is as critical as vehicle requirements in establishing an appropriate timing pattern. Pedestrians walking speed in crosswalks in the most important factor in the consideration of pedestrians in signal timing. At unsignalized crossing locations, gap-acceptance behavior of pedestrians is another important consideration Yoseph. A (2015).

## **2.7. Types of Road Traffic Management Techniques**

There are four principal types of road traffic management techniques namely,

### **A. Physical Measures**

This technique involves a physical alteration to the road system, physical alterations to the road system may be undertaken for a variety of purposes and these are as follows: Re-allocation of existing highway space by introducing changes of level, bollards and other physical barriers, differences in surface coloring or texture, Alteration to road layout at junctions often allied to changes in the type of control or range of permitted (E.g right or left turn bans), Closing or opening roads to particular classes of vehicular traffic in one or both directions, Changes to surface levels, texture and alignment to control speed of traffic, Coordinating the passing of traffic signals where they exist, The provision or alteration to traffic signs and road markings either to reinforce other physical measures or for regulatory or informatory purposes.

The provision of crossing facilities for pedestrians and cyclists. Physical measures do not rely on any order or traffic sign. They are essentially self enforcing. Road user compliance, in particular drivers, is assured without the presence of a law enforcement officer or resource to legal penalty.

### **B. Traffic Regulations Strategies**

This technique involves some form of regulatory measure. Methods of regulating the use of the road include Control by traffic signals, Imposition of speed limits, Introduction of one-way operation, Restrictions on the directions of movement at junctions, Restrictions on parts of the carriageway for use by specified classes of vehicles, Exclusion of vehicles by size or weight with or without exemption for access and, Limitation on parking and loading including special provision for parking by those with a mobility handicap and control of foot way parking. Regulations can be applied for some or all of the times and are usually of the prohibitive rather than permissive nature. (Federal Road Transport, 2000)

### **C. Provision of Information for Road Users**

The effectiveness of road traffic regulations relies on the acceptance by the general public. Clear traffic signs and road marking are very important to reduce uncertainty and encourage road users to follow routes. Comprehensive and clearly legible naming of streets can also assist drivers and reduce uncertainty. Direction signing for cyclists and pedestrians can encourage them to use safer routes and crossing places especially where there are many people. Systematic sign posting of car parks, perhaps, including information on the

availability of spaces and service areas encourages their use and reduces parking and loading in places prohibited (F. Road Transport, 2000). Maps designed especially for car drivers, lorry drivers and coach drivers can also be helpful, particularly for visitors. In some places, Multilanguage information signs may also be beneficial. (Federal Road Transport, 2000)

#### **D. Charging Systems**

When road traffic regulations are violated by road users a certain amount of punishment (usually a fine) is given. If the above techniques are properly implemented, the following benefits can be obtained:-Avoiding danger to persons or other traffic users, preventing damage to the road, building etc. Reduction in vehicle journey times, number of stops, fuel, consumption and environmental pollution, Creating prorates for certain road users such as buses, emergency vehicles, pedestrians etc. Improve utilization of car parks, Saving life and minimizing physical injury, Reducing property damage, Creating safe area or sustainable mobility. The road traffic management techniques should aim to enhance effectiveness, efficiency and affordability so as to improve the quality of life of the communities. Furthermore, they should improve accessibility, enhance travel opportunities, improve quality of travel, sustain development, and minimize environmental impact and the cost of providing transport services and infrastructure. (Silvestre O. Kasuku, 2002:5)

#### **2.7 Summery of the Literature review**

The literature survey sets the precondition to the authentic work of the author in order to make comparison, reference with the aspect of current road accidents circumstances in the world wide and then in Ethiopia. The current situation of transportation is increasing in the world and then in Ethiopia that causing road traffic accidents upper limit keeping the first in the world relatively. The possible problem identification techniques, the main factors for the world, African and Ethiopia roads traffic accident occurrences are identified by specifying the risk factors and road traffic exposure drivers. These factors where categorized in the review survey literature as the road users, vehicles and environments. In the literature the Drivers and traffic safety management principles with detail definition and synthesis were discussed that helps in the probable strategies of the counter measures to solve the main problems by relating the current situation of the study site with the reality of the literature.

### 3. METHODOLOGY

#### 3.1. Study Area

The study were conducted on the road between Durame to Mudula which is found in the South Nations, Nationality and Peoples of Region (SNNPR) of Ethiopia in the Kambata Tambato Zone, the road acrossing four districts (Durame, Kachabira, Hadaro-Tunto zuria and Tambaro), it is found at a road distance of 352 km to the south of Addis Ababa. Within the SNNPR state, it is located in the Alaba Kulito at a road distance of 125 km northwest of Hawassa, the regional capital city

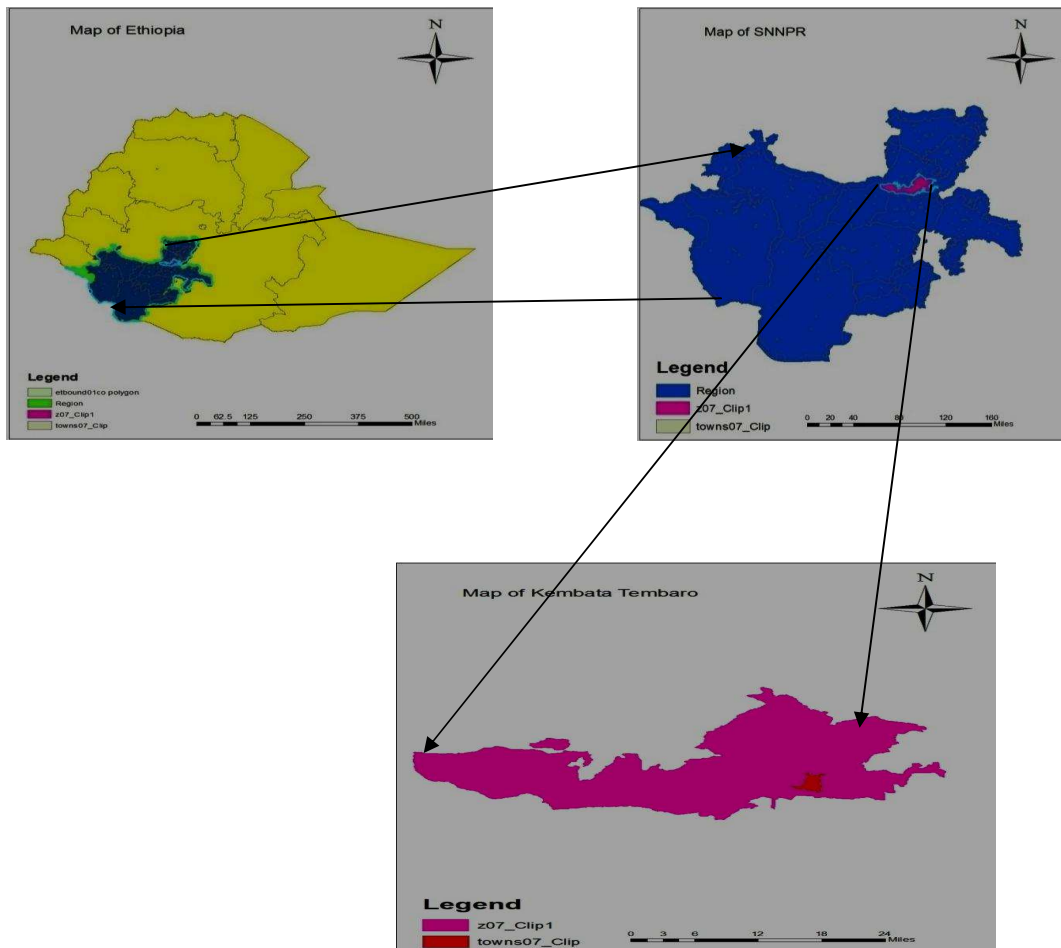


Figure 1: The study area

### **3.2. Research Design and period**

Cross-sectional type of research method was employed for this research and was done in July 2017-September 2017 G.C.

### **3.3. Population**

The populations of the study, Peoples who are in the KTZ in four districts in urban and rural are expected to use the road frequently were focused to this study. Accordingly the data were gathered from the peoples living in the four districts, the total population is 500,966 (male 246,626 and female 254,340) (CAS, 2007).

### **3.4. Sampling and Sample size**

In this research, both probability (simple random sampling and stratified sampling) and non-probability sampling (judgmental sampling) techniques were applied. For the purpose of this research, the population is stratified in to three groups i.e. the traffic police officers and the pedestrians and drivers stratifying the population helps increase the accuracy of the research by taking the same sample for homogenous group. Among these two groups of populations, 100 pedestrians were selected by judgmental sampling method and 100 traffic police by simple random sampling (Kassu. J, 2009) considering by Eligibility criteria.

### **3.5. Nature and Source of Data**

Qualitative and quantitative data were collected from both primary and secondary sources. The primary data were obtained by the means through interviews made with key informants form four districts of the zone and as total data from KTZ Traffic police Office officers. In addition to this, the secondary data (hard copy) were collected from the daily RTA recording file of the study area Traffic office, Construction and design office and health institution. The summary of types and sources of data which was used in this study are shown in below table

Table 1: Nature and source of data

S/N	Data	Data types	Sources of data
1	Road traffic accident data of KT zone	Secondary	From KTZ traffic police office
2	Loction of spots	Secondary	From KTZ traffic police office
3	Vehicle related data	Secondary	From KTZ traffic police office
4	Road type, quality and length	Secondary	From KT zone road transportation and constriction office(2017)
5	Additional road traffic data	Primary	Interviewing for traffic police, pedestrian and focus group discussion
6	Liretuers	secondary	Books, websites etc...

Source: Table designed by researcher

In relation to the discussion outlined above KTz traffic police station in districts and health institution were mainly chosen purposively for the study. The reason of choosing KTz traffic police office keeps all records traffic accidents from districts through 24 hours of the day, type of motor involved, number of injured persons, number of killed persons and recording where the accident took place, from each woreda and different data's of the persons who injured by accident in 30 days after accident appeared. With the objective of this study, I found choosing KTzone as the data collection point were relevant for it is within the case study area and it has all the necessary information that the study is looking for, the police station at KTz four districts is another data collection point of this study, the police in this area are the one responsible for the traffic safety, controls, ensuring traffic rules and regulation are followed, they also record and evaluate the causal factor of all traffic accidents in an area, again it was relevant for the sake of this study police station to be one of the data collection sources of the study. In an interview study, sampling is connected to the decision of about which persons should be interviewed. It is also about which of the interviews should be transcribed and interpreted and which cases of text can best be used to demonstrate the findings. The RTA data of four districts in the zone from 2012 to 2017 were collected from the daily RTA records



file of KTZ Traffic Office. Data collection format was prepared in excel document format which enables us to collect, filter and edit the required variables for the study. The main RTA input data sets collected from the daily RTA statistical records file of zone Traffic Office includes the following variables.

### **3.6. Study variables**

**A. Dependent variable:** Road traffic accident

### **B. Independent variables**

Motorized and non motorized Causality, social impact, economic impact, awareness of road users, major factors which related to Human, Environmental and vehicle related variables, Safety measure variable

### **3.7. Data processing and analysis**

The collected Data by using interview was coded, entered and cleaned for its completeness and errors, and then analysis was done using SPSSv20 software packages and Microsoft offices excel. Variables were explained by frequency tables, graphs and summary statistics.

### **3.8. Ethical issues**

The research proposal was presented at Department of water supply and Environmental Engineering, Environmental Engineering chair at Jimma University institute of Technology for approval. Then the authorities of the Environmental Engineering chair wrote an introductory letter which enabled me as an investigator to have access to my collection of data in KTz, and perform my field work without any doubtful and having relevant information and records. The police, zonal and district authorities, and health authorities granted permissions for this research. Accident fatalities are sensitive informants; therefore they were interviewed after they had given their consent. Highly drunk persons from a member of police and pedestrians were not interviewed due to their situation.

### **3.9. Data Quality Control**

Orientation was given to data collectors before the actual data collection. Interview questions were revised, edited, and those found to be unclear was modified. Pretest was done in Soro woreda by 20 questionnaires.

## 4. RESULT AND DISCUSSION

### 4.1. General Characteristics road traffic accident

#### 4.1.1. Temporal variation of road traffic accidents in hours of the days

The occurrence of RTA can vary within the 24 hours of the day. As discussed in the previous chapter, factors like the availability of light, the volume of vehicles, and the number of pedestrians have a great impact on the variation of RTA distribution within a day. Figure 2 below specifies the alteration of the distribution of RTA occurrences on the road from D-M internships over time.

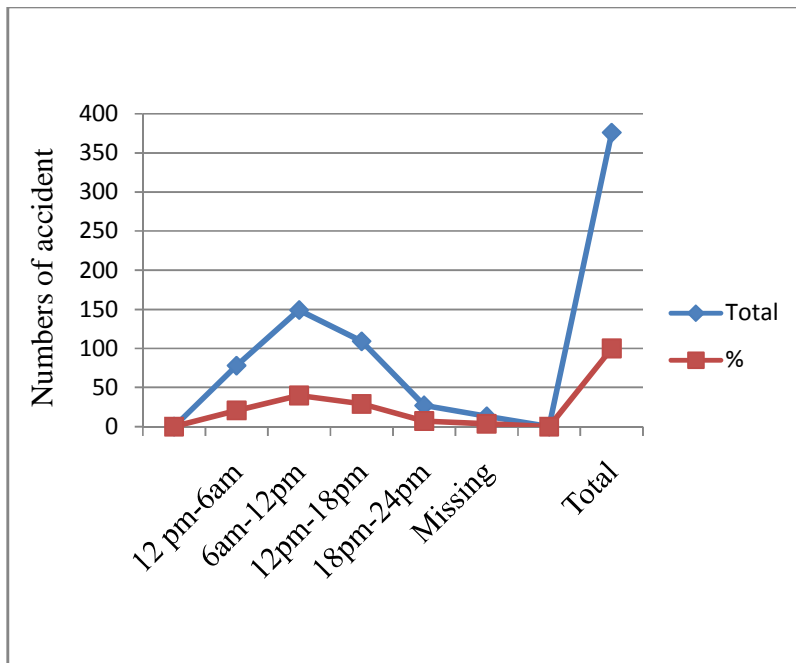


Figure 2. Temporary time variation of RTAs (2013-2017)

The variation of the hours of the day exhibits the difference in RTA occurrences in KTZ on the road from D-M. The time between 6am-12pm reveals the largest proportion (39.7%) of all RTA in between the years 2013-2017. 149 (39.7%) accidents recorded were observed in this time interval in the study site due to back coming from work, marketing, closing of schools increases the volume of traffic movement that led to RTA highly. Ironically, the time between 12pm-18pm contributes only 109 (29.1%) of the RTA recorded within the study.

time. This is similarly, with the study of Fenuel semeon (2006) in most of the 24 hours time, accident rate contributes much for the 80 % day time and there is only around the mid night to the early morning that accident rate relatively lower.

In nearly similar context Segin 2007, have discussed that the time between 3pm- 6pm contributes the for the majority of the RTA occurrence in the road found between Addis Abeba to Shashimane. This phenomenon is evident mainly due to the fact that the movement and volume of vehicles and pedestrians is more in the day time than in the night time in the study area. This result is different from Addis 2003, stated that about 51% RTAs in Bahir Dar City are commonly exhibit during the day time as opposed to 49% in the night time.

#### 4.1.2. Monthly temporal variation of road traffic accident

Like the variation in the distribution of the RTAs with in the 24 hours of the day, there is inconsistency of the RTA frequencies between the different months of the year.

Table 2: Temporal variation of RTAs in a year by months

Months	Accident year					Total accident	% Share
	2005	2006	2007	2008	2009		
September	4	4	1	2	8	19	5.0
October	6	6	5	6	10	33	8.8
November	11	12	9	10	12	54	14.3
December	5	6	7	4	7	29	7.7
January	6	8	9	10	16	50	13.3
February	2	1	3	2	5	13	3.5
March	2	2	1	5	5	15	4.0
April	1	3	3	2	3	12	3.2
May	3	4	2	2	1	12	3.3
June	2	3	2	2	1	10	2.7
July	9	10	11	14	16	60	16.0
August	7	8	14	15	17	61	16.3
Missing	1	-	2	3	3	13	3.5
Total	60	67	68	77	104	376	100.0

Table 3 describes that, there is a slight variation in the occurrence of RTAs among the months in road from D-M. Relatively, July and August are the months of highest RTA from 2012 to 2017 where they contribute out of 376 RTAs 60(16.0 %) and 61(16.3%) respectively of the total crashes occurred in July and August during the study period. This could be mainly due to the effect of weather conditions that means KTZ receives its maximum amount of rainfall in July and August are relatively with the other months. Supporting this idea Alister and Simon (2011) have discussed that, many several crashes have occurred during conditions of fog, which can reduce visibility. Similar to the findings of this research, Samson (2006) indicated that July and August were found to have frequent RTAs in Addis Ababa between the years 1996 to 2005.

#### 4.1.3. Numbers of road traffic accident causality (2005-2009) E.C

The trend of road traffic accidents in KTZ districts has been in increase for the past five years. The contribution of this district to the total motor accidents in the region was also very high. According to the Traffic police report in KTZ in the period between 2012 to 2017 RTA contributed from of all accidents in the Region, 83.2 % of all injured and 16.8 % of all deaths. The alarming high road accidents attributed to heavy traffic on the highway caused by human errors, environmental and vehicles related factors.

Table 3: Number of accident in four districts

Districts	Accidents years					Total	% share
	2013/5	2014/6	2015/7	2016/8	2017/9		
Durame Adm	20	21	23	23	31	119	31.6
Kacha-bira	8	10	10	13	17	58	14.4
Hadaro-tunto	18	17	17	20	26	98	26.0
Tambaro	14	19	18	24	30	105	28
Total	60	67	68	77	104	376	100.0

Table 5 above shows the trend of motor traffic accidents in KTz in four Districts from 2012 To 2017 G.C Overall there were a total of 376 accidents with an average of 75.2 accidents per a year. The percentage of reported road traffic accidents in study area was increasing with an

average of 20 accidents annually. According to the findings of this study (Confer next chapter on risk factors), it has been identified that, the following aspects are common risk factors which acceralate the Occurrence of road traffic accidents in study site: inappropriate driver's behavior, lack of law enforcement, lack awareness of road users, poor traffic management, inconsistent road designs, environmental condition Vehicles conditions and inappropriate information system. All these contribute to the increase of road traffic accidents in the four districts in Kambata Tambaro zone.

The number of road traffic accident from four districts gathered from zonal traffic police office as follow. These findings on table 5 marches to the information obtained from the KT zone which recorded from Durame Adm town, Kach-Bira, Hadaro-Tunto And Tambaro districts through annually report. According of this data a large numbers of accident 119 (31.6%) occurred in Durame Adm next to Tambaro 105 (28%) this is because the large number of blank spots occurs respectively in both area. Especially in Durame Adm town in the black spots of Hospital exit they are a lot of motor cycle and Bajaj are move to transport the patients and patient supporters ,this were lead for a large number of accident. The rests are Kachabira and Hadaro- Tunto are 58 (14.4%) and 98 (26.0%) respectively.

In addition to Commander of zone traffic police in a focus group discussion, who mentioned that, there is a significant increase of road traffic accidents in the zone especially the number of accidents on the road from Durame to Mudula and the acceleration of this road traffic accident in under in the study area is mainly contributed due to inappropriate driver's behavior such as over speeding, alcoholism and corruption, other factors such as lack of law enforcement, poor traffic management, inconsistent road designs, deteriorating road conditions. Similarly,this Deus. D (2006) recommended that RTAs in the Tanzania remarkable increasing from year to year due to in generally drivers' behaviors. According to the information received from the interview with the zonal police Commander, he mentioned that, Traffic accidents are increasing every year in all spots, and same accidents which are not reported, and in most cases police receive the information of these unreported accidents through insurance companies who wants to verify the occurrences of these accidents when their customers claim for the compensations. The following fig shows that clearly the distribution of traffic accident in four districts in five ye

#### 4. 2. Charactersticsts of Road length and type

Table 4: Road type and length

Districts towns road length (Durame to Mudula) in km	Road type	Accident Year					
		2005	2006	2007	2008	2009	% of road length
Durame– Kachabira (shinshicho)	Asphalt	-	-	-	9 km	17 km	
	Cobblestone	-	-	-	-	-	
	Gravel	17 km	17 km	17 km	8 km	-	
	Total	17 km	17 km	17 km	17 km	17 km	26.2%
kechabira- Hadaro-Tunto) (Hadaro)	Asphalt	-	-	-	10 km	16 km	
	Cobblestone	-	-	-	-	-	
	Gravel	16 km	16 km	16 km	6 km	-	
	Total	16 km	16 km	16 km	16 km	16 km	26.6%
Hadaro- Tambaro to Mudula (Mudula)	Asphalt	-	-	-	12km	32km	
	Cobblestone	-	-	-	-	-	
	Gravel	32 km	32 km	32 km	20 km	-	
	Total	27 km	27 km	27 km	27 km	32km	49.2%

Source: Kambata Tambaro zone road transportation and constriction office (2017)

### 4.3. Causality of Motorized and non motorized vehicles

The various ways of Road Traffic Accidents can happen. The type of RTA may include collision between vehicles and animals, vehicles and pedestrians or vehicles and fixed obstacles (Safecarguide, 2004). This shows that RTA can have a varied ways. The major types of RTA in the road from D-M (2013-2017) G.C are shown in the table to follow

Table 5: Type of collision in the road

Category	Accident types	Accident year					Total	% shar
		2013	2014	2015	2016	2017		
Non motorize Vehicles	Bicycle to Pedestrian	5	6	10	11	12	44	11.7
	Horse Cart crash	0	1	0	0	0	1	0.3
	Horse Cart to Material	0	0	0	0	1	1	0.3
	Horse Cart to Pedestrian	0	2	3	0	4	9	2.4
	Total	5	9	13	11	17	55	14.6
Motorized vehicle	Motor bicycle crash	1	0	0	1	1	3	0.8
	Vehicle crash	11	5	6	7	10	39	10.3
	Vehicle to Animal	3	4	6	8	9	30	8.0
	Vehicle to bicycle	1	2	4	4	8	19	5.0
	Vehicle to Horse cart	0	1	3	0	0	4	1.0
	Vehicle to Material	7	8	7	8	11	41	10.9
	Vehicle to Pedestrian	16	18	17	19	20	90	24.0
	Vehicle to Vehicle	14	19	21	17	23	94	25.0
	Missing	2	1	3	2	3	11	2.9
	Total	55	58	55	66	87	321	85.3

The RTA occurred in the study area between the study periods are of varied types and their contribution to the road crashes also vary considerably. The number of all motorized vehicle crash gets the biggest proportion i.e. 310 (82.4%) of RTA crashes of all types of RTAs in the road followed by non motorized crashes which covers 55 (14.6%) . 11(2.9%) of road traffic accidents were not categorized under missing that means 11 of all accident whether it was non motorized or motorized or both crashes (table 6).

## 4.4 Socio-Economic Impacts of Road Traffic Accidents

### 4.4.1 Social Impacts of Road Traffic Accident

#### 4.4.1.1 Road Traffic Accident and Sex of Casualties in KTZ

It is obvious that, the sex of casualties as being male or female by itself does not have any implication to the destiny of prevalence to RTA incidents. However, other human made factors built blocks of differences among sexes incidence to RTAs. The following Table portrays the distinction among sexes prevalence to RTA

Table 6: RTA by sex and accident severity class in (2013-2017)

Accident severity	Accident years													
	2013		2014		2015		2016		2017		Total (F&M)			
	F	M	F	M	F	M	F	M	F	M	F	M	total	%
Killed	4	14	4	6	5	6	7	9	11	33	311	68	99	16.7
Seriously injured	3	16	1	27	6	32	10	40	9	40	29	156	185	31.0
Slightly injured	14	30	6	54	8	56	10	51	27	53	65	244	309	52.3
Total	21	60	11	88	19	94	27	100	67	126	125	468	593	100.
%	3.6	10.1	1.8	14.9	3.2	15.9	4.5	16.7	7.9	21.3	21.6	78.4	100	100

Source: KTZ Health department

The number of persons who lost their lives, seriously and slightly injured missed either of parts of their body and visits a hospital due to RTAs were 99, 185 and 309 respectively. The data in the table 10 above also proves that, males are more frequently vulnerable to road crashes than females in the study. According to my study, 468 (78.4%) males and 125 (21.6%) females were affected by RTAs in the periods from 2012 to 2017. More specifically, males are 3.6 times much vulnerable than females to fatal accidents, serious injury and slight injury in the above data. This gender based difference is similar to the findings of (WHO



2009). Supporting this study, males accounted for 73% of all road traffic crashes with an overall rate almost three times that for females 27% (WHO 2002). Road traffic mortality rates are higher in men than in women in all regions regardless of proceeds level, and also across all age groups WHO (2004).

#### 4.4.1.2. Road traffic accident fatality and injuries rate by group

Table 7: Fatality and injuries rate by group of road user in KTZ

Fatality group/severity		Accident year						
		2013	2014	2015	2016	2017	Total	%
Drivers	Fatal	1	0	3	2	3	9	1.5
	Injure	3	5	5	3	14	30	5.1
Passengers	Fatal	5	4	6	6	16	37	6.2
	Injure	31	39	43	29	58	200	33.7
Motorcyclist	Fatal	2	1	2	3	10	18	3.0
	Injure	10	11	15	10	15	61	10.3
Pedal Cyclist	Fatal	0	2	2	0	1	5	0.8
	Injure	3	2	5	2	3	15	2.5
Pedestrians	Fatal	3	3	3	5	14	28	4.7
	Injure	29	32	34	28	55	178	30.0
Total	Fatal	11	10	16	16	47	99	16.7
	Injure	87	89	102	72	145	493	83.3

The analysis of these Statistical Data indicates that, the fatality and injuries of passengers group(6.2%, 33.7%) is the most affected in terms of fatalities and followed by pedestrians(4.7%, 30%), pedal cyclists, drivers and motor cyclist in above table 8 indicate lower number of fatalities and injuries. The rapidly increasing number road traffic accidents have a negative impact on the economy and society of the study area. The social and economic impact of road traffic accident is a very sensitive issue. The impact is not only on individual life or his family but also on the government and on the society at large. When we see the specific social and economic impact of road traffic accident we can find the following (Alemgena 2005). The social impact that results disability of many people, Create high dependency burden, Jobless too many people Increase in number of widows and female

headed households, Unable many children to complete their education, Long period of hospitalization, Cost of Medical care, Hampers economic growth, Loss of household productivity, and Backwardness of the country, this is similar to the study of (Alemgena, 2005).

#### 4.4.2 Economic Impacts of Road Traffic Accident

Road Traffic Accidents have multifaceted impacts over the economy of a nation. In addition to the social impacts of RTAs, KTZ is also suffering huge economic loss from road crashes. Some of the impacts of RTA have direct economic impact when it is manifested over a property and have indirect influence when it is exhibited on pedestrians, drivers and/or passengers.

Table 8: Estimated cost of property damaged by RTA

Estimated cost of property damaged by RTA	Number of accidents Resulting property damage	RTA Estimated cost (ETB)	Average cost (ETB)	% share of ETB
2005	4	931,460	232,865	15.16
2006	5	643,432	128,686.4	10.5
2007	7	732,640	104,662.86	11.9
2008	6	1,832,700	305,450	29.8
2009	16	2,002,805	125,175.3	32.6
Total	38	6,143,037	161,658.86	100.00

Source; KTZ traffic police office annual report (2012-2017) G.C. and fiancé and economic development bureau

In the table 9 the estimated total cost of RTA under the study area from 2012 to 2017 reaches ETB 6,143,037. The highest estimated RTA cost has been recorded at ETB 2,002,805 (32.6%) in 2017 while the lowest at ETB 643,432 (10.5%) in 2012 on the road. The years 2012, 2015 and 2016 exhibited ETB 931,460 (15.16%) ETB 732,640 (11.9%) and ETB 1,832,700 RTA cost respectively. This means, the zone has lost ETB 6,143,037 in the last five years only due to RTAs. Out of 376 RTAs occurrences in the four districts in the last five years, 38 of the accidents have been accompanied with property damages

In this regard, (WHO, Naci, Chislom et al., 2008) urges that, in economic terms, the cost of road crash injuries is estimated at roughly 1% of Gross National Product (GNP) in low-income countries, 1.5% in middle-income countries and 2% in high-income countries. When we come to Ethiopia, RTA's economic impact is even worse. As far as the economic impact of RTA in Ethiopia is concerned, Persson (2008) have discussed that, the economic impact of RTAs is substantial for Ethiopians as the annual cost is estimated to be around £40 million. In similar study Ethiopia losses about 700 million birr a year (2010)



Figure 3: Minibus crashed around Doje in Hadaro -tunto district (august 2017)

#### 4.5 Questionnaire Distributed to Pedestrians

Table 9: Characteristics of respondents

No	item	Category	Pedsterians		Traffic police	
			No	%	No	%
1	Sex	Male	50	50	94	94
		Female	50	50	6	6
2	Age	<18	16	16	2	2
		18-24	38	38	9	9
		25-34	20	20	29	29
		35-45	17	17	45	45
		>45	9	9	15	15
3	Job	Peasant	27	27	-	-
		Civil servant	13	13	100	100
		Business man	17	17	-	-
		Others	-	-	-	-
4	Address	b/n the two	100	10	100	100
		Outside of the	-	-	-	-

Source: Table designed by researcher

#### 4.5.1 Questionnaires distributed to pedestrians

In addition to the secondary data source, the researcher distributed questionnaires to FGD, pedestrians, and traffic police. The researcher gathered information to identify the awareness of the pedestrians and drivers how to use the road, problems of traffic accident safety measure has been taken by different level of authority through questionnaire distribution.

Question 5 “is a car accident seriously problem on the road from D-M?” know the awareness of community in order to using the road, the status of traffic accidents.

It was Tried to know the level of RTAs, question were asked to pedestrian, the responses were 76% answered RTAs were serious problem in the site of the road between Durame and Mudula and 18% answered the the car accident was not serious problem (table 19 see appendix 2b) and the rests were confused to decide whether the RTAs were serious problem or not. The following fig shows clearly the serious problem of RTA.

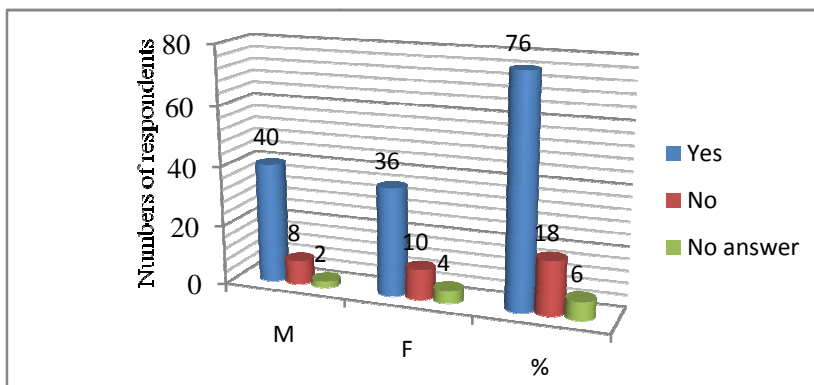


Figure 4: a bar chart showing road traffic accident problem

Question 6 the survey it was has conducted depicts the following figure to the question Have you given the priority to vehicles as required by the law?

As shown on the fig 13, the majority (58%) of pedestrians were not awarded in order to giving priority to vehicles, only 32(32%) pedestrians always give first priorities to vehicle, and some of them i.e. 10 (10%) are do not knowing about giving the priority to vehicles. In fact, this is a big problem in KTz especially on the road from Durame to Muudula when pedestrians cross the main road. The researcher also tried to collect information about the

above questions from different members of FGD and most of them said that, they have highly indicate pedestrian’s behavior in suitable way of putting traffic rules and laws in to effect at the time of using roads. According to inspectors, some peoples start crossing roads even when cars coming at high speed, haphazardly cross road, play on highways, etc. These and other weak behaviors of pedestrians have all the time caused fatal traffic accidents.

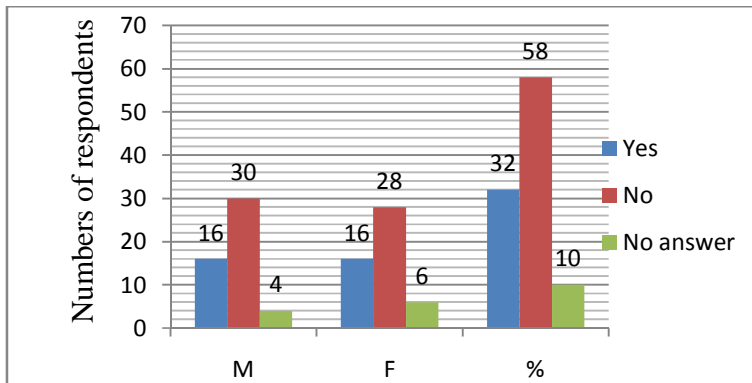


Figure 5: Priority of pedestrian giving to vehicles

Question7 the survey, It was conducted display the following figure to the question “Where do you usually cross the main roads?”

Accordingly, about 64 % of the pedestrians have awareness about the crossing signs of the road and symbols around the pedestrian crossings, but 31% of the pedestrians did not know about their responsibilities as they crossed the roads at any point. About 5% of them had doubts about what is a Zebra crossing and the others sing of the road. The following fig 6 shows clearly their awareness to wards to using the road.

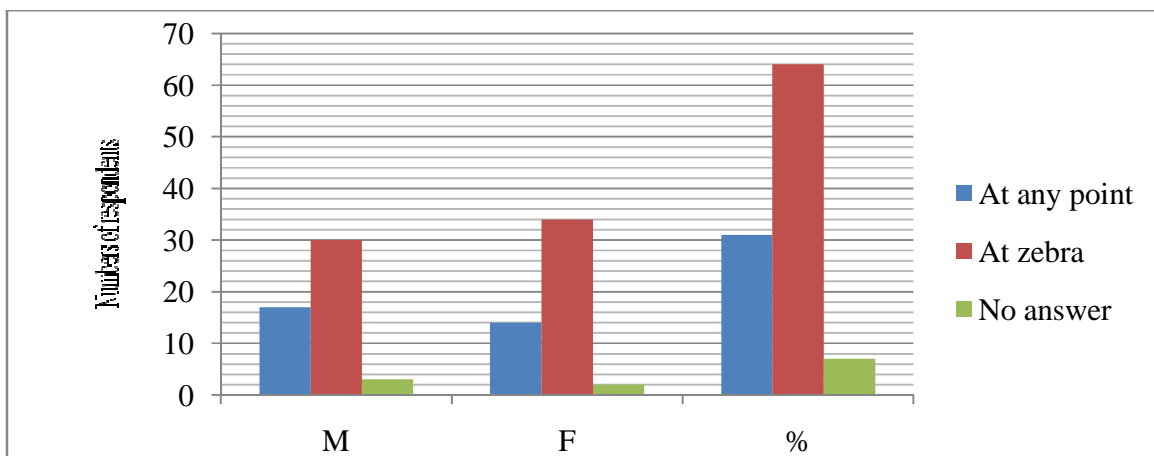


Figure 6: Communities crossing the road

Question 8, the question was conducted to collect the rate of traffic police commitment to their duties

“How do you rate the traffic police commitment to their duties?”

The response of the pedestrians with respect to the above question, 38 (38%) indicated that large number of traffic polices are not committed to effectively discharge their responsibilities. The respondents replied that the commitments of the traffic police to their duties are poor. Similarly this study, the combination of poor road traffic management, low level of infrastructures and low level commitments of traffic police to their duty aggravate the current road traffic accident in Addis Ababa Fekedu (2015)

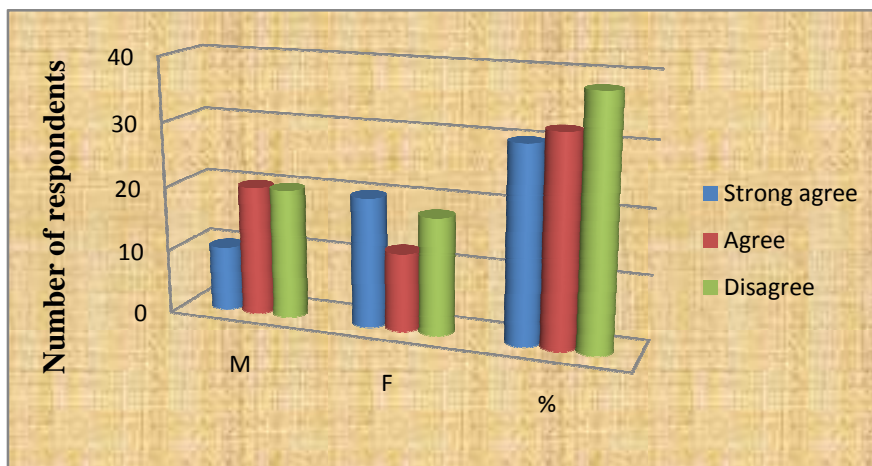


Figure 7: Rating the traffic police commitment to their duties

Question 9 the question was conducted to know the knowledge of “How the people view crossing the main road in your area?”

To know the perception of pedestrians towards traffic safety on the road, researcher asked question as to whether crossing the road especially in the towns easy or difficult. For this question the majority of the surveyed pedestrians, 80 (80 %) indicated that they perceive crossing roads under the study area is too difficult as shown blow fig 16. It is generally observed that driver’s behavior towards pedestrians is rather bad-mannered; especially they do not respect pedestrians on road crossing i.e. drivers are less likely to be willing to stop for pedestrians.

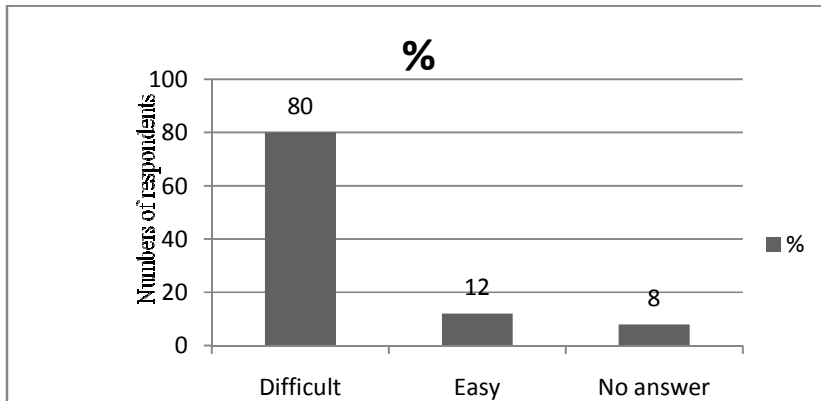


Figure 8: The view of peoples crossing the road

Questions: 10 “How frequent do you leave sidewalks/walk along road?” As indicated in the table 22 (see annex 2b) & fig17 under the study area there are notable tendency of pedestrians towards walking along vehicle roads. When asked to indicate how frequent do pedestrians have to leave the walk along roads, 21 (21%) indicated that they always use vehicles road deliberately or accidentally, 57(57%) indicated that they sometimes do this, while 32(32%) indicated that they never do this and they use the right pedestrians road except exceptional phenomena (road status, order from police or traffic police and etc.) This habit of pedestrians to leave the sidewalks and walk along the roads increases the risk of a pedestrian being exposed to traffic accidents.

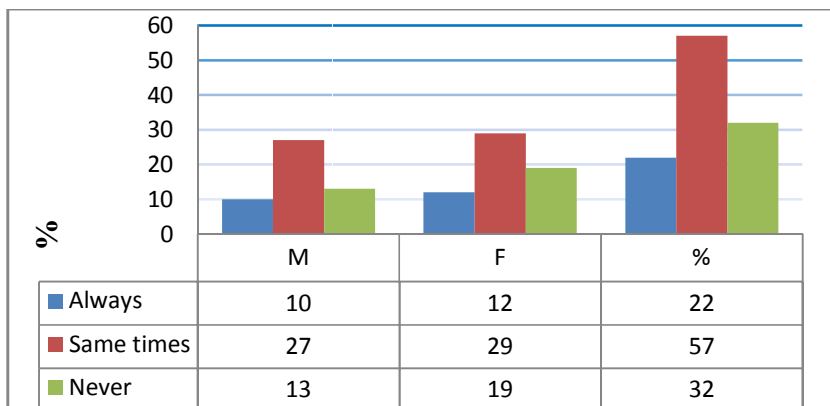


Figure 9: Pedsterian side walk habit

Question: 11, the survey I have conducted depicts the following figure to the question “In your opinion, “do drivers in KTZ on the road from Durame to Mudula give priorities to pedestrians as required by law?”

As shown on the below fig 18, the majority of pedestrians believe that only 20(20%) drivers always give first priorities to pedestrians, 28(28%) sometimes give priority to pedestrians. However, the largest share which account for 52(52%) shows they do not give priority to pedestrians. In fact, this is a big problem in KTz especially on the road from Durame to Muudula when pedestrians cross the main road.

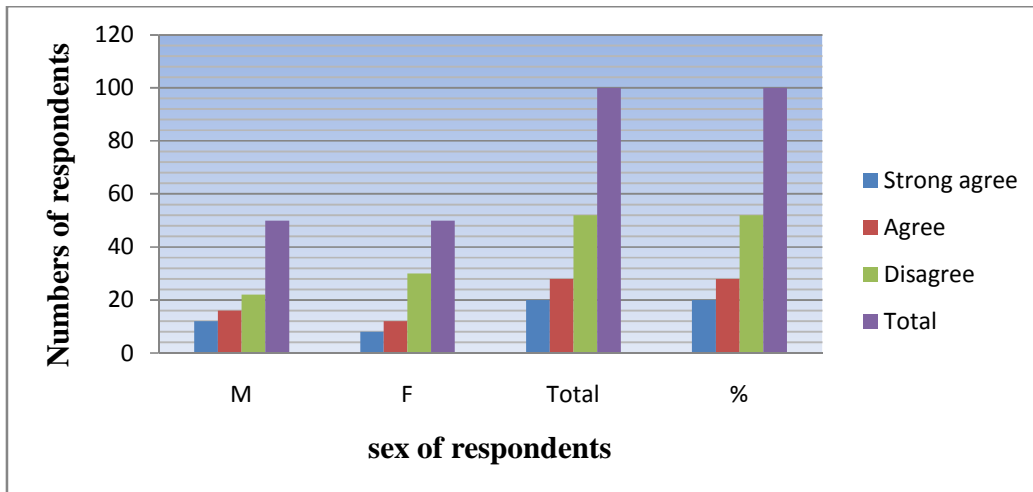


Figure 10: Drivers giving priorities to pedestrians

#### 4.5.2. Questionnaire Distributed to Traffic Police

The researcher distributed questionnaire to 100 traffic polices to know the grade of RTA of KTZ the four districts on the road from D-M traffic accidents during the study period. The answers obtained through questionnaire are presented together with the data obtained from KTZ traffic office.

Question 5 is the car accident serious problem on the road from Durame to Mudula?

In the table 24(annex2b) shows that 80% of the respondents answered yes and 18% respondents said the no, this indicates that in the Kambata Tambaro zone on the road from Durame to Mudula the car accidents were a serious problem that affects the human life and economical wastage were occurred. In addition to this the information gathered from focused group discussion, more of the groups were said that, currently the RTAs are alarming problem resulting lives of people and economic wastages have been occurred in all woredas of the zone as well as the country.



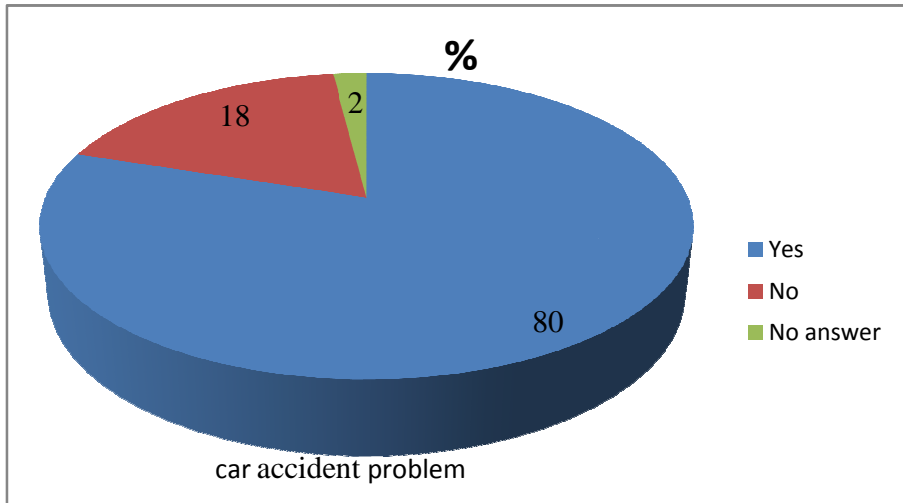


Figure 11: Car accident problem

Questions: 6 “Which type of vehicles is causing high number of road accidents in the zone of KT on the road from D-M?”

Table 10: Potential of vehicles causing accidents

Types of vehicles	M	F	Total	%
Heavy (trucks, buses)	36	4	40	40
Medium ( tax, automobiles )	44	2	46	46
Light (cycles, Bajaj)	14	-	14	14
Total	94	6	100	100

The above table indicates that 46% of the respondents argue that most of the accidents recorded in towns are mainly caused by medium vehicles such as tax, medium automobiles and others and 40% of the respondents argue that accidents recorded in towns are caused by heavy vehicles (trucks, buses and the rest 14% are caused by light vehicles (two wheels, three wheels).

Question: 7 “Which types of collision or road accidents were highly widespread in the?”

According to traffic police response, in the above table 26(see appendix 2b) about 77% of the traffic collision or road accidents are between motor vehicles with pedestrians which consist of high figure in the study are, motor vehicles with motor vehicles have accounted for 16% and the rest is between motor vehicle with bicycles, Motor vehicle with non-motor vehicle and static object are 5%, 3% and 1% respectively.

Question:8 In which roads/ locations of the city car accidents are the highest?

As shown table 27 (appendix 2b) the major locations of traffic accidents funds. Accordingly, the majority of traffic police, 84% of the accidents occur in the main roads of the road from D-M. This is because of high number of vehicles involved in the transportation at a time denseness, poor pedestrian’s practice of road usage, etc. 12% of car accidents occur at the residential areas of the zone and the rest 4% occur at the peripheral roads.

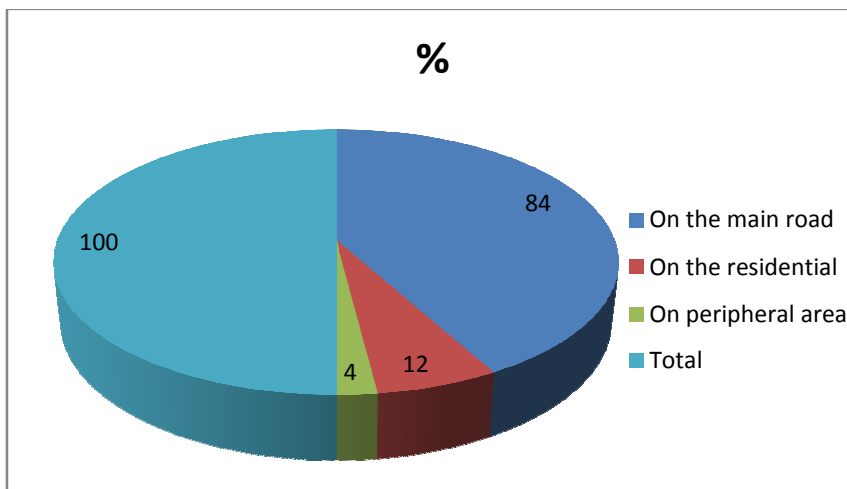


Figure 12: Location of traffic accident

Question: 9 How do you rate pedestrian’s expectation for vehicles in giving priorities where they use roads?

Table 11: Pedestrian’s reception for vehicles in giving priorities

Option	M	F	Total	%
Good	10	1	11	11
Modret	11	3	14	14
Poor	73	2	75	75
Total	94	6	100	100

From the table 12 the majority of the traffic police 75 (75 %) confirmed that pedestrians vehicles respect is smallest or poor. Thus, the traffic police have highly criticized pedestrian’s behavior and habits of using roads in applying the laws and rules of traffic

Question 10 “how is RTAs affecting the livelihood of the society in the zone?”

Concerning of this question in the table 40% respondents answered the road traffic accident affect the livelihood of the society in very high level,35% of the respondents answered that the road traffic accident affects the society in high level and the others said that its' influence was low level.

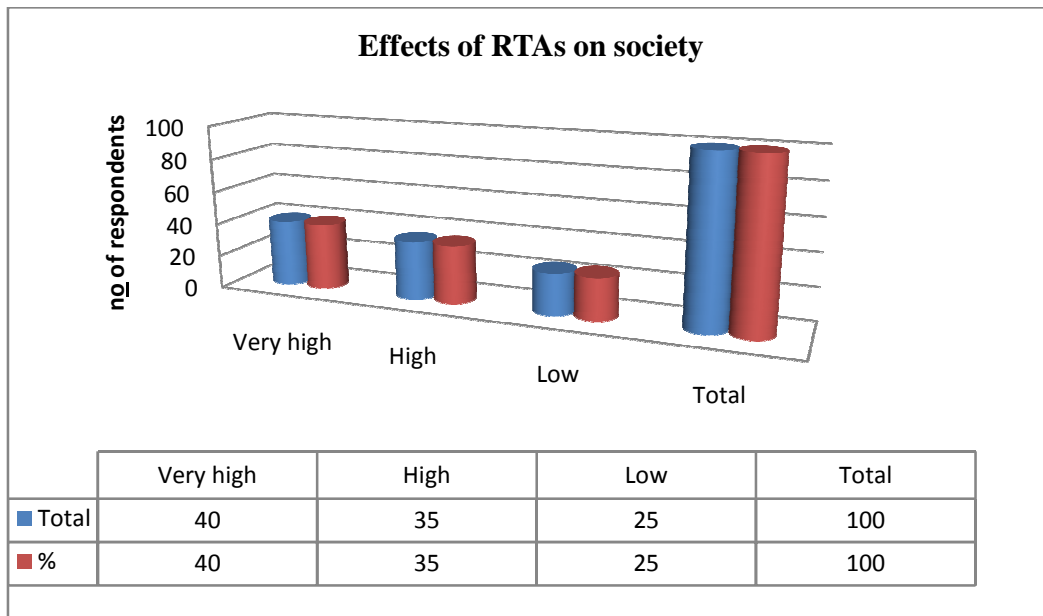


Figure 13: Effects of RTA on society

Question 11 Do you think the zone has enough road signs, symbols, and traffic lights in all important area.

Concerning the this question in the table 32(appendix2b) the response of traffic police regarding the accessibility of traffic signs, symbols and lights throughout the road which are important for traffic flows, Yes the only 4% and 93 % of the traffic police answered “No” This is also the researcher’s observation as well as commander’s responses (heads of KTZ traffic police office) during interview. According to commander’s responses the offices have launched a program to build different types of traffic signs, signals, symbols and lights throughout the road in districts of the zone.

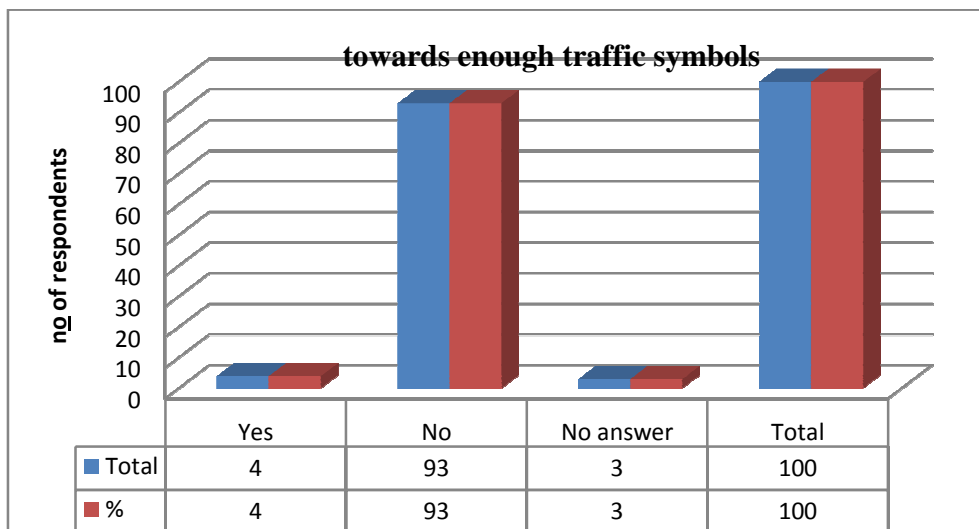


Figure 14: Traffic police towards traffic symbols

#### 4.6. Factors for Road Traffic Accidents

##### 4.6. 1. Human related variables and road traffic accidents

##### 4.6.1.1. Drivers age and RTA

Human beings are the chief causes of RTA. Several studies have witnessed that the age of drivers have a greater impact over the occurrence of RTA. This is due to the fact that, the age of drivers affects their driving behavior, attention, sense of responsibility and tolerance.

Drivers between the ages of 18 and 30 are more frequently engaged in road crashes than drivers in the other age groups (Table 13). Drivers aged 18 to 30 contribute 259 (69.0%) of all the RTA crashes in the study period followed by age groups between 31 and 50 which contributes 84 (22.4%) to the unhappiness. Driver age group above 50 years contributes only 16 (4.3%) road crashes on the road during the study period. The underage car drivers/riders contribute for 14(3.7%) of total crashes during the study period. As mentioned by traffic police commander, this not shows that less than or equal to 18 age group drivers are awarded how to drive. But most of the time non motorized vehicles drivers' age not considered but they mad accident. Drivers found in the age group between 18 and 30 (young drivers) on the road are approximately 3 times more frequently involved in RTAs than drivers aged 31 to 50 under study area. Similarly, in general terms, Lisa, David et al., 2005, suggested that, young drivers are significantly more likely to be involved in a fatal crash than aged drivers. In

addition to this, a study on drivers killed in road crashes estimated that young drivers are five times level to the risk of crash accidents compared to the drivers aged above 30. This is mainly due to the fact that many demonstrated behaviors and attitudes can place young drivers in more hazardous situations than other road users. The following fig shows that the road traffic accident decreasing as increasing of the drivers age group with excluding the age group under eighteen.

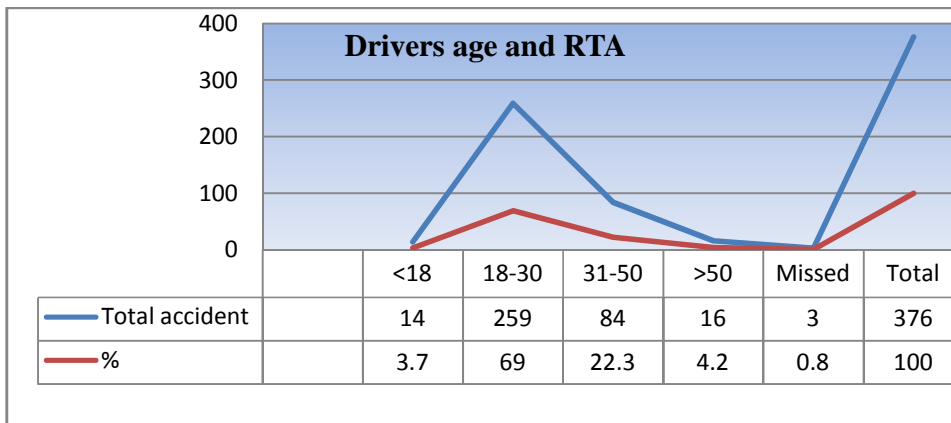


Figure 15: Relation b/n driver's age and RTA

#### 4.6.1.2. Drivers driving experience and RTA

It is supposed that the experience of drivers play a supreme role in road crashes. The distributions of road crashes under study area are also affected by the driving experience. Table 13 summarizes the difference in RTA occurrences in relation to driving experience.

Table 12: Driving experience and RTA

Driving experience	Number of accident					total	%
	2005	2006	2007	2008	2009		
<1	23	30	39	48	71	209	55.6
1-2	17	25	20	17	29	98	26.1
2-5	16	10	7	11	10	54	14.4
5-10	4	1	2	1	3	11	2.9
>10	1	-	-	1	1	3	0.8
Missed	1	-	-	-	-	1	0.2
Total	60	67	68	77	104	376	100.0

Source: compiled from KTZ traffic police office

Table 13 shows that 209 (55.6% RTA occurrences have been exhibited by drivers whose driving experience is < 1 year. The drivers with driving experience between 1 and 2 years have caused 98 (26.1%) road crashes in the study period. In addition to this, with the exception of the drivers in their first year experience, the result shows that the frequencies of RTA occurrences decrease with increasing in driving experience under study area. Drivers with an experience of 2 to 5 years cause 4.9 times more road crashes than drivers with driving experience between 5 and 10 years. This result on the road from D-M is found conflicting with the correlation between driving experience of drivers and frequency of their involvement in road crashes. Similarly, highly experienced drivers are engaged in frequent RTA scenarios than the least experienced ones in Addis Ababa (Mekonnen 2007).

In addition to this, there are additional variables of human errors that contribute to the road traffic accidents are driving beyond speed limit, neglecting priority to pedestrians, driving drink alcohol are the major factors for the road traffic accident in the site of the study (see table 33 annex2b). Driving beyond speed limit 121 (32%) of the total accident occurred next to neglecting priority to pedestrians 97 (25.8). In accordance to this, recent studies have proved that as speeds increase, so do the number and severity of injuries. Similarly, the study reported at WHO (2004) shows that the higher the impact speed, the greater the likelihood of serious and fatal injury. The same report WHO (2004) proved that the higher the speed of a vehicle, the shorter the time a driver has to stop and getaway a crash.

Similar study (WHO 2009) developing this idea, for car occupants in a crash with an impact speed of 80 km/h, the possibility of death is 20 times what it would have been at an impact speed of 30 km/h. 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 or beyond.

In addition to this, failure to respect the right-hand rule, Condition of road, (roads unsuitable for vehicles, such as narrow, low quality dangerous curves),lack of keeping distance among other vehicles( non using helmet and belt and Using hand phone during driving contributed to 27 (7.0%) 21(5.6%), 8 (2.1%) 6 (1.6%) and 1 (0.3) accidents respectively. Totally 79.2 percent of road traffic accidents are contributed due to human errors. As shown in the table 33 (appendix 2b) This shows that the RTAs is under the study areas are mainly characterized with the involvement of drivers behaviors. The commander of the zone traffic police during

the FGD said that, though it not true to point out just a single factor that can be identified as the catalyst facilitating the acceleration of the number of road traffic, but the most frequently factors experienced by the Police involve a combination of reckless/dangerous driving behavior such as excessive speed and over loading, poor vehicle standard, carelessness of pedestrians using road, motorcyclist and pedal cyclists, driving while under influence of alcohol. This phenomenon results in a huge property damages and severe consequences in the life of the urban and rural dwellers.

#### **4.6.2. Environmental characteristics and RTAs**

Environmental parameters are important contributory factors to RTAs. For example, the physical environment, various climatic threats and geohazards like heat, fog, high winds, snow, rain, ice, flooding, and avalanches have effects on roads hence on traffic accidents. The weather (rain dizzily) also threatens surface transport and impacts road way safety, mobility (Lankarani *et al.*, 2014). It affects road safety through increased crash risk as well as exposure to weather related hazards. Weather impacts roadway mobility by increasing travel time delay, reducing traffic volumes and speeds and reducing road way capacity. Weather and road conditions in terms of road qualities therefore have a role in the causes of traffic accidents (Komba, 2006).

##### **4.6.2. 1. Weather condition and RTAs**

The weather condition of the moment in RTAs plays an important role in varying the frequency and risk of road crashes. (Lisa, David et al. 2005); Alister and Simon (2011) stated that the climatic and environmental conditions can be a factor in RTAs. Experiences show that several crashes occur during conditions of smoke or fog, which reduces visibility.

In below fig 9 showed that Road Traffic Accidents in Kambata Tambaro zone in four districts on the road from D-M frequently occur during good weather conditions than during rainy and drizzle falling events. Accordingly, 454 (76.6%) RTAs in the zone have been recorded in good weather conditions but only 91 (15.7%) and 45(7.7%) accidents recorded in rainy and drizzle falling weather conditions respectively. Bright/good and dry weather of the districts

which covers the longer days of the year in the zone produces greater number of RTAs than the rainy and drizzle falling weather. and bad road environment when it is dark or raining

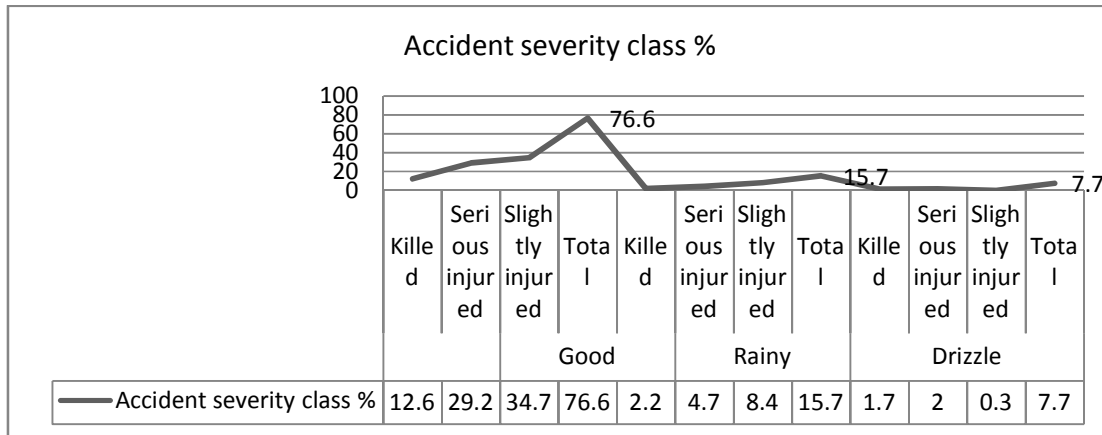


Figure 16: Whether condition and RTAs (2012-2017)

#### 4.7. Road environments and RTAs

Road environments related Causes considerable contribution to the increase or decrease of RTA risks. (WHO, 2004) supports this idea by saying that, the road network has an effect on crash risk because it determines how road users perceive their environment and drivers instructions for road users, through signs and traffic panels, on what they should be doing. Many traffic management and road safety engineering measures work through their influence on human behavior. Road pavement is found as the main contributing variable for the occurrence of RTAs since it is directly related to the speed of the vehicle. Drivers wish to drive in higher speeds in smoother road pavements like in asphalt roads.

Table 13: Road Pavement and RTA in the road from D-M (2013-2017)

Road type and Number of accident	Accident year					Total accidents	%
	2013	2014	2015	2016	2017		
Cobblestone	-	-	-	-	-	-	0
Gravel	60	67	68	-	-	195	51.9
Asphalt	-	-	-	76	102	178	47.3
Missing	-	-	-	1	2	3	0.8
<b>Total</b>	<b>60</b>	<b>67</b>	<b>68</b>	<b>77</b>	<b>104</b>	<b>376</b>	<b>100.0</b>

Source: complained from KTZ traffic police office



Table 14 about comparison of RTA before and after the road environment was paved during the study period 195 (51.9 %) of all the accidents has occurred on Gravel road in the three year of the study. Asphalt roads and Missing covered roads contribute 178 (47.3%) and 3 (0.8%) between the years 2016 to 2017 respectively. This indicates that If the two periods are equal in fact that the RTA occurrence on asphalt road will be greater than the gravel and others. Drivers have high rider at hazard locations compared to low hazard locations. This is to mean in places where drivers perceive a location as hazardous, they take more care. Accidents may be more likely to happen when hazardous road or traffic conditions are not clear at a momentary look, or where the conditions are too complicated to perceive.

#### 4.8. Road traffic accident black spot identification

Road Traffic Accidents Spot/s where even a single RTA has occurred regardless of its frequency or severity level of its consequence.

Table 14: RTAs location (RTAs black spots)

Districts	No	RTAs spot name	No of accident					Total RTA	%
			2013	2014	2015	2016	2017		
Durame Adm	01	Hospital entera	4	5	6	5	9	29	24.3
	02	Ambo exit	3	2	3	4	6	18	15.1
	03	Around Shifera	3	4	2	3	4	16	13.4
	04	Sike town exit	2	3	3	2	4	14	11.7
	05	Around Mesale	4	3	3	3	3	16	13.4
	06	Danboya exit	2	2	3	3	3	14	11.7
	Other	Unidentified	2	2	3	3	2	12	10.0
	Total		20	21	23	23	31	119	100
Kacha-bira	08	Wadole	4	4	5	5	8	26	44.8
	09	Shandore	2	3	2	4	4	15	25.8
	Other	Unidentified	2	3	3	4	5	17	29.4
	Total		8	10	10	13	17	58	100
	10	Sana curve	7	6	6	8	10	39	39.8

Hadaro	11	Doje	8	7	8	8	11	42	40.8
Tunto	Other	Unidentified	3	4	3	4	5	19	19.4
	Total		18	17	17	20	26	98	100
Tambaro	12	Aroun Durgi	2	4	5	7	8	26	24.7
	13	Badoye	2	4	2	3	4	16	15.2
	14	Mudula-02	2	3	2	3	4	14	13.3
	15	Sigazo coca	4	5	4	6	7	26	24.7
	16	Aroun Buho	3	1	3	2	3	12	11.4
	Other	Unidentified	1	2	2	3	4	12	11.4
	Total		14	19	18	24	30	105	100

Source; fulfilled by four districts (2013-2017)

It shows in the (table 15) 16 RTA Black Spots have been identified in the road from Durame to Mudula from 2012 to 2017. This part however focused only on the Top 6 most severe RTA Black Spots identified in the road in the whole study period from 2012 to 2017. RTAs recorded from all 16 RTA Black Spots of the study area in the study period, Hospital entrance 29 (24.3%) Doje 42 (40.8)% wadole 24(44.8)% , sana curve 39(39.8%.) and around Durgi 26(24.7)% are recorded as large black spot area have occurred in the Top 5 RTA Black Spots (Table 15.). Totally 180 (47.8) RTA are found in 5 RTA spot out of 16 RTA and the rests are 196 (42.2%) found in 10 RTA out of 16 RTA. According to commanders recommendation most of the time the occurrences of RTAs that found in above 6 out of 16 are caused by drivers behavior, road condition such as Doje and Wadole, pedestrians' less awareness of road using problem. Supporting this study ( Elvic, Runee *et al.*, 2005) road users acquire the knowledge needed to travel safely by means of formal training and their own experiences. However, insufficient knowledge of traffic regulations, traffic signs, vehicles and other elements may be some of the factors contributing to unsafe behavior and road conditions.

#### 4.9. The Failures of the Vehicles and the Accidents

The vehicles related problem in Ethiopia is one of the problems of car accidents causality. But most of the time the problems arise from the aspect of no problems. The following figure

depictst that the problems are caused when no problem of the vehicles due to many other causes of the traffic accidents stated throughout the work. The cars problem attained has no significant accident cause but the highest accident is due to the drivers and without the failure of the vehicles parts considering and the other contributory factors (it may be environmental and human errors) for the causality. Sometimes the drivers do not know the problem of the cars but they cause accidents or the traffic data registered unfulfilled documents from the accident area. Here 86.2% of the accident committed was due to no problem to the vehicle in the course of its service life (see table 17 appendix 2b).

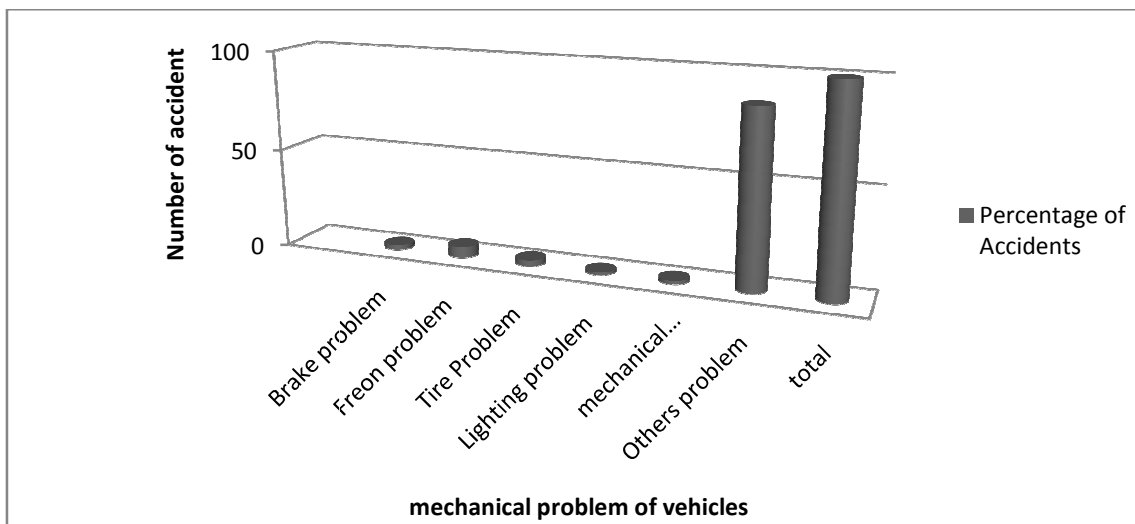


Figure 17: The vehicle problems and its accidents situation.

To summarize the most frequently factors experienced by the Police data involve a combination of human related, environmental, road situation and vehicles mechanical problems spesfically,

Human factor specially the driver, it is considered as the major contributor of road crash. Some of unnecessary actions made by the drivers are giving misleading signals, driving without respecting pedestrian priority, behaving in undisciplined way, driving recklessly, ignoring traffic rules and regulations, relocating driving under the influence of alcohol and drugs, getting driving licenses by corruption, competition with other drivers, following to close etc.

As far as the other human factors are concerned, the following contributory factors are observed. In attention (Failed to look and looked but did not see), crossing a road without

watching left and right, playing on road, animal drawn carts found in main road, crossing from behind parked vehicle, ignoring lights at crossing, animals without control, walking without holding the left side of the road, ... etc.

Environmental related factors: Bad road physical environment such as curves, lights, lack of side walk, zebra and etc, weather condition when it is fog /cloud and raining.

Vehicles related factors : Mechanical vehicles problems, such as brake, freon, tire, lighting and others are as the risk factors for road traffic accidents in this study.

With regards to factors which are related with road, the following can be mentioned. Poor visual guidance, Narrow road, poor road surface, steep hill, Lack of pedestrian facilities (E.g. pavement), Engineering efforts that did not consider safety, Poor maintenance of roads, slippery road, Steep ditches and hard objects near the road, In adequate or absence of road signs Therefore, from the above results in this study of factors that affect the road traffic accidents were ranked as table following fig 18 (table 33 see annex 2b).

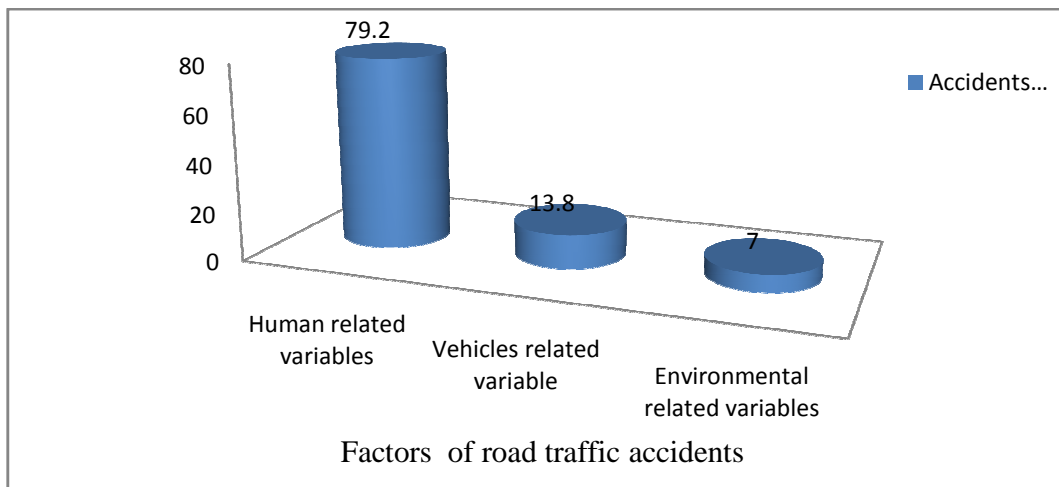


Figure 18: Factors of road traffic accident

#### 4.10. Safety measures taken by authority

The traffic safety measures: Involves the traffic safe administration management (the mechanism, traffic safety policy, traffic safety duty of the traffic safety management), traffic safe practice (driver's physiology and psychology, etc), vehicle safe practice, traffic crash analysis and countermeasure) and road traffic safety facilities (road safety facilities, free and help in vehicle safety facilities, traffic participant's safety facilities, safety education of the

traffic), etc (Wang, W. *et al.* 2003). The compatible traffic safety management is prerequisite of ensuring unobstructed road and people's safety, and promoting economic developing.

The findings on road safety measures implemented and adopted by local Government district authorities in different levels of the zone. The findings are based on interviews with the Government officials from Focus group discussion with Local District Authorities and Traffic Police in four districts. It seeks to identify what are the safety measures undertaken to prevent the prolonging road traffic accidents in zone of districts. In zone districts, road safety is one of the very strong issues in the management of the road transport sub-sector. The number of road accidents reported in the media day after another, coupled with the statistics released by the Traffic Department of the Police Force clearly lends authority to this submission. The statistics have all along demonstrated that the rate of accidents has kept on increasing annually and this trend is unlikely to be reversed particularly with the increase of motor vehicles on site of highway road. This is, of course, does not take into account on the increase in the use of non-motorized transport on the highway road especially in urban area in the district.

#### **4.10.1 Safety measures undertaken by local government authority**

Based on the focus group discussion with the local government authority in kambata Tambaro zone districts, The district executive secretary made an introduction note on behalf of the district commissioner that, “four districts like other districts in KTZ has a special Road Safety Committee dealing with traffic safety activities in coordinating and organizing different activities relating to control and prevention of road traffic accidents in the district, the Committee create and provide Conducive environment for other Organizations or Government institutions to participate in implementing road safety measures in the district. In regard with this provision, the Road Safety Committee in districts of zone is mandated responsible to implement and initiate road traffic safety measures and reduce traffic accident. According to this statement, it means that at the district level there is a special committee which is legally mandated to deal with traffic safety measures to reduce and control traffic accidents within the districts.

Basing on the interviews done with the Local Government Authority who are also part of the Road Safety Committee in the district the following are the safety measures undertaken by the Local district authorities in KTZ.

*Budgeting*, it was mentioned in the focus group discussion that: The local government authority has planned to increase the size of the budget relating to road traffic safety in the districts, even though this simply budget planning is not sufficient but efforts have been made to at least make road safety activities one of the priorities in the budget allocation and distribution, this has enabled the district to implement more activities than other previous years,

*Construction of bumper*, According to the interview with district executive secretary in the focus group discussion, he mentioned that, the local government authority has managed to construct 20 pumps on a highway road in the districts to control vehicle speed in areas where children cross the road to schools, the construction was done in collaboration with the community. The community identified all places where there is high frequency number of people crossing the road especially in areas where there are schools or market and the Local district authority funded the construction of the bumper.

*Repair and replacement of the road signs*. According to district executive secretary in the focus group discussion, “the local government authority have repaired 60 poll signs, 30 zebra cross mark and replaced 50 road signs including the distance poll mark in a period between 2012 to 2017, it was also mentioned that, plate polls are very expensive to repair and the budget allocated is low. In his comments, the district executive secretary said, “the construction and maintenance of the high way road is basically the responsibility of the central government and not local government authority, the decision to repair and replace road signs is just a step and decision within local district authority towards road safety in the districts.”

*Organizing road safety week promotion*. Based on the focus group discussion with local government authority, it was mentioned that: the local government authority in collaboration with traffic police department , prepares and conduct road safety week promotion carried out every year to emphasize road safety awareness among the public. The preparation of activities to be done and addressed on the Road Safety Week campaign in districts involve community participation on identifying and deciding what should be addressed and what should be the target activities to be met on the coming year. Community groups like youth, women and students are involved effectively on creating theatre for development relating to road safety, by evaluating and debate different issues on traffic safety.

*Education sharing*, According to Social security officer in the focus group discussion, he mentioned that: “the local government authority in zone of districts in collaboration organize and broad cast( in local language) the information and knowledge about road safety measures in covering of 15 minutes. Accordingly the content of the broadcast includes roads, the meaning types and their importance, proper use of roads, responsibility and rights of road users, riding bicycle, road accidents, first aid in road accident situation, reinforcement of road safety rules and regulations, learning to drive and licensing requirements”.

Mass media campaigns in district is expected to achieve the following:

To increased awareness of a traffic accident as a problems which can be prevented and avoided,

To Raised level of information to the community about traffic safety, road users

To change behaviors and respect traffic rules and regulations.

To integrate Local government authority and community in planning and implementation of road traffic measures in the district.

#### **4.10.2 Safety measures undertaken by the traffic police**

According the interview with the Zonal police commander he said that “The police Fatigue in road safety activities associate much with the local government plans and decisions, most activities are done in respect of decision from the local districts authority, he mentioned that, conducting frequent inspection of motor vehicles to ascertain their road worthiness in the district and those passing through Durame –Mudula highway, is one of the local measures initiated by the Local districts authority to restrict defective vehicles being in use without proper service, some of the vehicles plying high way road are not road worthy”. This was also mentioned in the focus group discussion that, there is no mandatory vehicle inspection in KTzone and the motor vehicle owners lack the culture of repairing their vehicles, hence, this cause such vehicles to be part of the main causes of road traffic accidents in zone. The current vehicle inspection carried by police is primarily a visual examination due to lack of vehicle inspection equipments, due to that the police only check, tires, brakes, steering system, lightning system, driving license, and the availability of safe equipment like seatbelt at least in front seats and restricting open cars like pick-up to carry passengers in the district. In general this is considered part of the road safety measures taken in the districts. There are several

organizations which are also implementing road safety activities in KTz districts, and these organizations are working hand in hand with local government authorities, the following are some of the intuitions identified in the focus group discussion when interviewing the local district authorities.

In general, the aims of such promotion are to change the road user behavior, attitude or knowledge in order to increase road safety in the district.

Generally, as the interviews done with the local authority in KTZ, it appears that there are excellent safety measures undertaken in the district to control and prevent road traffic accidents, but in actual fact, these measures appear to be more theoretical than practical. Most accident pedestrian when interviewed criticized and mentioned that, vehicle inspection by police is done only once a year and it is just one week, the inspection is not technical but visual. It was also mentioned by the pedestrian respondents that, there are very good road traffic safety plans mentioned to be implemented in the districts but they are not implemented, Institutions involved are working hardly but they are mainly concentrating to students who are not drivers. With these recommendations from different respondents it appears that, these safety measures are not effective that's why the trend of traffic accidents is increasing. To developing the above concept the researcher prepared the following Questions: 12&13

Table 15: Attitudes of traffic police towards safety measures

Questions	Options	M	F	Total	%
Is the safety measures have been taken by the local authority to prevent the road traffic accident?	Yes	34	2	36	36
	No	58	1	59	59
	No answer	2	3	5	5
	Total	94	6	100	100
Do available safety measures reduce the traffic accident?	Yes	86	4	90	90
	No	5	2	7	7
	No answer	3	1	4	4
	Total	94	6	100	100

From the above table indicates the first box there are 59% of respondents answered no enough safety measures have been taken by local authority and 36% of respondents answered it was taken to reduce RTAs, and the rest 5% are not sure whether it was taken or not. Concerning the second question in the above box, the response of traffic police regarding the availability of safety measure 90% of traffic police are agree that taking of safety measure is one way of



reducing the RTA. 7% of the traffic police answered “No”. This is also the researcher’s observation as well as commander’s responses during interview. According to commander and members of focus group discussions, the safety measures that taken by different local governmental authorities were not enough but all of them Saied that, the available safety measures of the road can be reduce the traffic accidents

## 5. CONCLUSION AND RECOMMENDATIONS

### 5.1. Conclusion

This study was carried out to investigate the risk factors for the RTAs, the comparison of motorized and non motorized vehicles causality and frequent RTAs, analyze the socio-economic impacts of RTA in terms of time and space, describe the awareness' of road users, identify major causes of RTAs, assess the safety measures taken by local authority and propose appropriate interventions which could help to reduce RTAs in districts were done.

This study shows that the frequency and 376 occurrence of RTAs in the study area exhibits variations because of the impact of various variables like age and driving experience of drivers, road pavement, road moisture condition, weather conditions and mechanical problem of vehicles.

The interaction of human road users, the motor vehicles and the prevailing physical environmental conditions if not harmoniously managed can lead to road traffic accidents which in effect contribute to road safety problems and challenges. From the results of this study, it is evident that effective enforcement of traffic rules and regulations is a major governance factor which with strict implementation can reduce RTAs on our roads. But governance factors are outside the scope of this study.

Road Traffic Accidents were distributed in the districts in terms of time and space. The RTA Black Spots exhibit the highest frequency of RTA occurrences. The frequencies of RTAs as well as the socio-economic impacts of RTAs have shown an increasing trend in the study period. Among the various reasons causing numerous RTAs in site of road, failure to give way for vehicles, speed driving, failures to give way for pedestrians, failure to respect the right-hand rule contributed much to the unhappiness of road crashes in the road.

In order to reduce the exposure to RTAs for road users, the results of this study show that visible road signs, driver speed controls, removal of motorists obstructions of road view and election of road bumps also referred to as 'sleeping policemen' are some of the observed physical/ environmental control features that can reduce

RTAs on the roads. The results of this study have also shown that pedestrian motor conflicts on the roads and roadsides increases pedestrian road traffic accidents. This is mainly due to the encroachment of roads side activities onto the roads and pedestrian road side walks. This pushes pedestrians onto the roads and makes them prone to road accidents.

Road Traffic Accidents are affecting the dwellers of the towns in various aspects. The RTA casualties of the districts mainly belong to the all age groups. Some casualties have lost their lives, others have got serious or slightly injuries due to RTAs. Road Traffic Accidents are also failing the economic wealth of the zone of districts as well as the country.

Thus, it believed that this study contributes much to those who need to understand the general characteristics of RTAs in districts in terms of time and space and motivate other stockholders to conduct further studies in the field. On the basis of these research findings, some key recommendations have been proposed and are discussed below.

## 5.2. Recommendations

Based on the core findings of this study, the following are recommended.

- Motorized vehicles which are used to convey majority of the district dwellers are found more likely to be involved in frequent RTAs than other non motorized vehicle categories. Therefore, it is recommended that the implementation of continuous, sudden and special technical investigation as well as training is required on this vehicle category.
- The frequencies of RTAs as well as the socio-economic impacts of RTAs have shown an increasing trend in the study period. Therefore, the community lives and property should have saved, that could have been lost due to RTAs, by creating the road traffic awareness.
- The pedestrians and passengers are the main sufferers of the accidents. Intervention such as continuous creating awareness should be given by the responsive body.
- Drivers aged 18 to 30 are more frequently involved in RTAs than the other. The Kambata Tambaro zone Road Transport and Construction Office which gives the driving license should seriously assess the capability of drivers and monitor the training given to learners by private agencies and Special awareness creation programs should be organized especially for the drivers of this age group so that they could develop the sense of responsibility and ownership.
- The prevalence of road casualties is increasing in terms of number and severity from time to time in the study area. The time which takes to transport casualties from the place of accident to hospitals or clinics determines the consequence. Therefore, it is recommended that hospitals be more equipped with an emergency vehicle /Ambulances/ to safeguard the destiny of survival of RTA casualties.
- As it can be clearly seen in this research, under-reporting has been challenging the reliability of the study. Traffic polices should therefore record the accident data and information on the daily RTA recording format consistently to make the RTA data complete, meaningful and rational so that proper safety/protection measures will be put in place.
- Pedestrian traffic education that has been offered through radio, television and newspaper should also encourage. This approach addresses the traffic system as a whole and looks up

the interactions between vehicles, road users and the road infrastructure to identify solutions

- Implement drink/drive measures (alcoholic test measurement), in all site countries of the roads in Ethiopia.
- In this study, no attempt was made to examine the effect of governance factors on road traffic accidents. These can form the basis for further academic research. It would be important to examine the relationship governance factors on road traffic and occurrences of RTAs and whether enforcement of traffic regulations would reduce traffic crashes.
- Efforts should be made by other researchers to curb the multifaceted impacts of RTA of the city through studying the engineering characteristics of roads and settlements, drivers driving behavior, law enforcements, pedestrians road using behaviors, methods of vehicle inspections, role of private driver learning agencies and the like in the study area.

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## **APPENDIXES**

### **Appendix 1: questionnaire**

Jimma University



Faculty of civil and environmental engineering Environmental engineering chair Interview

Questions prepared for the Pedestrians Foreword:

This interview is prepared to assemble information which can help to study the risk factors for road traffic accident and impact in the road from Durame to Mudula, partial fulfillment for the requirements of the award of masters degree in Science specialization of Environmental Engineering. The information that you will provide to me undoubtedly will have paramount significance for the success of the study. The researcher here by kindly requests you to give genuine information. I would like to thank you in advance for your time and cooperation.

***Section one: \_Individuals background***

1. Age in years (1) < 18 (2) 18 – 24 (3) 25 – 3 (4) 35 – 45 (5) >45
2. Sex: (1) Male (2) Female
3. Job (1) Peasant (2) Civil servant (3) Business (4) Others (specify)
4. Address: (1) b/n the tow twons Durame & Mudula (2) Outside of the two towns

***Section tow about the accidents***

5. Is the car accident serious problem on the road from D-M? 1=yes 2=no
6. Have you given priorities to vehicles as required by law whenever you cross the Road?" 1= Yes 2= No 3 = no answer
7. Where do you usually cross the main roads?" 1= zebra crossing 2= at any point 3=no answer
8. How do you rate the traffic police commitment to their duties?" 1=strong agree 2= agree 3=disagree
9. How the peoples view crossing the main roads in your area ?" 1=difficult 2= easy
10. How frequent do you leave sidewalks/walk along roads and walk on the vehicles road? 1=always 2= sometime 3= never
11. In your opinion, do drivers in KTz on the road from Durame to Mudula give priorities to pedestrians as required by law?" 1=strong agree 2=agree 3=disagree
12. What kinds of safety measures have been taken by the local authority to prevent road traffic accident? 1=creating awerness 2=giving traing 3=punshiment
13. Do available safety measures reduce the traffic accidents? 1=yes 2=no

Jimma University

Faculty of civil and environmental engineering

Environmental engineering chair

Questionnaire Distributed to Traffic Police

***Section one: \_ Individuals background***

1. Age in years (1) < 18 (2) 18 – 24 (3) 25 – 34 (4) 35 – 45 (5) >45
2. Sex: (1) Male (2) Female
3. Job : (1) Peasant (2) Civil servant (3) Business (4) Others (specify
4. Residence: (1) b/n the tow twons Durame & Mudula (2) Outside between the two towns

***Section tow about the accidents***

5. Is the car accident serious problem on the road from D-M? 1=yes 2=no
6. Which type of vehicles is causing high number of road accidents in KT on the road from Durame to Mudula ?” 1=Havy vehicles 2=Medium vehicles 3=Light vehicles
7. Which types of collision or road accidents were highly prevailing?”  
1=Motor vehicles with motor vehicles 2= Motor vehicles with bicycles 3= Motor vehicles with pedestrians 4= Motor vehicles with static object 5=Motor vehicles with Non- motor vehicles
8. In which roads/ locations of the city car accidents are the highest?  
1=On the main road 2= On the residential 3= On the peripheral area
9. How do you rate pedestrian’s respectation for vehicles in giving priorities where they use roads? 1= Good 2=Moderate 3= Poor
10. How is Road Traffic Accident affecting the livelihood of the society in the zone ?  
1=Very high 2=High 3= Low
11. Do you think that the zone has enough road traffic signs, signals, symbols and lights in all important areas? 1=Yes 2= No 3=No answer
12. Is safety measures have been taken by the local authority to prevent road traffic accident?  
1=yes 2=No
13. Do available safety measures reduce the traffic accidents? 1=yes 2=n

Jmma University

Faculty of civil and environmental engineering

Environmental engineering chair

**INTERVIEW GUIDE QUESTIONS FOR A FOCUS GROUP DISCUSSION**

1. Is road traffic accident a serious problem in between Durame & Mudula?

2. What are the main factors which are associated to the cause of road traffic accidents in road between Durame & Mudula?
3. What is done so far to minimize the frequency of occurrence of Road Traffic Accidents and their consequences?
4. Who are the main victims of road traffic accidents in road between Durame & Mudula?
5. Do available safety measures reduce the traffic accidents?
6. Do available traffic rules and regulations reduce road traffic accidents?
7. Who is mostly responsible for the road traffic accidents?
8. What has been done by the Central government to reduce traffic accidents?
9. Do they pedestrians and drivers know the signs of road properly?
10. What measures have been taken to reduce traffic accidents in kambata tambaro zon
11. Do you think that the zone has enough road traffic signs, signals, symbols and lights in all important areas?
12. What are the major causes and contributing factors for road traffic accidents occurring in the road from D-M?
13. Does your office give continuous awareness-lesson to the people, drivers and traffic police

## Appendix 2: Different tables fulfilled by responses' of respondents

Table17: The vehicle problems and its accidents situation

Failures of the Vehicles' part	Number of accident	Percentage of
Brake problem	9	2.4
Freon problem	21	5.6
Tire Problem	11	2.9
Lighting problem	5	1.3
mechanical problem	6	1.6
Others problem	324	86.2
Total	376	100

Source: KTZ RTAs annual report (2012-2017)

Table17: problem of care accident

Option	M	F	Total	%
Yes	40	36	76	76
No	8	10	18	18
No answer	2	4	6	6
	50	50	100	100

Table21: Crossing point of pedestrians in the main roads

Item	M	F	Total	%
At any point	17	14	31	31.0
At zebra	30	34	64	64.0
No answer	3	2	5	7.0
Total	50	50	100	100

Table22: Police commitment

Option	M	F	Total	%
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Strong agree	10	20	30	30
Agree	20	12	32	32
Disagree	20	18	38	38
Total	50	50	100	100

**Table23: Peoples' view on the road crossing**

Item	M	F	Total	%
Difficult	42	38	80	80
Easy	7	5	12	12
No answer	1	7	8	8
Total	50	50	100	100

**Table24: Pedestrians side walking habits**

Option	M	F	Total	%
Always	10	12	22	22
Same times	27	29	57	57
Never	13	19	32	32
Total	50	50	100	100

**Table25: Drivers priorities to pedestrians**

Item	M	F	Total	%
Strong agree	12	8	20	20

Agree	16	12	28	28
Disagree	22	30	52	52
Total	50	50	100	100

Table26: Car accident problem (2013-2017)

Option	M	F	Total	%
Yes	77	3	80	80
No	16	2	18	18
No answer	1	1	2	2
Total	94	6	100	100

Table27: Potential of vehicles causing accidents

Types of vehicles	M	F	Total	%
Heavy (trucks, buses)	36	4	40	40
Medium ( tax, automobiles )	44	2	46	46
Light (cycles, Bajaj)	14	-	14	14
Others (courts )	-	-	-	0
Total	94	6	100	100

Table28: Nature of collision

Types of collision	M	F	Total	%
Motor vehicle with motor vehicle	15	1	16	16
Motor vehicle with bicycle	5	1	5	5

Motor vehicle with pedestrians	72	2	77	77
Motor vehicle with static object	1	2	3	3
Motor vehicle with non-motor vehicle	1	-	1	1
Total	94	6	100	100

Table29: Show accident level road locations

Option	M	F	Total	%
On the main road	80	4	84	84
On the residential	10	2	12	12
On peripheral area	4	-	4	4
Total	94	6	100	100

Table31: Effects of RTAs on society

Option	M	F	Total	%
Very high	38	2	40	40
High	34	1	35	35
Low	24	1	25	25
Total	96	4	100	100

Table32: Attitudes of traffic police towards enough traffic symbols

Option	M	F	Total	%
Yes	3	1	4	4
No	89	4	93	93
No answer	2	1	3	3

Total	94	6	100	100
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Table 33 Factors of Road Traffic Accidents

Related factors	Accident factors ( reasons)	Accident year and number of accidents					Total	%
		2005	2006	2007	2008	2009		
Environmental factors	Weather conditions such as rainy, fog, cloud ,dizzily	4	7	2	6	8	27	7.0
	Condition of road, (roads							
Human factors	Driving beyond speed limit.	15	17	26	32	31	121	32.0
	Negligent priority to pedestrians	22	27	15	16	17	97	25.8
	Lack of keeping distance among other vehicles.	2	-	1	2	3	8	2.1
	The Use of Hand-Held Mobile Telephones	-	-	-	-	1	1	0.3
	Non using helmet and belt	1	2	1	1	0	6	1.6
	Violating traffic rules and regulation.	5	3	4	7	3	21	5.6
	Driving drunken alcohol or	6	10	9	8	18	51	13.6
Vehicles factors	Mechanical defects of vehicles such as brakes,	5	6	10	5	26	52	13.8



### Appendix 3: Different photos during data collection



Fig ; Vehicle to vehicle Fig :researcher and vice sajin in the KTZ police office

Source: photo taken by Co/r Mathew

### Appendix 4: Standard Definition of Basic Terms

Terms related to RTA can have different definitions in different places. However, (WHO 2010, Alister and Simon 2011) have quoted the following as standard definitions of basic terms of RTA.

**Accident:** Involves personal injury occurring on the public highway (including footways) involving at least one road vehicle or a vehicle in collision with a pedestrian and which becomes known to the police within 30 days.

**Damage:** vehicles or property involved in the accident are damaged.

**Disability Adjusted Life Years:** The years lost by an individual because he or she is disabled as a result of being involved in a Traffic Accident.

**Fatal injury:** Injury causes death within 30 days of the accident.

**Injury:** Physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy.

**Road traffic:** Any movement of a road vehicle on a given road network.

**Road user:** a person using any part of the road system as a non-motorized or motorized transport user.

**Serious accident:** Accident in which no one is fatally injured, but at least one casualty received serious injuries.

**Serious injury/ casualty:** Injury does not cause death within 30 days of the accident and either results in the casualty being detained in hospital as an in-patient, or any injury which causes death more than 30 days after the accident.

**Slight accident:** Accident in which at least one casualty receives slight injuries but no fatal or serious injuries.

**High-income countries:** Are countries whose Gross National Income Per capita is US\$ 12,616 or more.

**Low-income countries:** Are countries whose Gross National Income Per capita is US\$ 1,035 or less.

**Middle-income countries:** Are countries whose Gross National Income Per capita is between US\$ 1,036 to 12,615.