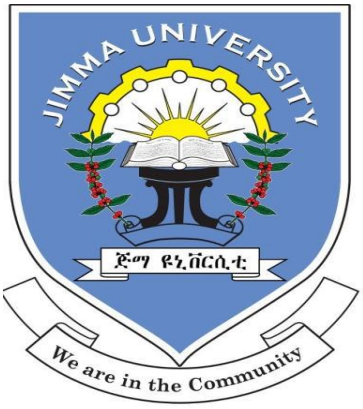


# Jimma University

## School of Graduate Studies

## Jimma Institute of Technology

## Faculty of Civil and Environmental Engineering

## Highway Engineering Stream

Assessment of Road Traffic Crashes in the Addis Ababa to Adama Old Main Road.

A Thesis Submitted To School of Graduate Studies of Jimma University, in Partial Fulfillment of the Requirements for Degree of Masters of Science in Civil Engineering (Highway Engineering Stream).

By: Endalkachew Yesuneh

Jan, 2018

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Advisor: Eng.Elmer C.Agon

Co-advisor:Mr. Markos Tsegaye

Jan, 2018

Jimma, Ethiopia

# DECLARATION

This is to certify that this thesis entitled "ASSESSMENT OF ROAD TRAFFIC CRASHES IN THE ADDIS ABABA TO ADAMA OLD MAIN ROAD" submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science in Highway Engineering at Jimma University, Faculty of Civil and Environmental Engineering done by Endalkachew Yesuneh, RM/0351/08 is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for an award of any degree or diploma to the best of our knowledge and belief.

**Submitted By**:

**Endalkachew Yesuneh** _____ ____/_____/____

**Signature** **Date**

**Advisors;**

**1. Eng. Elmer C.Agon** _____ ____/_____/____

**Main Advisor** **Signature** **Date**

**2. Mr. Markos Tsegaye** _____ ____/_____/____

**Co-Advisor** **Signature** **Date**

# ABSTRACT

*Road traffic crashes occur as a result of several factors associated with the traffic systems such as humans, vehicles, and roadways. Traffic crash is the most and worst leading testimony of death and injuries but now a day it is possible to reduce causes that results in great loss of life and property damages in developing country like Ethiopia. Addis Ababa to Adama old road is main old route which interconnects capital city with regional city and neighbor country like Djibouti.*

*The main objective of this study was to assess the road traffic crashes in Addis Ababa to Adama old main road. Road crashes were characterized using descriptive analysis to examine the relationships among factors and to identify possible causes and contributing factors. Crash rates were also been used to compare the total crashes occurred and crash severity is identified using crash data from traffic police.*

*The result of the study revealed that on average total traffic crashes including PDO occurred on the road before and after expressway constructed was 383 and 225 respectively. The average percentage of the type of crash due to vehicle and pedestrian collision occurred before and after expressway constructed is 60.26% and 54.1% respectively which accounts the largest cause of fatality. Driver whose education level is junior and age between 18-30 account highest traffic crashs before and after expressway constructed. Based on the result of this study the major causes of crashes attributed were failure to observe and give priority to pedestrians, following too closely and over speeding while driving. With regard to safety features installed along the road, problems identified during observation were mostly faded zebra, faded reflector and bent guiding post, missing value of grade, faded sign giving information, poor installation of speed limit.*

*It was concluded that the rate of traffic crash occurrence is decreasing from year to year in the analysis period and traffic crash is reduced after expressway constructed. In general the study recommends implementing of overall road safety improvements that ensure the existence of appropriate legislation and rigorous enforcement of road safety law and also driving training and examining should be improved and quality assurance should be given to target professional drivers.*

*Key Words: Addis Ababa, Adama, Road Crash Data, safety devices, expressway.*

# AKNOWLEDGMENT

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| | |
|---|---|
| **AA** | Addis Ababa |
| **AADT** | Average Annual Daily Traffic |
| **AIDS** | Acquired Immune Deficiency Syndrome |
| **CSA** | Central Statistical Agency |
| **DALY** | Disability Adjusted Life Year |
| **ERA** | Ethiopian road authority |
| **ETB** | Ethiopian birr |
| **GNP** | Gross National Product |
| **HIV** | Human Immunodeficiency Virus |
| **HMVMT** | crashes per 100 million vehicle mile travel |
| **IRTAD** | International Road Traffic and Accident Data Base |
| **KDE** | Kernel Density Estimation |
| **PDO** | Property Damage Only |
| **RSDP** | Road Sector Development Program |
| **RTA** | Road traffic accident |
| **RTC** | Road Traffic Crashes |
| **RTI** | Road Traffic Injury |
| **SPSS** | Statistical Package for the Social Sciences |
| **SUVs** | Sport Utility Vehicles |
| **TRL** | Transport Research Laboratory |
| **UK** | United Kingdom |
| **UN** | United Nation |
| **USA** | United States of America |
| **USD** | United States Dollar |
| **WHO** | World Health Organization |
| **WISH** | World Innovation Summit for Health |

# CHAPTER ONE
# INTRODUCTION

## 1.1. Back ground of the study

There is uneven distribution of natural resources on the earth's surface. There is insufficiency of different goods and services exist in different places around the world. In addition, there is a difference in specialization in the production of varieties of commodities and services. As a result of these conditions and other related drives people exchange what they have produced with what they need regardless of the distance between them and their partners in trade. Accordingly, people have to move from place to place to do so.

Any movement of people for any perseverance using different means is known as transportation. As indicated in (Bamford and Robinson, 1978), "Transport by definition infers a movement, and each individual from an early age owns his own "built -in" capability to travel, although within a restricted area". Moreover, to express the crucial part of transport (Bamford and Robinson, 1978) generalized that it is difficult to conceive of a situation where transport does not play a major role in the life of an individual.

It is obvious that, among all modes of transportation, road transport is the nearby means of conveyance. Road Transport's major advantage compared with others is its elasticity, which permits it to function from door-to-door over short distances at the most competitive prices (Bamford and Robinson 1978; Wough 1990). In Africa over 80% of goods and people are transported by roads while in Ethiopia road transport accounts for over 90% of all the inter-urban freight and passenger movements in the country (Kifle A. ,1996).

Transportation is one of the basic necessities for the opposite functioning of societies as its demand is greatly related to the movement of people from one place to another. Since every bustle of human being has its own consequences ,(positive or negative) transport is not an exception to this circumstances.

In connotation to this (Rallis, 1997) have stated that the constraints associated with transport include the risk of traffic mobbing, traffic coincidence, pollution, noise, and the like.

According to (Ajit and Ripunjoy, 2004) RTAs have turned out to be a huge global public health and development problem killing almost million people a year and wounding or disabling about 20-50 million people. The statistical profile reflects that in 2002, RTAs charged the global community about US $ 518 billion.

As the number of motor vehicles and vehicle-mile travel increases throughout the world, the exposure of the population to traffic crashes also increases. "It has been estimated that over 300,000 persons die and 10-15 million persons are injured every single year in road accidents throughout the world. Detailed analyses of global accident statistics by the UK Transport Research Laboratory (TRL) and others indicate that fatality rates per licensed vehicle in developing countries are very high in comparison with the industrialized countries. Fatality rates (with respect to vehicle numbers) in the developing world, particularly in African countries, can often be 20 to 30 times as high as those in European countries "(Transport Research Laboratory Guide, 1991). Road traffic accidents occur as a result of several factors associated with the traffic system, namely: road users, road environment and vehicles.

Despite having low road network density and vehicle ownership, Ethiopia has a relatively high accident records. Road accidents are concentrated in few of the regions in the country. Researcher shows that mostly, Addis Ababa City and Oromia Region account large fatal accidents and injuries. Though the above researches focused on the entire nature and disastrous effect of Road Traffic Accident (RTA) at a global scale, this study was focused on assessing road traffic crashes on Addis Ababa-Adama old main road.

## 1.2. Statement of the Problem

The first road crash was allegedly writhed by a cyclist on 30 May 1896 in New York city, shadowed few months later by the first fatality, a pedestrian in London (Gibson D. ,1975 and Joseph A., Shyngle ,1980).Road Traffic Accident is the prominent cause of death by injury in the world. According to (UN, 2011) above million people die in the world's roads every year. In addition to this, about 65% of the total deaths in road crashes in the world include pedestrians, 35% of these are children.

The impact of road transport accident over the socio – economic aspects of Africa is even much worse. (UN ,2011) shows that RTA costs Africa $10 billion annually and remains the second leading cause of death for 5–44 age - groups around the continent. Ethiopia contributes much to the misery of RTA in Africa. (Tesema ,2005) have stated that, in Ethiopia, above 1800 people died while around 7000 were crippled or injured in

2003 due to RTA. In addition to this, (UN, 2009) proclaimed that: Recognizing the importance of the road transport, the Government of Ethiopia has launched a Road Sector Development Program (RSDP) since 1997 which focused on upgrading and rehabilitating the existing road network, expanding the road network, and providing regular maintenance. Since then, the condition of roads has improved and the network which was about 26,550 km at the beginning of RSDP in 1997 has improved to 44,359 km by 2008.

Even if the progress of road network and improvement in the quality and accessibility of road transportation is continuing, RTA remains to be one of the precarious problems of the road transport in Ethiopia. Addis Ababa to Adama old main road has high traffic flow which includes all vehicle types resulting high crashes. Now a days vehicle imported into our country are being greater than before. This paper investigated traffic crashes on the old Addis-Adama road at present-day. This research was the first of its kind for Addis Ababa to Adama old main road.

## 1.3. Research question

This research was conducted to answer the following basic questions.

1. What is the trend and characteristics of Road Traffic crash occurrence in AA – Adama old road before and after expressway constructed?
2. What is the behavior of drivers on the use of the installed road safety devices?
3. What is the performance of the installed road safety features along the road stretch?

## 1.4. Research objective

### 1.4.1. General Objective

The main objective of this study was to assess road traffic crashes occurred on Addis Ababa-Adama old main road.

### 1.4.2. Specific objectives

The specific objectives of the research were:

1. To investigate the trend and characteristics of road traffic crashes before and after expressway construction.
2. To determine the performance of the installed road safety features along the road stretch.

3. To assess drivers' behavior on the use of the installed road safety devices.

## 1.5. Significance of the study

Addis Ababa toAdama old road is one of the main routes which have higher traffic accident. Fortunately the road is the main route of the country's import and export corridor from the Port of Djibouti.

Accordingly, the study is helpful to:

- ✓ Give insight in to road traffic accident and managing risk exposure with land use planning, designing roads for safety, providing visible, crashworthy, setting road safety rules and improving transport policy.
- ✓ Although it is important to public keeping themselves from traffic accident, Ethiopian Road Authority can use this research output to make decision to use the road in safety manner, traffic office/department to concentrate causes and possible measures for accidents to be taken, driver to learn from different mistakes that has done and for researchers for those who are doing on similar topic possible.
- ✓ It can be used as one source of information for those institutions concerned with road safety management and helps to improve the quality of decision-making in urban and rural road transport safety planning.

## 1.6. Scope of the Research

The scope of the study was limited to Addis Ababa-Adama old main road. Beside this, among the factors that affect the precision of any study, the availability and reliability of the information it employs is very important which will have instrumental impact later on the precision of the results and conclusions. This study mainly used Addis Ababa to Adama old road traffic crash data and information for nine years (2000 – 2009) which is collected from the Road Traffic Crash records of five towns and two woreda Traffic Police Office and other offices and stake holders concerned with the issues of RTA and road safety.

This study was mainly concerned with the assessment of road traffic crashes in Addis Ababa to Adama old main road. Emphasis was given to examining, identifying and analyzing, trend, characteristic, and possible cause of RTA in the Addis Ababa to Adama old road.

# CHAPTER TWO
# LITERATURE REVIEW

## 2.1. Definition and concepts:

The term traffic, from the point of view of road transport is defined as the flow of vehicles and pedestrians along a route. And traffic congestion is also defined as an overgrowing of pedestrians and vehicles along a route (Webster's Dictionary, 1976).

The term "traffic" can mean movement of people and vehicles on along roads and streets, or air craft's in the sky. However, the actual meaning of traffic usually sights and road markings which are to function in regulating, warning, guiding, and channelizing traffic. The term traffic control refers not only to road, rail, sea and air transportation but also the traffic of shoppers in a supermarket, the flow of paper in large offices and the movement of component on an assembly line (WHO, 2008).

Road traffic crash: A collision or incident involving at least one road vehicle in motion, on a public road or private road to which the public has right of access. Included are: collisions between road vehicles; between road vehicles and pedestrians; between road vehicles and animals or fixed obstacles and with one road vehicle alone. Included are collisions between road and rail vehicles. Multi-vehicle collisions are counted as only one crash provided that any successive collisions happen within a very short time period. Single vehicle accidents that involve a single vehicle, which means without other road user, are also enclosed (Safe Car Guide, 2004). In a similar manner (Ajit and Ripunjoy , 2004), have mentioned that Accident is an occasion, occurring abruptly, unpredictably and inadvertently under unforeseen circumstances.

Traffic, traffic congestion and road safety are terms used repeatedly in the assessments of road safety problems. Road safety refers the movement of pedestrians and vehicles along a street over a given area. When the flow of pedestrians and vehicles is not smooth and it is interrupted by accident causalities, most probably triggered by traffic congestion or other factor, then the safe movement will be replaced by traffic accident. Therefore, traffic accident and road safety are said to have an inverse relationship between each other (Adeolalu, A., 1977).

According to (Wikipedia, 1984) the term road traffic laws and regulations are the law which govern road traffic and regulates vehicles in order to facilitate the orderly and timely flow of traffic.

Most of all traffic crashes are due to human error. The term human error however is often controversial for It doesn't satisfactory describe that large number of injuries and deaths that occurs on the road as the result of driving errors while abilities to do so are mentally or physically unfit by alcohol or drugs, lack of experience, lack at distribution of attention etc.

Car crashes can damage one or more autos, people, or structures. Car crashes also called traffic crashes, auto crashes, road crashes, and motor vehicle crashes cause thousands of deaths and hundreds of thousands of disabilities each year. Worldwide, car crashes kill an estimated over one million people each year.

**Car Crash Types**

A traffic crash is defined as any vehicle crash occurring on a public highway (i.e. originating on, terminating on, or involving a vehicle partially on the highway). These crashs therefore include Collision with railroad train, Collision with street car, Collision with Bicycle, collisions between vehicles and animals(animal-drawn vehicle and with animal), vehicle and other motor vehicle, vehicles and pedestrians, or vehicles and fixed obstacles. Single vehicle crashs(Non-collision running off roadway and Non-collision overturning on roadway), in which one vehicle alone (and no other road user) was involved, are included(WHO, 2002).

**Common Car Crash Collisions**

A. **Rear-end collisions** -Rear-end collisions are very common.

These types of traffic crashs are often caused by sudden deceleration (slowing down or braking). In some cases, another driver is following too closely or accelerates to a higher speed than the car in front of it. Whiplash is a common injury that occurs in a rear end collision and usually affects drivers and passengers of the impacted car. Fault is usually attributed to the driver of the car that rear-ends the other vehicle.

B. **Side-impact collisions** -Side-impact collisions can cause grave injuries.

Often called "T-bone" or "broadside" collisions, side impact crashs occur when the side of a vehicle is impacted. It can be impacted by the front or rear of another vehicle or in some cases a fixed object. Vehicle damage is often severe and drivers or passengers on the impacted side of the vehicle usually sustain far worse injuries than they would in another type of crash.

C. **Sideswipe collisions** –

Sideswipe collisions occur when two cars that are parallel touch. In many cases, the damage is only severe, as the cars have just "swiped" each other.Injuries and damages are typically minimal, unless one of the drivers loses control of their vehicle as a result of the collision.

D. **Vehicle Rollover** -Vehicle rollover crashs are extremely dangerous and frightening.

A rollover occurs when a vehicle literally flips over onto its side or roof. Any vehicle can be involved in rollover crash, but cars with a high center of gravity such as SUVs (Sport Utility Vehicles) are especially prone to this type of crash. Often caused by sharp turns at high speed, rollover crashs can lead to serious injuries including spinal cord injuries and brain trauma.

E. **Head-on collisions** - These types of collisions are often fatal.

Head-on collisions are exactly what they sound like - they occur when the front ends of two vehicles impact each other.

F. **Single car crashs** - Crashs involving only one vehicle are also common.

They occur when a vehicle strikes objects such as poles, trees, fire hydrants, and walls. In some cases they may involve pedestrians and other innocent bystanders. Single car collisions can result in driver and passenger injuries, pedestrian injuries, and often extensive property damage.

G. **Multi-vehicle collisions** - Multi-vehicle collisions are sometimes referred to as

"Pile-ups" and often occur on busy roads such as highways and freeways. They can involve many vehicles and be the most dangerous. Vehicles can be impacted multiple

times and it may be difficult to escape. It is also difficult to determine fault in these cases (Kifle, A. 1996).

Road safety is a multi-sectoral subject which cannot be delivered by a single agency. In practice, road safety is shared responsibility national, regional and local level. It requires government and non-government agencies and the civil community to foster effective goals. Road safety involves three major components: the road system, the human factor and the vehicle element. These three elements are inter-linked through geo-referenced traffic events and provide the basis for road safety analyses and attempts to reduce the number of road traffic incidents and improve road safety.

## 2.2. Global and Regional Trends of Road Traffic crashes

As the number of motor vehicles and vehicle mile of travel increases, exposure of population to traffic accidents also increases. Road traffic accident is an accident with causal participation of road users in road transport (public roads, paths and squares); its regulation is an important area of traffic civil law. Road safety is complex of factors which ensure the safe situation for the traffic and pedestrians on the roads, preventing from accidents and dangerous situations (WHO, 2002).

Road traffic crashes occur on all continents, in every country of the world. Every year they take the lives of more than a million people and incapacitate many millions more. Rapid economic development has resulted in an increase in the transport sector in Ethiopia. However, the increase in the transport sector has been a problem in road safety by increasing the number of road accidents. Incidences of road accidents are one of the main problems to the nation. Road accidents are one of the major contributors of human deaths in Ethiopia. (Abdul-Kareem, 2003) has stated in his book that 1.17 million deaths occur each year worldwide due to road accidents 70% of which occur in developing countries. 65% of deaths involve pedestrians, 35% of which are children.

In 2004, the World Report on Road Traffic Injury Prevention was published, presenting valuable information about the causes, risks, and interventions related to RTIs. It was a hallmark report and greatly increased awareness of RTIs as a major health burden on the global community. Since then, the political momentum for road safety has gathered strength, with the UN General Assembly proclaiming 2011-2020 as the Decade of Action for Road Safety. The overall goal of the Decade of Action is to stabilize and then halve the level of road traffic fatalities around the world. If successful, an estimated 50 percent

reduction could avoid five million fatalities and 50 million non-fatal injuries, and save US$3 trillion in social costs (WISH, 2013) figure below.

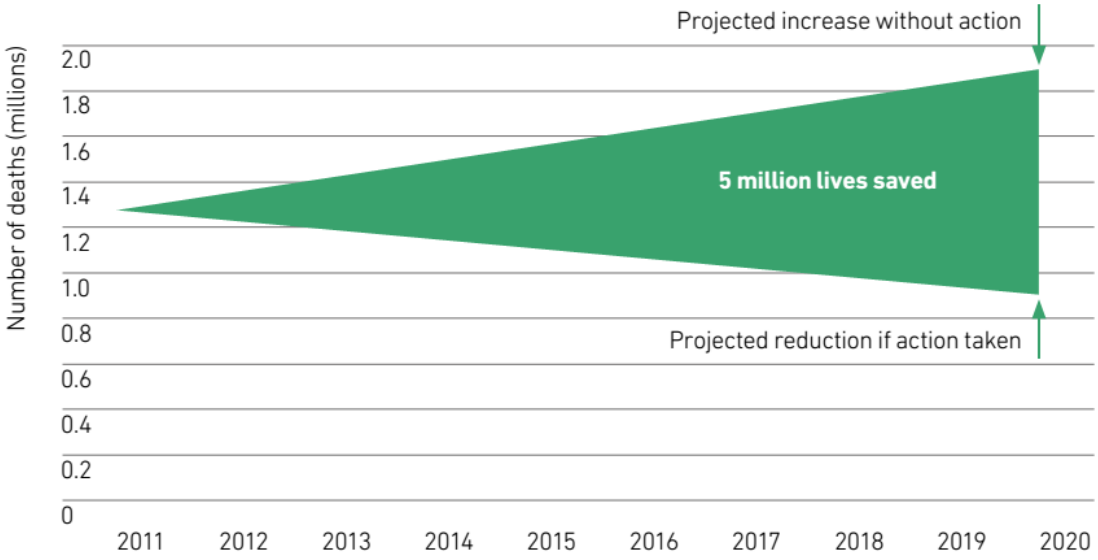



**Figure 2.1:** Goal of the Decade of Action for Road Safety 2011-2020

**Source:** Commission for Global Road Safety

According to (WHO, 2004), road traffic deaths have risen from approximately 999, 000 in 1990 to just over 1.1 million in 2002. Low-income and middle-income countries account for the majority of this increase. Although the number of road traffic injuries has continued to rise in the world as a whole, time series analysis reveals that road traffic fatalities and mortality rates show clear differences in the pattern of growth between high-income countries, on the one hand, and low-income and middle-income countries on the other. In general, since the 1960s and 1970s, there has been a decrease in the numbers and rates of fatalities in high-income countries such as Australia, Canada, Germany, the Netherlands, Sweden, the United Kingdom (UK) and the United States of America. At the same time, there has been a pronounced rise in numbers and rates in many low-income and middle-income countries.

The trends are based on a limited number of countries for which data were available throughout the period and they are therefore influenced by the largest countries in the regional samples. Such regional trends could mask national trends and the data should not be extrapolated to the national level. The regional classifications employed are similar too, but not exactly the same as those defined by The World Health Organization (WHO). There has been an overall downward trend in road traffic deaths in high-income

countries, whereas many of the low-income and middle-income countries have shown an increase since the late 1980s (WHO, 2004).There are, however, some marked regional differences; Central and Eastern Europe witnessed a rapid increase in road traffic deaths during the late 1980s, the rate of increase of which has since declined. The onset of rapid increases in road traffic fatalities occurred later in Latin America and the Caribbean, from 1992 onwards. In contrast, numbers of road traffic deaths have risen steadily since the late 1980s in the Middle East and North Africa and in Asia, particularly in the former (WHO, 2004).

The reductions in road traffic fatalities in high-income countries are attributed largely to the implementation of a wide range of road safety actions, including seat -belt use, vehicle crash fortification, traffic-calming interventions and traffic law enforcement. However, the reduction in the reported statistics for road traffic injury does not necessarily mean an improvement in road safety for everyone. According to the International Road Traffic and Accident Database (IRTAD), pedestrian and bicyclist fatalities have decreased more rapidly than have fatalities among vehicle occupants. In fact, between 1970 and 1999, the proportion of pedestrian and bicyclist fatalities fell from 37% to 25% of all traffic fatalities, when averaged across 28 countries that report their data to IRTAD. These reductions could, however, be due, at least in part, to a decrease in exposure rather than an improvement in safety (WHO, 2004).

## 2.3. Governance and leadership challenges

The WHO Global Status Report highlights interventions that have demonstrably reduced the burden. However, bringing about this reduction requires strongpolitical will and increased financial investments. Strengthening of national lead agencies is critical, particularly in developing countries where there is weaker institutional capacity, insufficient funding, and often limited political will. Though many countries are taking the right steps, progress is slow: 89 percent of the countries surveyed had established a lead agency for road safety, yet only 28 countries covering 7 percent of the world's population had been able to enact legislation across all the major risk factors.

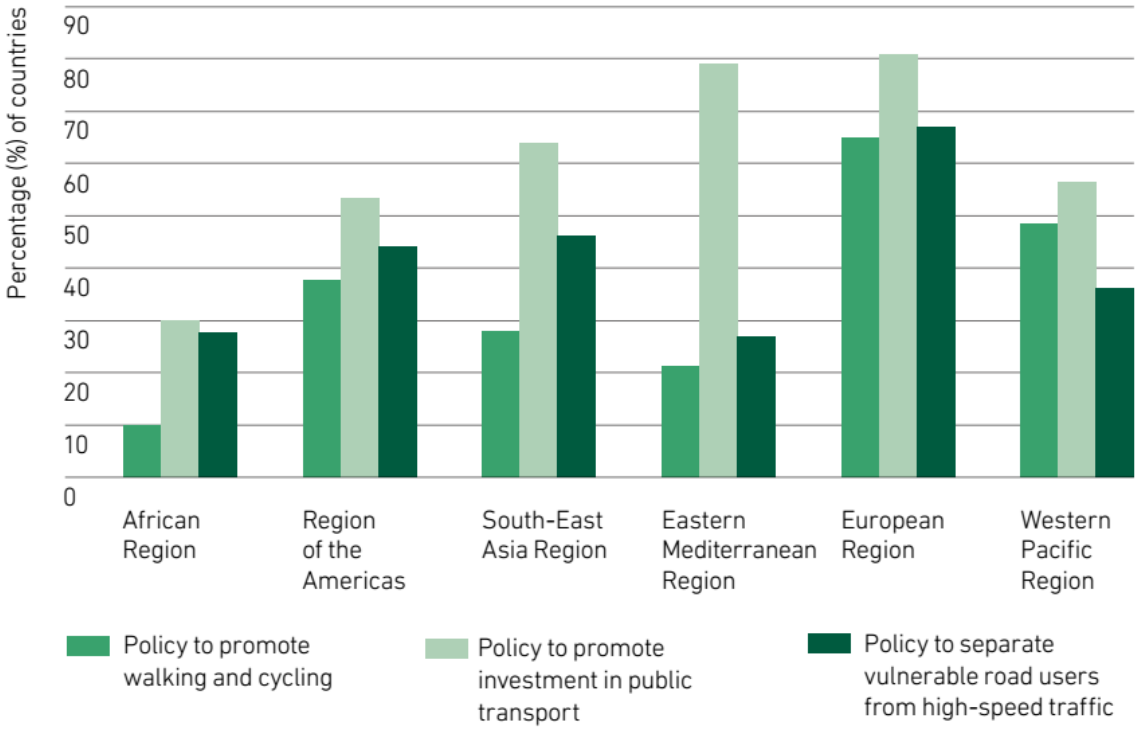



**Figure 2.2:** Proportion of countries with policies to encourage non-motorized modes of transport, by Who region

**Source:** Global Status Report 2013, WHO

## 2.4. Causes of Road Traffic Accident

Road traffic crash results from a combination of factors related to the components of the system including roads, the setting, vehicles and road users, and the way they interact. 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 trauma 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, K. S., B. David, et al. ,2005).

### A. 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, K. S., B. 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.

### B. Drink Driving

Driving drunk 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, driving drunk 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. For the overall driving population, as the blood alcohol content escalates from zero, the risk of being involved in a crash starts to upsurge significantly at a blood alcohol content of 0.04 g/dl. Inexperienced young adults driving with a blood alcohol content of 0.05 g/dl have 2.5 times the risk of a crash compared with more experienced drivers. If a blood alcohol content limit is static at 0.10 g/dl, this will upshot in three times the risk of a crash than that at 0.05 g/dl, which is the most common perimeter in high-income countries. If the legal limit stands at 0.08 g/dl, there will still be twice the risk than at 0.05 g/dl. Alcohol ingestion by drivers puts pedestrians and riders of motorized two-wheelers at risk.

### C. 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, K. S., B. 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 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% and among the rear seat car occupants by 25-75%.

**D. Choice of Less Safe Forms of Travel**

By one or another reason, many passengers use less safe forms of travel. It would be nothing if the passengers could arrive at their destination using any form of transportation. But several studies in different countries of the world showed that, the lesser the safety of travel is accompanied with miserable RTA occurrences. It is claimed by (WHO ,2004) that "Of the four main modes of travel, road travel scores by far the highest risk in most countries – using almost any measure of exposure – compared with rail, air and marine travel."

**E. 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 8 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.

### F. Age of Drivers

The age of drivers affects to the behaviour 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 y 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.

### G. Non-Use of Helmets

The use of helmets has a paramount role in reducing the severity of RTA. However, several riders in different countries of the world are enjoying their journey without using helmets until the worst effect of failing to use helmets come in to their lives. Regarding this (WHO ,2004; WHO, 2009; WHO, 2010) dictates that Non-helmeted users of motorized two-wheelers are three times more likely to sustain head injuries in a crash compared to those wearing helmets. Helmet-wearing rates vary from faintly over zero in some low-income countries to almost 100% in places where laws on helmet use are efficiently enforced. Though helmets have generally been extensively worn in most high-income countries, there is a confirmation of a decline in practice in some countries. More than half of adult riders of motorized two-wheelers in some low-income countries do not wear their helmets appropriately secured. Child passengers rarely wear helmets, or wear adult helmets that do not effectively protect them. Helmet use does not have adverse effects on neck injuries, visibility or the ability

to drive safely in traffic. Wearing a motorcycle helmet correctly can reduce the risk of death by almost 40% and the risk of severe injury by over 70% (WHO, 2010).

### H. The Use of Hand-Held Mobile Telephones

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

### I. Lack of Road User Information and Campaign

Road users ought to acquire the knowledge needed to travel safely by means of formal training and their own experiences. However, inadequate knowledge of traffic regulations, traffic signs, vehicles and other elements may be some of the factors contributing to unsafe behaviour and road calamities. Road user information and operations are intended to reduce accidents by promoting safer behaviour in traffic, by giving road users better knowledge and more favourable attitudes towards such behaviour. 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. On the other hand, campaigns made to specific target group such as use of seat belt, drink-driving campaign and the like have led to a decrease in number of accidents in particular types during the campaign periods.

### J. 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 delivers 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 behaviour. Some variables regarding the road related causes of RTA are discussed as to below.

### i. Road Environment

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. (Terje, 1998) indicates that in Africa road network is mounting fast, preservation standards have started improving lately, and there is potential for improving the safety standards of the roads. 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.

### ii. 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. If the tires lose contact with the pavement then the vehicle starts fishtailing.

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, K. S., B. David, et al., 2005).

### iii. 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, V., Gomes, 2000).

### K. Vehicle Related Causes of Road Traffic crash

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 manoeuvre. 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.

### L. Environment Related Causes of Road Traffic crash

The climatic and environmental conditions can also be a factor in transportation crashes. Supporting this idea (Lisa, K. S., B. David, et al. ,2005; Alister, C., OBE and B. Simon ,2011) argued that, Weather on roads can contribute to crashes: for example wet pavement reduces friction and flowing or standing water greater than 1/8”deep can cause the vehicle to hydroplane. Many several crashes have occurred during conditions of smoke or fog, which can reduce visibility. Vehicles travelling at high rate of speed are unable to see the slowing and or stopped vehicles in front of them which can lead in to multi –vehicle pileup. Glare can reduce driver visibility especially on east – west road way during the hours of sun rise and sun set.

During foggy conditions glare off of street lights and stop lights can also affect visibility. Wind gusts can affect vehicle stability. Slippery road (due to weather), deposit on road, animal or object in carriageway, poor or defective road surface, Inadequate or masked signs or road markings are also responsible for the disaster caused by environmental characteristics to RTA.

## 2.5. Impacts of Road Traffic crashes

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

### 1. Economic Impact

Road traffic accidents are currently deteriorating the financial wealth of many nations. In this regard, (WHO, 2004; Naci, H., D.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, A. , 2008)have discussed that, the economic impact of RTAs is substantial for Ethiopians as the annual cost is estimated to be around £40 million.

### 2. 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. Morbidity rates for males are considerably higher than those for females. 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 as paraplegia, quadriplegia, 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. Serious burns, contusions or lacerations can lead to emotional trauma associated with permanent disfigurement.

(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 diarrhoea, malaria, HIV/AIDS and tuberculosis.

**3. Generate congestion**

Of course, crashes themselves generate congestion, by distracting other drivers and blocking lanes and shoulders. And drivers frustrated by congestion may take risks that offset some of the benefits of reduced speeds, such as tailgating, using shoulders as traffic lanes, cutting across dense oncoming traffic, and speeding up excessively when permitted. Such behaviors are typical of ''road rage'' and may worsen congestion and result in crashes.

## 2.6. Road Traffic Accident in Ethiopia

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 contrary, in the heavily motorized countries, drivers and passengers account for the majority of road deaths involving children (Bunn F.T., 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.

Conferring 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 behaviour 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 to145.07 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).

**Road Traffic Accident Reporting System in Ethiopia**

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, 1963), 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 Woreda" 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.

The accident statistics, although not complete and with all sorts of limitations, can, however, be used by interested stakeholders to make a broad accident analysis for various purposes. Moreover, the existing data can be used to create awareness and define policy and mobilize human and financial resources towards alleviating the problem.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1. Background of the Study Area

### 3.1.1. Location and Administrative Setup

The study site is a road from Addis Ababa to Adama, with a total length of 100 kilometer. The road is a two-lane two-way highway with high standard in the country. The section between Addis Ababa to Modjo is the main route of the country's import and export corridor from the Port of Djibouti. The road is also part of the Trans East African Highway that is envisaged from Cairo in Egypt to Hebron in Botswana. Furthermore, more fertile land which is suitable for agriculture is located along the route especially large scale farmers of flowers and other plants, and also coffee growing peasants are inhabited at the sides of the road. The surface of Addis Ababa to Adama exhibits varied all slope characteristics and exhibits different rainy and dry seasons while it passes through different Woreda. Its average annual rainfall of the road encompasses the summation of the whole.

In general, the road connects the capital city of the country to sea ports of neighboring countries as well as recreation centers, and to the main agricultural potential area. Since this study was focus on crash assessment on old road due to expressway constructed the investigation was traversed through four towns; Gelan, Dukem, Bishoftu Modjo, and two woreda's Ada'a and Lome. Due to these facts, the road is considered as the most vital route in terms of economic and traffic volume.

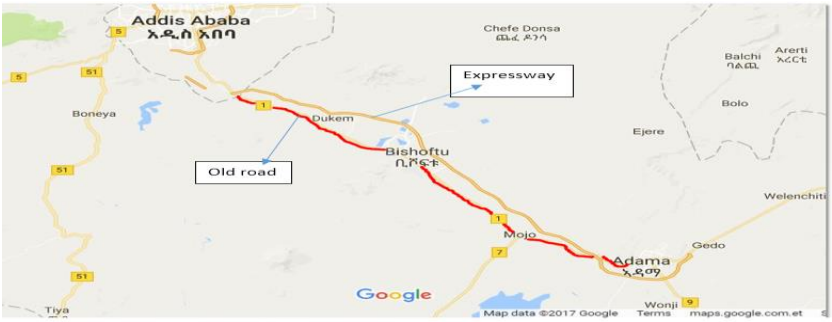



**Figure 3.1:** Map of AA to Adama road

## 3.2. Study design

Road crash was characterised using descriptive analysis to examine the relationships among factors and to identify possible causes and contributing factors. This helped to

know which crashes are significantly higher compared to crashes of other locations. Crash rates, severity type was also be used to compare the total crashes.

The methodology that was employed to analyze the data was descriptive statistics and parameters. The organized data was classified, tabulated and transferred in the form tables, figures, graphs and photos were analyzed and interpreted using descriptive methods.

### 3.3. Study Variables

For the execution this research the following research variables was included.

I. Independent Variable:

-Magnitude, severity, crash type, vehicle composition and rate of crash on the route.

-Performance of safety features: visibility and functionality at poor light conditions and weather conditions.

-Driver's behaviour on installed road safety devices: based on age, sex, educational status, driving experience, level of driver's license determining behavior of driver to use safety feature.

II. Dependent Variable: assessment of traffic crashes

### 3.4. Sampling Method and respondent

In this research purposive sampling techniques was used to conduct the study. Respondent were selected based on their knowledge of the study area. With this specific purpose the sampling started with three representative populations that have included all types of vehicle drivers which travel through Addis to Adama old road, traffic polices and transport officers.

### 3.5. Data Collection, Processing and Analysis

To accomplish this study depending on the research perspective and strategy chosen, the researcher must choose methods for collecting data. The data or information collected by the researcher can be either primary, that is to say the researcher collects the material himself, or secondary, i.e. already documented material are being used as a data source, which can be done in quantitative way. In this thesis, both primary and secondary data were used to accomplish the study. Since this study focused on crash assessment on old road due to expressway constructed, the investigation was traversed through five towns; Gelan, Dukem, Bishoftu Modjo, Adama and two woreda's Ada'a and Lome. To test the magnitude of relationship between dependent variable (crashes) and independent

variable (crash factors), percentage and other accident analysis parameters were also applied.

### 3.5.1. Data gathering tools

#### *3.5.1.1. Questionnaires*

Question papers were distributed using pre-prepared questionnaires to drivers, traffic polices and transport officers through which the road passes. Their responses to specific questions on the questionnaire relating to the use, and the appropriateness of the road traffic safety measures installed on the road were noted. For the traffic police and transport officer their answer to crash trend and future plan to further reduce the crashs along the route were noted.

#### *3.5.1.2. Field observation*

Field survey was under taken by the researcher to assess the performance of road safety features and capturing of road safety features was done using digital camera. In this study all traffic signs, symbols and other traffic safety devise were captured with their insignificant application.

### 3.5.2. Secondary Data Collection

#### *3.5.2.1 Accident Records*

Crashes were recorded by the traffic police on yearly basis. This study was based on a secondary data obtained from five towns and two woreda's for the Addis Ababa - Adama old highway for six years period from 2001-2006 before and three year period from 2007-2009 after expressways constructed.

#### *3.5.2.2 Traffic data*

To achieve the objective report, traffic data was obtained from ERA in order to determine the rate of traffic crash before from 2001-2006 and after from 2007-2009 expressway is constructed.

### 3.7.3. Method of Data Analysis

In order to characterize the populations of crash, statistical analysis was applied to determine the uniformity of the collected data. Road crash were characterised using descriptive analysis to examine the relationships among factors and to identify possible causes and contributing factors.

After the data was collected and organized well, it was expressed in terms of numbers or words. To figure out the rest of assessment the data was analyzed using Microsoft excel. A crash rate was calculated before and after expressway constructed. Traffic Crash severity was categorized as follows: fatal, serious injury, slight injury and property damage. Graphical techniques provide an excellent method to visualize the variability and other properties of a set of data. To the powerful interactive system of one's brain and eyes, graphical displays provide insight into the form and shape of the data and lead to a preliminary concept of the generating process. Based from the analysis conclusion and recommendation was forwarded.

Crash rate was determined using equation below;

$$A\ (road\ section) = \frac{C * 100{,}000{,}000}{365 * T * AADT * L}$$

Where,

A (road section) = Crashes per 100 million vehicle miles traveled (HMVMT),

C = Number of crashes in analysis year period (before and after expressway constructed),

T = time frame of the analysis, years

AADT = average annual daily traffic, and

L = length of the road section, in miles

### 3.6. Ethical consideration

Before the research was started different ethical problem were investigated and removed by discussing about the issue based on the proposed proposal. It may include; data collection methods with relating to the ethics, proposal writing techniques, evaluate the ethical value of research for country.

# CHAPTER FOUR

# ANALYSIS AND DISCUSSION

## 4.1. General Characteristics of Traffic Crash

### 4.1.1. Traffic Crashes in Towns or Woredas through which the Road Passes

The study was conducted through five towns (Gelan, Dukem, Bishoftu, Modjo, and Adama) and two woreda's (Lome, Ada'a). The trends of traffic crashes for two woreda's and five towns along the road before and after expressway constructed including towns internal road are shown below in Table 4-1.

**Table 4 -1:** Traffic Crash (2001-2009).

| No | Town and Woreda | Population | Road traffic crashes before expressway constructed (2001-2006) | | Road traffic crashes after expressway constructed (2007-2009) | |
|---|---|---|---|---|---|---|
| | | | Number | Percentage | Number | Percentage |
| 1 | Gelan | 794,489 | 318 | 8.40 | 79 | 5.70 |
| 2 | Dukem | 8,704 | 422 | 11.15 | 118 | 8.52 |
| 3 | Bishoftu | 99,928 | 528 | 13.95 | 255 | 18.41 |
| 4 | Ada'a | 130,321 | 247 | 6.52 | 56 | 4.04 |
| 5 | Lome | 140,030 | 278 | 7.34 | 62 | 4.48 |
| 6 | Modjo | 49,521 | 410 | 10.83 | 126 | 9.10 |
| 7 | Adama | 220,212 | 1583 | 41.81 | 689 | 49.75 |
| Sum | | | 3786 | 100.00 | 1385 | 100.00 |

**Source**: Traffic police commission office

Table 4.1 depicts that all traffic crash that happened along the road segment at the five towns and two woreda's, except Adama town that accounted nearly 41% and 49% of total crashs and Bishoftu accounted nearly 13% and 18% of total crashs before and after expressway constructed respectively, were decreased.

### 4.1.2. Traffic Crashes along the road

Table 4.2 and Figure 4.1 depict the yearly trends of traffic crashes as identified during police investigation. Accordingly, the crash increases from year 2001 to 2004 and slight decrease for the two year (2005 and 2006) before expressway constructed. Likewise,

traffic crashes in the year2007 and 2009 decrease too much and insignificant increase in year 2008 after expressway constructed. This indicates that at the opening of expressway crash decrease due to diversion of traffic flow from the old road.

**Table 4 -2:** Yearly crash trends on the road including PDO

| year | crash | %crash |
|---|---|---|
| 2001 | 347 | 15.07 |
| 2002 | 384 | 16.68 |
| 2003 | 394 | 17.12 |
| 2004 | 450 | 19.55 |
| 2005 | 390 | 16.94 |
| 2006 | 337 | 14.64 |
| SUM | 2302 | 100 |
| After | | |
| 2007 | 236 | 34.96 |
| 2008 | 276 | 40.89 |
| 2009 | 163 | 24.15 |
| SUM | 675 | 100 |

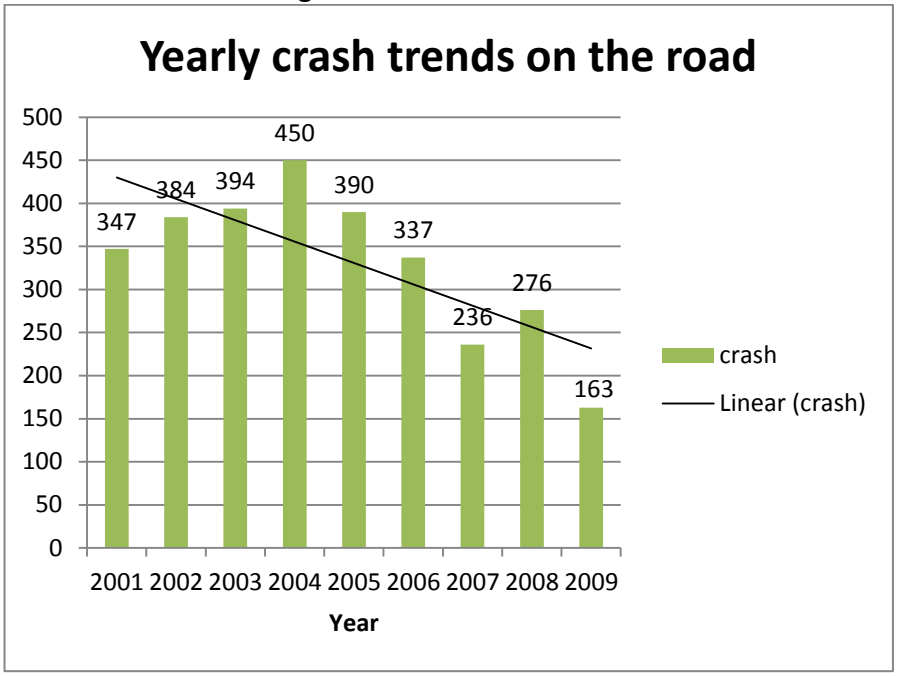



**Figure 4.1:** Yearly crash trends on the road

**Data Source**: Traffic Police Commission.

But the crash for the year 2008 increases by5.93 percent from the year 2007 after expressway constructed. This indicates that there were some causality like an increase in number of vehicle along the route, driver defect, pedestrian defect and other contributing factors.

### 4.1.3. Collision type

As shown in table4.3 ,among the ten type of collision on average pedestrian, side to head collision and back collision accounts the highest crash with (53.29, 11.88, and 11.08) percent respectively before expressway constructed. But after expressway opening from the type of collision; collision to pedestrian, overturning, side to head accounts the highest crash (53.33, 12.33, and 10.67 respectively). Even if the expressway is constructed the result indicate that an increase number of crash for the collision type; collision to pedestrian and overturning. But a decrease of crash for side to side, side to head, back and face to face collision type after expressway constructed.

**Table 4 -3:** Crash based on collision type excluding PDO

| Variable | type | 2001-2006 | | | | | | 2007-2009 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A. Number of Death | % of A.Death | A.Number of Injuri | % of A. Injuries | Total crashes | %crashes | A. Number of Death | % of A. Death | A.Number of Injur | % of A. Injuries | Total crashes | %crashes |
| Collision type | Head on | 4 | 5.13 | 6 | 6.12 | 10 | 5.99 | 3 | 4.22 | 2 | 7.69 | 5 | 5.33 |
| | Back/ head | 5 | 6.84 | 13 | 13.44 | 19 | 11.08 | 6 | 7.17 | 3 | 11.54 | 9 | 8.67 |
| | side/head | 7 | 9.40 | 13 | 12.76 | 20 | 11.88 | 7 | 9.28 | 3 | 12.82 | 11 | 10.67 |
| | side to side | 3 | 3.85 | 8 | 8.16 | 11 | 6.29 | 3 | 3.80 | 1 | 3.85 | 3 | 2.67 |
| | Over turning | 2 | 2.99 | 9 | 8.78 | 10 | 5.69 | 8 | 10.55 | 4 | 15.38 | 12 | 12.33 |
| | To pedestrian | 47 | 60.26 | 42 | 42.86 | 89 | 53.29 | 43 | 54.01 | 11 | 41.03 | 53 | 53.33 |
| | To animal | 3 | 4.36 | 3 | 2.55 | 4 | 2.20 | 2 | 2.53 | 1 | 3.85 | 2 | 1.67 |
| | To vehicle | 3 | 3.21 | 1 | 1.02 | 2 | 1.30 | 3 | 3.80 | 0 | 0.00 | 3 | 3.00 |
| | To object | 2 | 1.92 | 2 | 2.04 | 2 | 1.20 | 2 | 2.53 | 0 | 0.00 | 1 | 1.33 |
| | To rail | 2 | 2.24 | 2 | 2.04 | 2 | 1.30 | 2 | 2.53 | 1 | 3.85 | 1 | 1.33 |
| AV.TOTAL | | 78 | | 99 | | 169 | | 79 | | 26 | | 100 | |

### 4.1.4. Possible Causes As Identified By Police

According to the police reports, more than 93 per cent of the traffic crashes are caused by human errors. Of these crashes, drivers are indicated as responsible causes in about 92 per cent both before and after expressway constructed. Table 4-4 depicts the causes of traffic crashes as identified during police investigation. Accordingly, the major causes of traffic crashes in the year of the studies are following too closely, failure to give-way

for pedestrians, over speeding, failure to give way for vehicle, and failure to respect right hand rule before expressway constructed. But, the major causes of traffic crashes after expressway constructed are following too closely, failure to give-way for pedestrians and over speeding. However, the major causes of fatal crashes are following too closely and failure to give way for pedestrians before and after expressway constructed. The cause of these crashes is mainly drivers' errors.

**Table 4-4**: Causes of Road Traffic Crashes in Addis Ababa-Adama old road, 2001-2009

| **Cause of Traffic Crash** | Traffic crashes (2001-2006) | | Traffic Crashes (2007-2009) | | **Causes** | % age | %age |
|---|---|---|---|---|---|---|---|
| | **Total crash** | **%** | **Total crash** | **%** | | | |
| Influence of alcohol or drug | 21 | 0.912 | 10 | 1.481 | Human error | 93.745 | 93.481 |
| Failure to respect right hand rule | 218 | 9.470 | 57 | 8.444 | | | |
| Failure to give -way for Vehicle | 256 | 11.121 | 94 | 13.926 | | | |
| Failure to give -way for pedestrians | 370 | 16.073 | 99 | 14.667 | | | |
| Following too closely | 413 | 17.941 | 109 | 16.148 | | | |
| Improper overtaking | 169 | 7.341 | 52 | 7.704 | | | |
| Improper turning | 106 | 4.605 | 29 | 4.296 | | | |
| Overtaking on curve | 52 | 2.259 | 12 | 1.778 | | | |
| Over speeding | 257 | 11.164 | 82 | 12.148 | | | |
| Failure to respect traffic Signs | 44 | 1.911 | 14 | 2.074 | | | |
| Improper stopping | 52 | 2.259 | 18 | 2.667 | | | |
| Road failure | 48 | 2.085 | 10 | 1.481 | Road factor | 2.085 | 1.481 |
| Driving with fatigue | 50 | 2.172 | 18 | 2.667 | Human error | | |
| Driving without attention | 17 | 0.738 | 3 | 0.444 | | | |
| Improperparking/Moving from parking | 55 | 2.389 | 13 | 1.926 | | | |
| Over loading | 18 | 0.782 | 5 | 0.741 | | | |
| Failure in Vehicle | 32 | 1.390 | 9 | 1.333 | vehicle factor | 1.39 | 1.333 |
| Defective Environment | 15 | 0.652 | 6 | 0.889 | Env'tal factor | 0.652 | 0.889 |
| Pedestrian error | 28 | 1.216 | 4 | 0.593 | Human error | | |
| others | 32 | 1.390 | 9 | 1.333 | | 2.606 | 1.926 |
| unidentified | 17 | 0.738 | 10 | 1.481 | | | |
| Failure to respect traffic police order | 32 | 1.390 | 12 | 1.778 | Human error | | |
| **Total** | **2302** | 100 | 675 | 100 | | | |

**Data Source:** Traffic Police Commission

Table 4.4 depicts the possible cause of traffic crash in the year 2001-2009, in general the most critical type of traffic crash is following too closely both before and after expressway constructed. The main factor of traffic crashes speed and speeding has a great impact on pedestrian safety. Clearly, the faster the drivers go to travel, the more likely they are to be involved in a crash, and are more likely to severely injure vulnerable road users. Higher driving speeds reduce predictability and reduce a driver's ability to control the vehicle, negotiate and manoeuvre around obstacles on the roadway. Higher speed also increases the distance a vehicle travels while the driver reacts to a potential collision, reducing the time available to avoid a collision.

Generally report shows that most of the road crashes are largely due to a range of human error, road and vehicle factors that include:

a. Negligence of pedestrians;
b. Over speeding, unsafe overtaking;
c. Alcohol and drug abuse;
d. Driver negligence, poor driving standards;
e. Vehicle overload;
f. Poor maintenance of vehicles;
g. Bad roads;
h. Improper parking/Moving from parking
i. Failure to respect traffic police order

These findings need to be taken with caution as the single causes usually reported by the police oversimplify the reality. Also, traffic police are often more inclined to cite the driver as being at fault than a pedestrian because of the rules and guiding principles existing at this moment in time along the road specifically in the town through which the road passes, special investigation teams are needed to assess the contribution of the various risk factors at the time of a crash. And also traffic police commission office co-work with health center to have better recorded crash data.

### 4.1.4. Road Crash Deaths by Road User Types

Table 4.5 depicts that road crash death by road user type in Addis Ababa to Adama old road from 2001 to 2009EC, before and after expressway opened. Before expressway constructed from the total fatalities, about 45.45 % of the road traffic crash fatalities are pedestrians, 42.57% are passengers, and only 11.97 % are drivers. After expressway

constructed from the total fatalities, about 44.49 % of the road traffic crash fatalities are pedestrians, 43.62% are passengers, and only 11.88 % are drivers. The figure of pedestrians and driver are reduced after expressway constructed but figure of passenger increased. Even if the fatalities of pedestrians decrease after expressway constructed the figure is large which indicates that poor safety behaviour of road users and lack of pedestrians facilities and driver disrespect for pedestrians.

**Table 4 -5:** Traffic Crash Deaths by Road Users Type through the road

| Year | Total No. of Death | Drivers | | Pedestrians | | Passengers | |
|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | Number | Percent |
| 2001 | 74 | 17 | 3.77 | 35 | 7.76 | 22 | 4.88 |
| 2002 | 86 | 14 | 3.10 | 43 | 9.53 | 29 | 6.43 |
| 2003 | 71 | 9 | 2.00 | 25 | 5.54 | 37 | 8.20 |
| 2004 | 79 | 3 | 0.67 | 31 | 6.87 | 45 | 9.98 |
| 2005 | 76 | 7 | 1.55 | 32 | 7.10 | 37 | 8.20 |
| 2006 | 65 | 4 | 0.89 | 39 | 8.65 | 22 | 4.88 |
| Total | 451 | 54 | **11.97** | 205 | **45.45** | 192 | **42.57** |
| Av. | | | | | | | |
| 2007-2009 | | | | | | | |
| 2007 | 71 | 9 | 3.96 | 33 | 14.54 | 29 | 12.78 |
| 2008 | 102 | 16 | 7.05 | 36 | 15.86 | 50 | 22.03 |
| 2009 | 54 | 2 | 0.88 | 32 | 14.10 | 20 | 8.81 |
| Average | 75.67 | 9 | 3.96 | 33.67 | 14.83 | 33 | 14.54 |
| Total | 227 | 27 | **11.88** | 101 | **44.49** | 99 | **43.62** |

In terms of collision types, pedestrian crash are the dominant types of collision, as motorized traffic and pedestrians share the same facilities. Failing to observe pedestrian priority, and speeding are the likely root causes for the high level of crashes in the Addis Ababa to Adama old main road.

This is due to in adequate drivers' training and public awareness on traffic safety; Inadequate traffic facilities such as traffic lights, signs, signs crossing marks and speed regulator. As the issue of road safety is vital by its virtue it needs a special treatment in order to save the lives of citizens.

### 3.1.4 Severity of Crashes

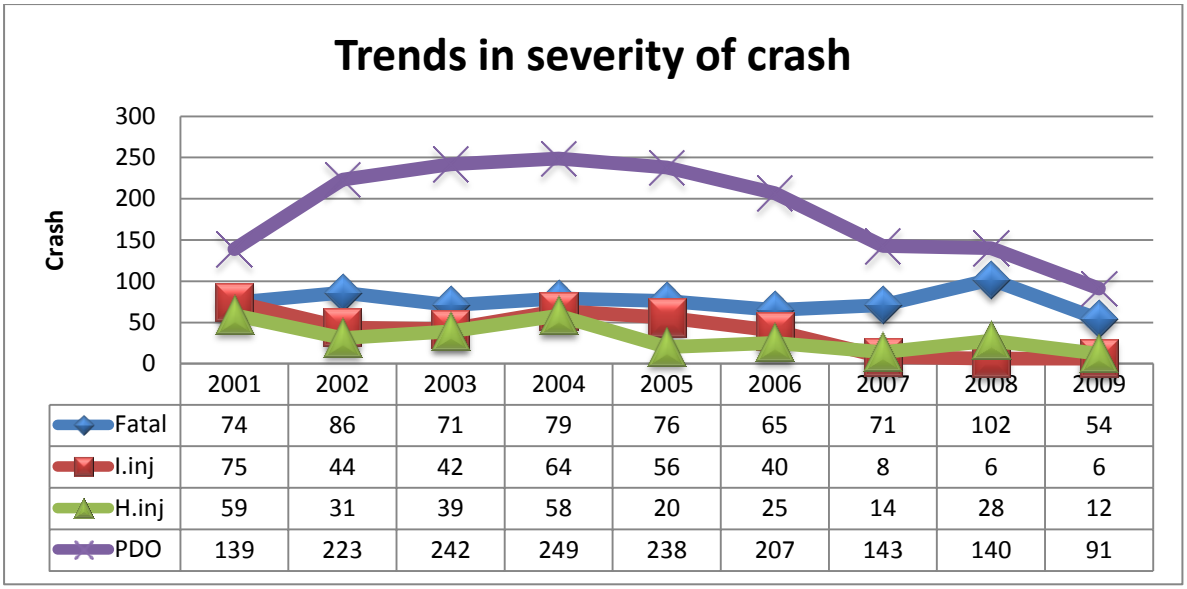
**Table 4 -6**: Trends in Severity of Traffic Crashes in Addis Ababa-Adama road

| **2001-2006(Total crash=2302)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Year** | | **Type** | | | | | | |
| | Fatal Crashes | %Fatal Crashes | Slight Injury | %Slight Injury | Heavy Injury | %Heavy Injury | PDO | **%** PDO |
| 2001 | 74 | 3.21 | 75 | 3.26 | 59 | 2.56 | 139 | 6.04 |
| 2002 | 86 | 3.74 | 44 | 1.91 | 31 | 1.35 | 223 | 9.69 |
| 2003 | 71 | 3.08 | 42 | 1.82 | 39 | 1.69 | 242 | 10.51 |
| 2004 | 79 | 3.43 | 64 | 2.78 | 58 | 2.52 | 249 | 10.82 |
| 2005 | 76 | 3.30 | 56 | 2.43 | 20 | 0.87 | 238 | 10.34 |
| 2006 | 65 | 2.82 | 40 | 1.74 | 25 | 1.09 | 207 | 8.99 |
| Total | 451 | **19.59** | 321 | **13.94** | 232 | **10.08** | 1298 | **56.39** |
| **2007-2009 (Total crash=675)** | | | | | | | | |
| 2007 | 71 | 10.52 | 8 | 1.19 | 14 | 2.07 | 143 | 21.19 |
| 2008 | 102 | 15.11 | 6 | 0.89 | 28 | 4.15 | 140 | 20.74 |
| 2009 | 54 | 8.00 | 6 | 0.89 | 12 | 1.78 | 91 | 13.48 |
| Ave. | 75.67 | 11.21 | 6.67 | 0.99 | 18 | 2.67 | 124.67 | 18.47 |
| Total | 227 | **33.63** | 20 | **2.96** | 54 | **8.00** | 374 | **55.41** |

**Data Source:** Traffic Police Commission Annual Report, 2001 – 2009

Table 4.6 depicts the trends in severity traffic crashes occurring yearly, fatality crash increases after expressway opened. But as noticed on table after expressway is constructed the remaining severity of traffic crashes reduced. The high percentage of fatalities indicates the lack of pre-hospital and emergency medical services. Poor emergency medical services and the absence of compulsory liability insurance laws are among reasons contributing to the high fatality rates. A poor road condition and limited enforcement of existing traffic laws and the poor condition of vehicles are other factors.

Below is the chart which shows the yearly crash severity trends on the road; fatal crashes, slight injury, sever injury and property damage only (PDO) for the whole study period.




| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|
| Fatal | 74 | 86 | 71 | 79 | 76 | 65 | 71 | 102 | 54 |
| I.inj | 75 | 44 | 42 | 64 | 56 | 40 | 8 | 6 | 6 |
| H.inj | 59 | 31 | 39 | 58 | 20 | 25 | 14 | 28 | 12 |
| PDO | 139 | 223 | 242 | 249 | 238 | 207 | 143 | 140 | 91 |

**Figure 4.2:** Severity of traffic crashes

## 4.2. Independent Categories Variable

A nine year data is used in order to compare the impact of each variable on the number of injuries per crash, the number of death per crash, the percent variation of fatal and injuries before and after expressway constructed with respect to the levels of each variable was calculated.

The results are summarized based on the three indicators which can show the impact of different levels of each variable.

The three indicators are:

• Number of Crashes by each level of a variable

• Number of deaths by each level of a variable

• Number of Injuries by each level of a variable

### 4.2.1 Drivers Related Variables and road traffic crashes

More than 93 per cent of the traffic crashes are caused by human errors. Of these crashes, drivers are indicated as responsible causes in about 92 per cent.

### A) Driver's Age and Crashes

Human beings are the primary causes of RTC. Several studies have witnessed that the age of drivers have a greater impact over the occurrence of RTC scenes. This is due to the

fact that, the age of drivers affects their driving behavior, concentration, sense of responsibility and patience.

The age range of drivers involved in crash is shown in Table 4.7. Among these categories, drivers with in the age group 18-30 are responsible for the larger number of fatal crashes (53.44%), injuries (51.18%) and for the large number of crashes (58.38%) before expressway constructed. And also after expressway constructed drivers with in the age group 18-30 are responsible for the larger number of fatal crashes (52.42%), injuries (59.46%) and for the large number of crashes (48.15%). However, drivers with age 18 and below have the smallest share in all the three measurements with regards to the total percent of crash both before and after expressway constructed. Correspondingly percent of crashes and fatalities reduced after expressway constructed but, injuries increased by 8.29% crashes.

**Table 4 -7:** Death, Injuries, total crashes and percent of Injuries/Death per Crash by Driver's age, 2001-2009.

| | | 2001-2006 | | | | | | 2007-2009 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Levels** | **T. Number of Death** | **% of Total Death** | **Number of Injuries** | **% of Total Injuries** | **Total crashes** | **%crashes** | **T. Number of Death** | **% of Total Death** | **Number of Injuries** | **% of Total Injuries** | **Total crashes** | **%crashes** |
| **Driving Age** | Below 18 | 11 | 2.44 | 14 | 2.53 | 36 | 1.56 | 9 | 3.96 | 1 | 1.35 | 44 | 6.52 |
| | Between 18-30 | 241 | 53.44 | 283 | 51.18 | 1344 | 58.38 | 119 | 52.42 | 44 | 59.46 | 325 | 48.15 |
| | Between 31-50 | 161 | 35.70 | 201 | 36.35 | 739 | 32.10 | 89 | 39.21 | 25 | 33.78 | 262 | 38.81 |
| | Above 51 | 38 | 8.43 | 55 | 9.95 | 183 | 7.95 | 10 | 4.41 | 4 | 5.41 | 44 | 6.52 |
| | Total | 451 | 100 | 553 | 100.00 | 2302 | 100 | 227 | 100.00 | 74 | 100.00 | 675 | 100 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average | 112.75 | 25 | 138.25 | 25.00 | 575.5 | 25 | 56.75 | 25 | 18.5 | 25.00 | 168.75 | 25 |

**Data Source**: Traffic Police Commission Annual Report

Among age groups, driver's aged less than 18 accounts for only 6.52% of total crash although they make up more than half the population, such that the 18-30 and 31-50 age groups account for more than three-fourth of total crashes. This is consistent with international reports that indicate that road traffic injuries are the second and third leading causes of death for age groups 15-29 and 30-44 (2002 WHO).

Likewise, 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 prone to the risk of crash accidents compared to the drivers aged above 30. This is mainly due to the fact that many exhibit behaviors and attitudes can place young drivers in more hazardous situations than other road users.

### A.1.Crash by Driver Licenses

Listed in Table 4.8 from 2001-2009 on the Addis Ababa –Adama old main road before and after expressway constructed, are the number of accident with regard to driver license.

**Table 4 -8:** Trends of crash by driver Licenses level

| Level | Crash based on driver license | | | | | |
|---|---|---|---|---|---|---|
| | 2001-2006 | | | 2007-2009 | | |
| | Sum | Ave. | % | Sum | Ave. | % |
| 1st level | 11 | 2 | 0.48 | 7 | 2 | 1.04 |
| 2nd level | 221 | 37 | 9.59 | 57 | 19 | 8.44 |
| 3rd level | 883 | 147 | 38.32 | 256 | 85 | 37.93 |
| 4th level | 632 | 105 | 27.43 | 196 | 65 | 29.04 |
| 5th level | 514 | 86 | 22.31 | 145 | 48 | 21.48 |
| Unique license | 15 | 3 | 0.65 | 4 | 1 | 0.59 |
| No license | 26 | 4 | 1.13 | 10 | 3 | 1.48 |
| Total | 2302 | | | 675 | | |

**Data Source**: Traffic Police Commission Annual Report

The results of the above table show that on the average number of crashes higher for the drivers whose licences were 3rd, 4th, 5th and 2nd level driving license both before and after expressway constructed. Although, the number and magnitude (severity) of crashes for these level were higher the amount of crash was decreased after expressway opened.

There was a strong and consistent relationship between increasing driver license level and increasing risk of moderate to fatal injury. Below is the chart shows crash level based on driver license.

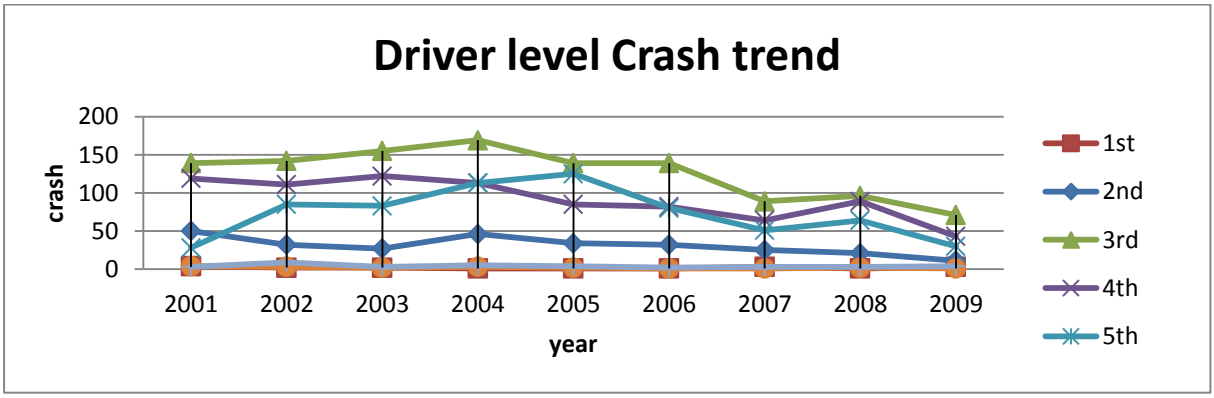



**Figure 4.3:** Driver level crash trends

Countermeasures are being carried out 3rd ,4th ,5th level driver's, authorities starting from creating awareness through education campaigns and enforcement of the traffic regulation along the road. Although the rate of road traffic crashes reduced, crashes are still large in number and occurring frequently.

**B) Driver's Educational Background**

Among the six categories of educational background depicts Table 4-9, those drivers with junior School level of education are responsible for the largest share of injuries (35.44%) and the largest share of death (43.68%) before expressway constructed. And also after expressway constructed drivers with junior School level of education are responsible for the largest share of injuries (37.84%) and the largest share of death (44.49%). This figure shows an increase in number of crashes for junior school driver after expressway constructed from other education levels. The number of injuries per crash and the number of death per crash, drivers with Basic Education and illiterate accounts for the smallest crash both before and after expressway constructed. In addition the other categories are almost reduced.

**Table4 -9:** Death, Injuries, % of Death and % of Injuries by driver's education, 2001-2009.

| | | 2001-2006 | | | | 2007-2009 | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Levels** | **T. Number of Death** | **% of Total Death** | **Number of Injuries** | **% of Total Injuries** | **T. Number of Death** | **% of Total Death** | **Number of Injuries** | **% of Total Injuries** |
| **Driving Education** | Illiterate | 2 | 0.44 | 7 | 1.27 | 3 | 1.32 | 0 | 0 |
| | Basic Education | 2 | 0.44 | 3 | 0.54 | 0 | 0.00 | 2 | 2.70 |
| | Primary School | 78 | 17.29 | 126 | 22.78 | 24 | 10.57 | 15 | 20.27 |
| | Junior School | 197 | 43.68 | 196 | 35.44 | 101 | 44.49 | 28 | 37.84 |
| | Secondary School | 119 | 26.39 | 167 | 30.20 | 63 | 27.75 | 20 | 27.03 |
| | Above Secondary | 53 | 11.75 | 54 | 9.76 | 36 | 15.86 | 9 | 12.16 |
| | Average | 75.17 | 16.67 | 92.17 | 16.67 | 37.83 | 16.67 | 12.33 | 16.67 |
| | Total | 451 | 100.00 | 553 | 100.00 | 227 | 100 | 74 | 100 |

The total number of crashes depicts that, the severity of crashes is higher for both junior school and Secondary School level drivers after expressway constructed. However, it is difficult to reach conclusions about the significance of the findings without knowing the education levels of drivers in the general population, it can be said that crashes are necessarily occurred due to shortage of knowledge or education driver.

Below was the chart which showed the trend of crashes by driver education level;

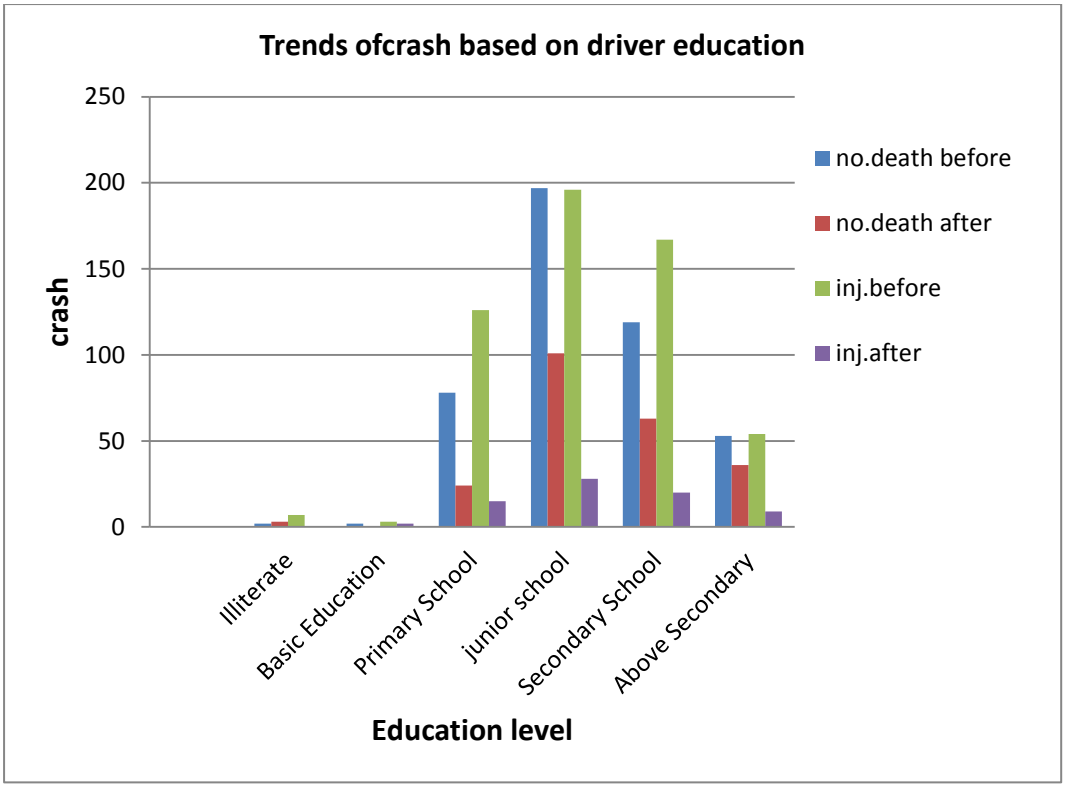



**Figure 4.4:** Crash based on driver education

### C) Driving Experience

Table 4-10 depicts that before expressway constructed drivers whose experiences exhibited high crash were Greater than 2year or less than or equal to 5 year represented 32.4% and 32.94% of fatally and injury crashes, respectively. Similarly, finding indicated that drivers whose experiences were greater than 5 year or less than or equal to 10 years indicated 32% and 24.91% of fatally and injury crashes, respectively. While after expressway constructed drivers whose experiences were Greater than 2year or less than or equal to 5 year represented 40.8% and 38.46% of fatally and injury crashes, respectively. Similarly, finding indicated that drivers whose experiences were greater than 5 year or less than or equal to 10 years indicated 27.6% and 20.51% of fatally and injury crashes, respectively. This figure indicate that crash increases for those driver experiences under Greater than 2year or less than or equal to 5 year and decreases for those driver experiences under greater than 5 year or less than or equal to 10 years after expressway constructed.

**Table 4 -10**: Death, Injuries, total crashes and percent of Injuries/Death per Crash by Driving Experience, 2001-2009.

| | | 2001-2006(Before) | | | | | | 2007-2009(After) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Levels** | **AV.Number ofDeath** | **% of AV. Death** | **AV.Number of Injur** | **% of Av. Injuries** | **T.Number of Crashes** | **% of Total Crashes** | **Av.Number of Death** | **% of Av. Death** | **Av.Number of Injur** | **% of Av. Injuries** | **T.Number of Crashes** | **% of Total Crashes** |
| **Driving Experience** | No driving license | 4 | 5.78 | 6 | 6.27 | 90 | 4.84 | 3 | 4.39 | 2 | 8.97 | 17 | 5.65 |
| | Less than or equal to 1 year | 3 | 3.78 | 3 | 3.44 | 126 | 6.77 | 3 | 3.95 | 2 | 5.77 | 12 | 3.99 |
| | Greater than 1year orless than or equal to 2 year | 10 | 13.3 | 19 | 19.89 | 153 | 8.23 | 12 | 16.2 | 4 | 16.67 | 50 | 16.61 |
| | Greater than 2year or ess than or equal to 5 year | 24 | 32.4 | 31 | 32.97 | 657 | 35.32 | 31 | 40.8 | 10 | 38.46 | 123 | 40.86 |
| | Greater than5 year orless than or equal to 10 year | 24 | 32 | 23 | 24.91 | 771 | 41.45 | 21 | 27.6 | 5 | 20.51 | 79 | 26.25 |
| | More than 10 years | 10 | 12.9 | 11 | 12.19 | 63 | 3.39 | 5 | 6.58 | 3 | 9.62 | 20 | 6.64 |
| | Total | 75 | | 93 | | 1860 | | 76 | | 26 | | 301 | |

**Data Source:** Traffic Police Commission Annual Report

Crashes were analyzed in terms of driver experience, and findings indicated that no driving licenses were involved in 5.78% of fatalities and 6.27% of injuries and 4.39% of fatalities and 8.97% of injuries are recorded before and after expressway constructed respectively.

### 4.2.2 Vehicle Related Variable

**Type of Vehicle**

This variable has six categories. On average among the nine categories, Taxi and Trucks are responsible for the largest number of crash with values 28.19% and 40.34 % before and 26.91% and 42.19 % after expressway constructed respectively. However, in average the crash of motorcycle, minibus less than 13 seats, truck, and gari was increased to some extent from other categories which are almost decreased similarly to each other after expressway constructed. The average of total crash, truck takes the liability for the largest percent (42.19) after expressway constructed.

**Table 4 -11:** Death, Injuries, total crashes and percent of Injuries/Death per Crash by Vehicle type, 2001-2009

| **2001-2006** | | | | | | | | **2007-2009** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Level** | **Av.Number of Death** | **% of Av. Death** | **Av.Numberof Injur** | **% of Av.Injuries** | **T.Number of Crashes** | **% of Total Crashes** | **Av.Number of Death** | **% of Av. Death** | **Av.Numberof Injur** | **% of Av.Injuries** | **T.Number of Crashes** | **% of Total Crashes** |
| **Type of vehicle** | motor bicycle | 2 | 2.63 | 3 | 3.47 | 30 | 2.99 | 2 | 2.99 | 2 | 6.41 | 12 | 3.99 |
| | Bus | 9 | 11.6 | 6 | 5.90 | 87 | 8.67 | 6 | 7.69 | 1 | 5.13 | 22 | 7.31 |
| | Minibus < 13 seats | 6 | 7.24 | 6 | 6.08 | 68 | 6.77 | 6 | 7.69 | 3 | 10.26 | 26 | 8.64 |
| | Taxi | 17 | 22.8 | 30 | 31.08 | 283 | 28.19 | 20 | 26.1 | 7 | 25.64 | 81 | 26.91 |
| | Truck | 32 | 42.1 | 36 | 36.98 | 405 | 40.34 | 35 | 44.9 | 7 | 28.21 | 127 | 42.19 |
| | station wagon | 2 | 3.07 | 3 | 2.95 | 31 | 3.09 | 1 | 1.28 | 1 | 3.85 | 3 | 1.00 |
| | Automobile | 6 | 7.46 | 6 | 6.42 | 71 | 7.07 | 4 | 5.13 | 3 | 10.26 | 20 | 6.64 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | liquid cargo | 1 | 1.64 | 4 | 3.65 | 19 | 1.89 | 2 | 2.56 | 0 | 0.00 | 2 | 0.66 |
| | Gari | 1 | 1.58 | 2 | 2.08 | 10 | 1.00 | 2 | 1.92 | 2 | 6.41 | 8 | 2.66 |
| TOTAL | | 76 | | 96 | | 1004 | | 78 | | 26 | | 301 | |

On average Truck, taxis and bus were involved in 42.1%, 22.8% and 11.6% of fatalities, respectively before expressway constructed. And also On average Truck, taxis and bus were involved in 44.9%, 26.01% and 7.69% of fatalities, respectively after expressway constructed. This shows an increase of fatalities on truck and taxis and decrease on bus. However, on average automobile, minibus less than 13 seats, liquid cargo, gari, station wagon and motorcycle currently decreased fatalities than before expressway constructed. On the other hand, comparatively station wagon vehicles had low fatality records after expressway opened; however, there were significantly high numbers of crash during the period. This may be due to the lower yearly kilometers travelled by this group of vehicles; however there are no data to confirm this.

Countermeasures might include higher training and licensing standards for professional drivers, adherence to vehicle capacity limits, and other improvements to infrastructure identified.

### 4.2.3 Location Related Variable

**Place of Crash**

Among the eight categories of places, on average entertainment and organization takes the highest crashes place both before (31.47% and 22.11%) and after (24.58% and 17.61%) expressway constructed respectively. This shows a decrease number of crash after expressway constructed. And also when it comes to the number of injuries, Table 4-12 depicts entertainment are the places with highest percent (31.7) followed by organization with percent (23.01) before and entertainment are the places with highest percent (32.05) followed by organization, Residence with percent (12.82) after expressway constructed. This indicates that crash at entertainment area increases after the opening of expressway. The lowest number of injuries per crash is for hospital with percent of 1.69 and 7.69 before and after expressway constructed respectively. Even if the number is lowest comparatively, the percent of injuries increased after expressway constructed.

**Table 4 -12**: Death, Injuries, total crashes and percent of Injuries/Death per Crash by crash place, 2001-2009

| | | 2001-2006 | | | | | | 2007-2009 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Levels** | **Av.Number of Death** | **% of Av. Death** | **Av.Numberof Injur** | **% of Av.Injuries** | **T.Number of Crashes** | **% of Total Crashes** | **Av.Number of Death** | **% of Av. Death** | **Av.Numberof Injur** | **% of Av.Injuries** | **T.Number of Crashes** | **% of Total Crashes** |
| **Crash place** | School | 3 | 3.85 | 7 | 7.43 | 59 | 5.88 | 4 | 4.82 | 2 | 7.69 | 18 | 5.98 |
| | Industrial area | 12 | 16 | 8 | 8.33 | 120 | 11.95 | 18 | 21.4 | 3 | 10.26 | 62 | 20.60 |
| | Religious place | 5 | 5.84 | 4 | 4.71 | 53 | 5.28 | 6 | 7.54 | 2 | 8.97 | 26 | 8.64 |
| | Market | 3 | 3.9 | 3 | 3.62 | 38 | 3.78 | 7 | 8.33 | 2 | 7.69 | 13 | 4.32 |
| | Entertainment | 24 | 30.5 | 29 | 31.70 | 316 | 31.47 | 16 | 19.4 | 8 | 32.05 | 74 | 24.58 |
| | Hospital | 3 | 3.46 | 2 | 1.96 | 17 | 1.69 | 5 | 5.95 | 2 | 7.69 | 7 | 2.33 |
| | Organization | 16 | 20.6 | 21 | 23.01 | 222 | 22.11 | 14 | 17.1 | 3 | 12.82 | 53 | 17.61 |
| | Residence | 12 | 15.2 | 18 | 19.75 | 179 | 17.83 | 13 | 15.1 | 3 | 12.82 | 48 | 15.95 |
| | Total | 78 | | 92 | | 1004 | | 83 | | 25 | | 301 | |

**Data Source:** Traffic Police Commission Annual Report

A probable contributor to this behavior is the lack of provision of transitional speed zones. As a result of the lack of transition, geometric parameters and roadside features can change abruptly and motorists may encounter heavy workload (Example: pedestrian and animal traffic) which creates safety risks.

### 4.2.4 Junction Related Variable

**Road Junction Types**

Among the six categories of places, on average the mid-block/no junction takes the highest crashes place which is (83.47% and 83.72%) of total crashes before and after expressway constructed respectively. And also from Road junction type categories listed below mid-block road junction, the number of death and number of injuries are the highest (82.9% and 78.07%) and (81.9% and 63.1%) before and after expressway opening respectively. This figure indicates that a decrease in number of crash after expressway constructed at mid-block road junction .But next to mid-block road junction when it comes to the number of death per crash, "T" junction is the highest percent (4.81) followed by "Y" junction and Four leg junction with a percent of (4.22) before and "Y" junction is the highest percent (7.41) followed by "T" junction (6.17)and Four leg junction with a percent of (4.94) after expressway constructed.

Mid-block road sections had a considerable share of fatal and non-fatal crashes in the 2001-2009 year, probably because much pedestrian crossing takes place in these sections. Marked and other crossing facilities are rare in midblock areas, which might result in increased fatal and non-fatal crashes.

**Table 4-13**: Death, Injuries, total crashes and percent of Injuries/Death per Crash Road junction type, 2001-2009

| | | 2001-2006 | | | | | | 2007-2009 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Levels** | **Av.Number of Death** | **% of Av. Death** | **Av.Numberof Injur** | **% of Av.Injuries** | **T.Number of Crashes** | **% of Total Crashes** | **Av.Number of Death** | **% of Av. Death** | **Av.Numberof Injur** | **% of Av.Injuries** | **T.Number of Crashes** | **% of Total Crashes** |
| **Type of junction** | Mid-block/no junction | 66 | 82.9 | 74 | 78.07 | 838 | 83.47 | 66 | 81.9 | 18 | 63.10 | 252 | 83.72 |
| | "Y" junction | 3 | 4.05 | 7 | 7.37 | 51 | 5.08 | 6 | 7.41 | 2 | 7.41 | 8 | 2.66 |
| | "T" junction | 4 | 4.81 | 6 | 6.53 | 50 | 4.98 | 5 | 6.17 | 3 | 9.26 | 15 | 4.98 |
| | Roundabout | 1 | 1.27 | 1 | 1.32 | 6 | 0.60 | 0 | 0 | 0 | 0.00 | 0 | 0.00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Four leg junction | 3 | 4.22 | 6 | 6.49 | 57 | 5.68 | 4 | 4.94 | 5 | 17.28 | 26 | 8.64 |
| | Five leg junction | 2 | 2.53 | 0 | 0.00 | 2 | 0.20 | 0 | 0 | 0 | 0.00 | 0 | 0.00 |
| | Total | 79 | | 94 | | 1004 | | 81 | | 28 | | 301 | |

**Data Source:** Traffic Police Commission Report

In addition, tangent alignment of road sections, and midblock areas were the most common locations of crashes. There is a need for good exposure data (such as traffic volumes) to determine whether these factors are over-represented among crashes. However, factors like speeding may be mitigated by provision of low cost engineering measures.

In the case of midblock crossings, advance warning signs and markings for vehicles and pedestrians, and road safety education may be viable solutions.

There are no road markings or signs to inform motorists that they must give way or to warn of the crossroad junction ahead. Typically found in quiet residential areas. Although unmarked crossroads appear quiet and stress-free, the often offer motorists some of the most hazardous conditions. Due to the lack of warning signs for the impending crossroads, no road markings to provide drivers with a clue that they must give way.

## 4.3. Rate of cash on the road

**A.** There are six steps involved with calculating and comparing route crash rates:

Step 1: Determine Segments length (mile)

Step 2: Determine Total Number of Crashes and KAB Crashes

Step 3: Determine AADT

Step 4: Calculate Crash Rates. Crash rates were also calculated and compared for the road before and after expressway constructed;

Step 1: Determine the roadway segments on your project. If multiple Peer Groups exist on your project, crash rates should be calculated for each Peer Group by combining adjacent segments of the same Peer Group.

$$A(road\ section) = \frac{C * 100{,}000{,}000}{365 * T * AADT * L}$$

$$A(Junction) = \frac{C * 100{,}000{,}000}{365 * T * AADT}$$

Where,

A (road section) = Crashes per 100 million vehicle miles traveled (HMVMT),

A (junction) = Crashes per 100 million vehicle entering a junction

C = Number of crashes in analysis year period (before and after expressway constructed),

T = time frame of the analysis, years

AADT = average annual daily traffic, and

L = length of the road section, in miles

**Table 4 -14:**Crash rate along the road

| Year | AADT | CRASH | Length(mi) | Yearly Crash Rate | Average Crash Rate |
|---|---|---|---|---|---|
| | | | | A | A |
| 2001 | 19852 | 347 | 51.57 | 92.85 | |
| 2002 | 24785 | 384 | >> | 82.31 | |
| 2003 | 30335 | 394 | >> | 69.00 | |
| 2004 | 38390 | 450 | >> | 62.27 | |
| 2005 | 30898 | 390 | >> | 67.06 | |
| 2006 | 34557 | 337 | >> | 51.81 | |
| Total | 178817 | 2302 | | | |
| Average | 29803 | 384 | | | 68.39 |
| 2007 | 23449 | 236 | >> | 53.47 | |
| 2008 | 23600 | 276 | >> | 62.13 | |
| 2009 | 22522 | 163 | >> | 38.45 | |
| Total | 69571 | 675 | | | |
| Average | 23191 | 225 | | | 51.54 |

**Data Source:** Traffic Police Commission Annual Report

As depicted in table 4.14 the yearly and average crash rate were determined. Accordingly on average the crash rate was reduced in number by 16.85 after expressway constructed. But based on the yearly result crash rate reduced from the year 2001 to 2006 (before

expressway constructed) and it was increased at the opening and reduced too much now as we compare, after construction of expressway. This shows that expanding the countries road network reduces the tendency of crash by reducing human loss and expenditure of economy. Additionally to clarify the result more follow figure below;

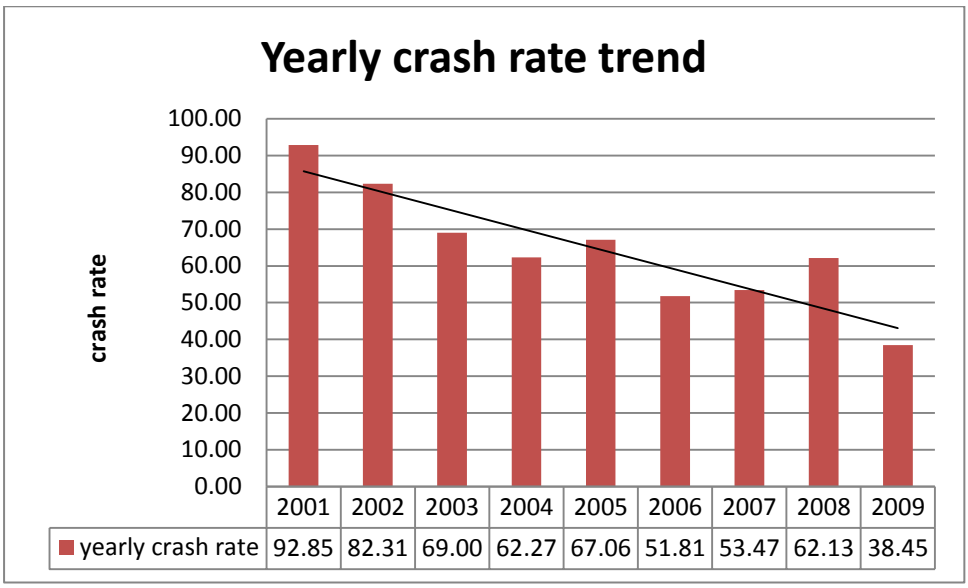



**Figure 4.6:** Yearly crash rate

**B.** calculating and comparing junction crash rates

**Table 4-15.**Junction crash rate

| 2001-2006 | | | | 2007-2009 | | |
|---|---|---|---|---|---|---|
| **Year** | AADT | CRASH | **Crash Rate** | AADT | Crash | **Crash Rate** |
| Mid-block/no junction | 29803 | 838 | 1283.93 | 23191 | 252 | 992.35 |
| "Y" junction | 29803 | 51 | 78.14 | 23191 | 8 | 31.50 |
| "T" junction | 29803 | 50 | 76.61 | 23191 | 15 | 59.07 |
| Roundabout | 29803 | 6 | 9.19 | 23191 | 0 | 0.00 |
| Four leg junction | 29803 | 57 | 87.33 | 23191 | 26 | 102.39 |
| Five leg junction | 29803 | 2 | 3.06 | 23191 | 0 | 0.00 |

Among the junction mid-block and four leg the remaining rate were decreased. Hence more treatment was required to further decrease the crash.

## 4.4. Transport experts and traffic police respond on road traffic crashes

As showed on appendices 'B', based on the questionnaire prepared by the investigator twenty traffic police and four transport officers were participated. Accordingly traffic crash was happened due to increase speed of the vehicle and mostly traffic crashes were happened at entertainment area along the route. Before expressway constructed from the type of vehicle truck was sufferer but after expressway constructed taxi was casualty and mostly from the type of crash vehicle to pedestrian was foremost crash type.

And also the road quality is not checked mostly. Even if the expressway constructed the number of vehicle is not decreased this much because of due to fees paid for the government. Before and after expressway constructed road traffic crash recording system was the same. Sometimes due to the number of vehicle may crash occur but specifically after expressway constructed it was due to the driver and pedestrian defect and crash were happened at noon because of the traffic police were at lunch.

As experts respond most of the driver have no well-trained both technically and theoretically skill as observed from them due to the trainer not giving better exam. Additionally for those governmental and nongovernmental organizations should focus on maintaining the road, installing additional traffic safety devices and pushing driver license awarding bureau as per the countries rule and regulation to build well examined driver to minimize or eliminate traffic crash.

## 4.5. Driver responds on the use of road safety devices

The implementation of overall road safety improvements that address young driver risk includes ensuring the existence of appropriate legislation and rigorous enforcement of road safety law, focusing on areas where young driver risk is especially high, including speeding, alcohol, drugs, unintentional driving and seat belt use. It is an area where immediate action can be taken, based on existing laws and regulations, and short-term gains will be seen. Effective communication will thus be required to gain public support. However, public resistance may be expected, particularly to enforcement.

As indicated on appendices 'A' the questionnaire divided into three parts, the first part: related to drivers certain personal demographics (such as: age, educational level, and driving experience). The second part: includes information about crashs (such as: location, time, cause, and type). Finally, the third part: introduces certain questions to identify driver's knowledge, behavior, and recognition of road traffic control devices

which respond by different types of vehicle drivers randomly. These drivers have direct contact with pedestrians with road safety conditions. Unsafe driving behaviors' are all serious risk factors for accident involvement. Source; field survey

**Table 4 -16:** Driver demographic response

| Information | Character | Total | In (%) |
|---|---|---|---|
| Sex | female | 0 | 0 |
| | male | 30 | 100 |
| | Total | 30 | 100 |
| Age Category | 16--19 | 1 | 3.33 |
| | 20--24 | 11 | 36.67 |
| | 25--35 | 11 | 36.67 |
| | Greater 35 | 6 | 20 |
| | Total | 30 | 100 |
| Educational Level | illiterate | 0 | 0 |
| | Read And Wright | 3 | 10 |
| | Primary School | 5 | 16.67 |
| | Secondary School | 12 | 40.00 |
| | Collage | 8 | 26.67 |
| | University Or Higher | 2 | 6.67 |
| | total | 30 | 100 |
| Marital status | Married | 6 | 20 |
| | Single | 16 | 53.33 |
| | Widowed/divorced | 8 | 26.67 |
| | Total | 30 | 100 |
| Age at which license taken | 18-19 | 1 | 3.33 |
| | 20-24 | 6 | 20.00 |
| | 25-30 | 19 | 63.33 |
| | Above 30 | 4 | 13.33 |
| | total | 30 | 100 |
| Experience | less than 5 | 7 | 23.33 |
| | 5_10year | 15 | 50.00 |
| | 11and above | 8 | 26.67 |
| | Total | 30 | 100.00 |

According to table above the sex structure of the surveyed respondents was all of them were male. Regarding age structure driver with the age of 16-19 were 3.33%, from 20-24 were 36.67%, from 25-35 were 36.67%, greater than 35 were 20%. The highest frequency age groups were 20 to 24 and 25 to 35.

In the age of educational status of driver, who have the ability to write and read were 10%, driver who attended primary school were 16.67%, respondent who attended secondary school were 40%,respondent who attended collage were 26.67%, respondent

who attended university or higher were 6.67% and there were no respondent who were illiterate. Concerning marital status 20% drivers' respondents were married, 53.33% drivers' respondents were married and 26.67% were divorced. Regarding Age at which license taken18-19 were 3.33, 20-24 were 20%, 25-30 were 63.33% and above 30 were 13.33%. Mostly driver experiences were 5 to 10year which accounts 50%.

**4.5.1. Driver response regarding traffic crashs** (such as: location, time, cause, and type);

From the total respondent almost less than half of them were face crash due to miss use traffic control devices (speed on pedestrian, improper aver pass at curve, improper turning/no U turn) at noon and evening. And due to this vehicle to pedestrian, head to side crash type were happened as per the response of the driver.

**4.5.2. Drivers reply on information about traffic control devices;**

Driver responds that almost all of them know traffic safety devices installed on the road. Greater than twenty of driver from all have information about those traffic control devices from different awareness creation mechanisms through radio and the remaining through television as they reply. Almost greater than half of them responds that from different awareness creation mechanisms radio was preferable due to most of our population was settled at rural area where other mechanism were limited access but others suggest television duet to it conveys clear and viable information towards the nation. Concerning the rule and regulation of traffic safety devices all of them have information and they respect sometime.

As responded by driver respecting road traffic safety devices can lead to save our life and other and save our property as well as countries economy. As replied by respondent most of the driver were not respecting the rule and regulation of traffic control devices intentionally so that the government should distribute enough traffic police through the road and the traffic police should punish the driver who did not obeyed the rule.

As responded by driver first of all the driver him/herself should take the commitment to further decrease crash occurrences and next the government or concerned office should install full road infrastructure.

## 4.6. Performance of installed road safety devices along the road

Countries that foster safe roads are better placed to win in the global competition for economic investment, and more likely to gain high returns on their education and health spending. But while safer roads can materially improve lives, resources and visibility for road safety trail many other global issues.

Road traffic crashs are one of the top causes of death worldwide. Now a days a few types of road safety devices are used to reducing the death rate by controlling traffic and managing the traffic in an efficient way. Road traffic crash trends are changed time to time in our country. There are three basic types of traffic sign: signs that give orders, signs that warn and signs that give information. Each type has a different shape. A further guide to the function of a sign is its color. Besides there are different safety devices installed on or side of road. In addition they should be properly installed and maintained periodically to save lives and countries economy. Below were mostly used sign.

Circle give order

Triangle warn

Rectangles inform

During the site visit and observation by the investigator from Addis Ababa to Adama old road there were so many safety devices with their insignificant application observed. Below photos were taken at some stations during site visit and discussions were provided separately for each station observed.


**Photos 4.1:** Problem observed up to Galan exit on installed safety devices

As it can be observed from the photos 4.1 the road segment at Galan mender in Gelan town there were no zebra cross and even some of them faded and also there was no installed safety device such as traffic sign for the indication of "T" junction, stop sign and yield sign.


**Photos 4.2:** Pedestrian crossing at Gelan with faded zebra

As it can be observed from the photos 4.2 the road segment at Galan entry in Gelan town even if the sign installed properly faded zebra and there were no strip on the sign which gives more emphasis to pedestrian.


**Photos 4.3:** Improper speed post Problem Observed from Galan to Dukem

As indicated on photo 4.3 there was improper speed post (too short) and priorities was given for notice board as observed from at Dukem entry.


**Photos 4.4:** Speed post and gradient sign problem

As shown on photo 4.4 there was improper location and missing grade value observed during investigation. And also bended speed post and faded written of detour were the problem observed at Dukem entry.

**Photos 4.5:** Written and station notice sign problem

Photo4.5 shows that faded written post which indicates that reduces speed on bridge and bended station announce post at Dukem Town were observed during site visit.

**Photos 4.6: Problem on school crossing**

As indicated on photos 4.6 school crossing being covered by road side tree with faded zebra and there was no strip on the sign were surveyed during site visit at Dukem Town.



**Photos 4.7:** School crossing and notice sign problem

Photos 4.7 showed that School crossing with faded zebra and no strip mark on the sign was observed during investigation. Bus station notice board was buckled and no stop sign here covered with private notice board and being bent at Dukem Town.


**Photos 4.8:** Zebra and information board problem

As indicated on photos 4.8 at three way junctions there was faded zebra color and at one side junction with faded animal cart sign at Bishoftu Town.


**Photos 4.9:** Junction sign and direction sign problem

Photos 4.9 showed that the problem of improper location of junction which is covered by private compound and Direction change sign covered with tree at the exit of Bishoftu town.


**Photos 4.10:** Speed post and no stop sign problem

As indicated on photo4.10 improper speed post sign and being turned down and no stop sign was in the forest and was being bent at exit of Dukem Town.

**Photos 4.11:** Road junction and turning sign problem

Photos 4.11 showed that there was faded road diversion sign and road junction sign supported to electric pole in between Bishoftu and Modjo town. And also no U turn with black cross bar which gives less warning for driver at Modjo town.

**Photos 4.12:** Guide post Problem

Photos 4.12 showed that the problem on the guide post with faded reflector, turned down and giving insignificant function for the road user in between Modjo and Adama.

**Photos 4.13:** Gradient sign and guide post problem

As indicated on photos 4.13 there were a problem of Missing grade value which gives more emphasis for driver to control speed and buckled guide post with faded reflector in between Modjo and Adama.

**Photos 4.14:** Junction and regulatory board problem

Photos 4.14 showed that "T" junction sign being collapsed and faded written "slow dawn" on regulatory sign at the entrance of Adama Town.


**Photo 4.15:** "U" turn sign problem

Photo 4.15 showed that as investigated by the researcher no "U" turn regulatory sign being covered with median tree at Adama town.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATIONS

## 5.1. Conclusion

The results in this study show that the number of injuries per crash is mainly determined by the variables related to vehicle and drivers. Drivers' Age, Educational background, license level, experience, type of vehicle, place of crash, and road junction, significantly affect the number of injuries per crash before and after expressway constructed.

- On average about 46.46 % of the road traffic crash fatalities are pedestrians, 47.28% are passengers, and only 6.36 % are drivers before expressway constructed and 44.49% of the road traffic crash fatalities are pedestrians, 43.62% are passengers, and only 11.88 % are drivers after expressway constructed. This shows a decrease of fatalities of pedestrian and passenger but an increase of fatalities for driver after expressway constructed.
- Drivers who are in the age group of 18-30 are accountable for most of crashes. Even if the figure is large the crash was reduced by 10.23% of crash after expressway opened.
- Drivers with junior school level of education take the major responsibility for the increased number of injuries per crash. Even if the figure is large the crash was reduced too much specifically the injury crashes after expressway constructed.
- With regards to places of crashes, entertainment, organizational and residential areas are where the highest injuries per crash are attained in the order given. Even if the figure is large the crash was reduced by 6.89, 4.5, and 1.88 percent respectively after expressway constructed.
- With regard to road junction crashes, mid-block/no junction and "T" junction on average accounts highest injuries. Although the figure is large the crash was reduced by1% in death, 14.97%in injury for midblock/no junction after expressway constructed. But for "T" junction crash was increased by 1.36% in death and by 2.73% in injury (slight and heavy) after expressway opened.
- Driver whose driving experience Greater than 2year or less than or equal to 5 year accounts an increased fatalities on average from 32.4%-40.8% which is by 8.4% after expressway opened.

- With regard to driver license level crashes, 3rd level, 4th level, 5th level accounts highest crashes on average in their order. Although the figure is large on average the crash was reduced by 0.39% in $3^{rd}$ level and by 0.83% in $5^{th}$ level license after expressway constructed. But driver whose $4^{th}$ license level crash was increased by 1.61%.
- With regard to yearly and average crash rate on average the crash rate was reduced in number by 16.85 after expressway constructed. But based on the yearly result crash rate reduced from the year 2001 to 2006 (before expressway constructed) and it was increased at the opening and reduced significantly now as we compare after(from the three year) construction of expressway.
- With regard to safety devices installed along the road problem identified during observation were mostly faded zebra, faded reflector and bent guide post, missing value of grade, faded sign giving information, poor installation of speed limit.

## 5.2 Recommendations

To begin with, proposed countermeasures should be realistic, and based on thorough research of the problem and the costs and benefits of proposed solutions, which must be clearly communicated. Senior-level decision-makers must show courage and leadership in publicly acknowledging the problem and the need to act. Countermeasures need to be implemented in a strategic manner that shows results both immediately and over the longer term. In doing so, particular attention should be paid to the key elements that underlie and aggravate risk.

The following is a suggested step-wise implementation of countermeasures:

1. **Road safety devices** and **its improvements**

Now a day a few types of road safety devices are used to reducing the death rate of by controlling traffic and managing the traffic in an efficient way. Various types of road safety are available which plays an important role in reducing the crash. Road signs are integral part of safety as they ensure safety of the driver himself (warning signs) and safety of the other vehicles and pedestrians on road (regulatory signs). Driver should be able to read the sign from a distance so that he has enough time to understand and respond. It is essential that they are installed and have correct shape, colour, size and location. It is required to maintain them as well, without maintenance in sound condition just their installment would not be beneficial.

In this study road safety features such as; **speed bumps** which is designed to make slowdown the driver's speed on street, **roadway reflectors which** provide information and cues for driver going through hazardous work zone areas and used to encourage safe driving condition and road **barrier** used for controlling the traffic, using highly visible radar speed signs that reduce fatalities by motivating drivers to drive within speed limit than written on board speed limit, marks grade value on the sign post and proper maintenance of zebra periodically as per the schedule and providing strip marks on pedestrian and school crossing sign can reduce fatalities of pedestrian along the route.

It can be generalized from this study that in addition to the efforts being made to reduce the traffic crashes rate special attention should be given to reduce the severity of crashes by taking the above road safety features into consideration.

**2. Driving Behaviour and Licensing**

As it is perceived from the respondents, there is ineffective and inappropriate driving behaviour and skills. Thus, an enforcement of road safety law and special licensing measures should be taken into action to be effective with concrete outcomes. The drivers should be subject to good driving behaviors' such as 'don't drink, while driving', don't chew kchat, give priority for pedestrians, do not use cell phone and patience. This is potentially one of the most effective countermeasures. However, it may require new legislation, meaning that it can't be implemented without concerned body's commitment.

Driving training and examining should be improved and quality assurance should be given to target professional drivers. Refreshment training program should also be promoted along with close monitoring of drivers working conditions and traffic crash trend. The Ethiopia Road Authority should make that close link with organization those give driving license in order to control the quality of license with the help of higher educational institute.

**3. Pedestrian facilities and its Improvements**

As it can be observed from the study pedestrians are the neglected as road users. There is problem on pedestrian facilities, so that features that assist pedestrian safety should be provided such as zebra crossing, pedestrian signal, safety zone and walkways. Moreover the vulnerable road user safety especially at Gelan, Dukem, Bishoftu and Modjo towns should be given first priority and improvement.

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# APPENDIXES

**Appendix A**. Research Questioner prepared for driver

On behalf of my effort to have remarkable achievement your feedback have endless support. Please try to provide real, tangible and confidential information for the success of this effort for further assurance of common goal on traffic control devices and traffic crashs that happen due to misuse of driver the devices in Addis Ababa to Adama old road. The questionnaire will be divided into three parts, the first part: related to drivers certain personal demographics (such as: age, educational level, and driving experience). The second part: includes information about crashs (such as: location, time, cause, and type). Finally, the third part: introduces certain questions to identify driver's knowledge, behavior, and recognition of road traffic control devices.

**Instruction**

- ✓ **For those candidate participate in this research question please try to answer all necessary data that is acquire from you with great pleasure.**

I) Make right (√) on rectangle based of the question to assure your feeling

II) For question that need detail decision please try to give your feedback.

1. Your Demographic characteristics including age, gender, marital status, education level, license type, and the age at which the driver obtained his license.

1.1. Gender :Male ☐ Female ☐

1.2. Age (Years)

16-19 ☐ 20-24 ☐ 25-35 ☐ More than 35 ☐

1.3. Marital Status

Single ☐ Married ☐ having kids; Yes ☐ No ☐

1.4. Your Educational level

☐ Illiterate

☐ Read and Write in

☐ Primary school

☐ Secondary school

☐ Collage

☐ University or higher

1.5. Age at which you Obtained your driving License

18 -19Years ☐ 20-24 years ☐ 25-30 years ☐

1.6. Your driving experience

Less than 5year ☐ 5-10year ☐ 11 and above ☐

2. Information about traffic crashs (such as: location, time, cause, and type).

2.1. Do you face accidents as before due to miss use of traffic control device?

☐ Yes ☐ No

2.2. If you say Yes; write the reason ,location, time, and type of crash

_____

_____

_____

2.3. Do you observe before while traffic crash occurs on driver due to miss use of traffic control devices? ☐ Yes ☐ No

2.4. If you say Yes; please write down the type of crash that you see, time and the place where it happen?

_____

_____

_____

2.5. What type of traffic crashs mostly occur due to miss use of traffic control devices?

_____

_____

_____

3. Do you have any information about traffic control devices before? Yes ☐ No ☐

3.1. If you say No; which of them are your optional reason behind lack of information's?

☐ Lack of serviceability

☐ Lack of education

☐ Lack of awareness creation

☐ Others

✓ If you resign others please discuss on space below.

_____

_____

_____

3.2. Do you have any information about those traffic control devices through different awareness creation mechanisms before? ☐ Yes ☐ No

3.2.1. If you say Yes; select the mechanism you had before; and

☐ Newspaper
☐ Radio
☐ Television
☐ Internet
☐ School discussion
☐ Meeting
☐ Home to home

3.2.2. Which one is most sensitive and attractive mechanism to create awareness to you and other road user in behalf of your capacity? Why?

_____

_____

3.3. Do you have any information about the rule and regulation of those traffic control devices? Yes ☐ No ☐

3.3.1. If you say Yes; how much you are loyal to those rule and regulations?

_____

_____

_____

3.3.2. What is the benefit you gain while being loyal to the rule and regulations?

_____

_____

_____

3.3.3. What can be expecting from you further respect the rule and regulations of traffic control devices?

_____

_____

_____

3.3.4. If you say No; what are the drawback that makes you not being loyal to the rule and regulations of those traffic control devices?

_____

_____

_____

3.4. How is your behavior on the use of traffic control devices while driving?

_____

_____

_____

3.5. Do you believe that the majority of driver can respect rule and regulations of traffic control devices? ☐ Yes ☐ No

3.5.1. If you say No; what can be expecting from driver and governor in order to enforce those driver to respect rule and regulation of traffic control devices?

_____

_____

_____

3.6. Do you believe that lack of using traffic control devices can enforce driver's respondent of accidents? ☐ Yes ☐ No

3.6.1. If you say Yes; by what means?

_____

_____

_____

3.6.2. So, what do you prefer in order to reduce further avoidances of crashes that happen due to lack of using traffic control devices?

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_____

**Appendix B**. Questionnaire's prepared for the traffic officers and for the transport office expert in the town through which the road passes.

This questionnaires are prepared to collect additional information which can help to study the assessment on road traffic crash in Addis Ababa-Adama old main road in partial fulfillment for the requirements of the award of masters of Science degree in Civil Engineering specialization in Highway 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 honest information. I would like to thank you in advance for your time and cooperation.

1. What are the major causes contributing for the majority of Road Traffic crashes occurrences in Addis Ababa to Adama road before and after expressway opened?

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   _____

   _____

2. How do you evaluate the trend of Road Traffic crash on this road before and after expressway?

   _____

   _____

   _____

3. Where the Road Traffic crash does frequently occurred on the road before and after expressway opened?

   _____

   _____

   _____

4. How do you assess the quality and distribution of road infrastructures like quality of roads, road traffic signs, side walkways and cross ways in the road?

   _____

   _____

   _____

5. How is the trend of vehicle flowing through the road before and after expressway constructed? Increase or decrease? Why?

_____

_____

_____

6. How is the Road Traffic crash Data recorded before and after expressway opened?

_____

_____

_____

7. Do you believe that road traffic accident is due to the number of cars moving on the road?

_____

_____

_____

8. In your opinion, drivers in Addis Ababa to Adama old main road give priorities to pedestrians as required by law.

_____

_____

_____

9. Which time of the day is more susceptible to road traffic crash? Please write three in their order.

_____

_____

_____

10. Which types of vehicles are causing high number of crashes in the Addis Ababa to Adama old main road before and after ?

_____

_____

_____

11. Which types of collision or road accidents were highly prevailing on the road?

_____

_____

_____

12. Do you think that the road has enough road traffic signs, signals, symbols and lights in all important areas before and after?

_____

_____

_____

13. Do you believe that there is enough traffic police distribution throughout the road before and after?

_____

_____

_____

14. Do you think that the trend of driving license award-ship by the bureau is given after intensive tests before and after expressway constructed?

_____

_____

_____

15. What is done so far to minimize the frequency of occurrence of Road Traffic crashes and their consequences?

_____

_____

_____

16. Please suggest some possible solutions to prevent and reduce road traffic crashs in Addis Ababa to Adama old main road?

_____

_____

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