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

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Abstract— **Road traffic crashes occur as a result of several factors associated with the traffic systems such as humans, vehicles and roadways. 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 crashes 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.**

Keywords— **AADT (Average Annual Daily Traffic), HMVMT (Crashes Per 100 Million Vehicle Mile Travel), PDO (Property Damage Only), RTC (Road Traffic Crashes) and WHO (World Health Organization)**

I. INTRODUCTION

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.

II. LITERATURE REVIEW

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.

III. OBJECTIVE OF THE STUDY

A. General Objective

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

B. Specific Objective

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.

IV. METHODOLOGY

A. 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 Ada'a and Lome. Due to these facts, the road is considered as the most vital route in terms of economic and traffic volume.

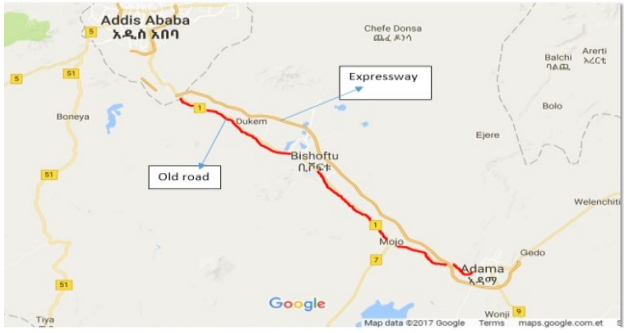

Figure 1 Map of Addis Ababa to Adama road

B. 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.

C. Study Variables

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

1) 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 behaviour of driver to use safety feature.
2) Dependent Variable: assessment of traffic crashes

D. 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.

E. 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 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.

F. Data Gathering Tools

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 crashes along the route were noted.

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.

G. Secondary Data Collection

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 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.

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.

H. 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

I. 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.

V. ANALYSIS AND DESIGN

A. General Characteristics of Traffic Crash Traffic Crashes in Towns or Woreda through which the Road Passes

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

TABLE I
TRAFFIC POLICE COMMISSION OFFICE

S. 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

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

B. Traffic Crashes Along The Road

Table II and Figure 2 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 II
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		
Year	**Crash**	**%Crash**
2007	236	34.96
2008	276	40.89
2009	163	24.15
SUM	675	100

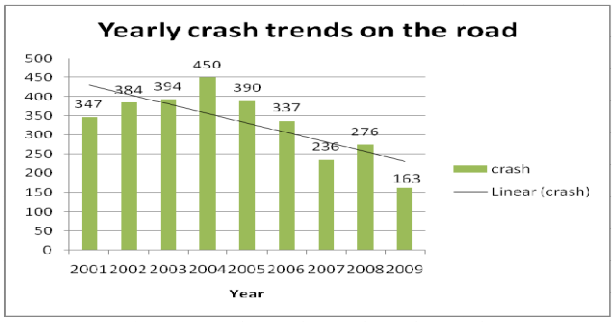

Figure 2 Yearly Crash Trends on the Road

1) Data Source: Traffic Police Commission.

But the crash for the year 2008 increases by 5.93 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.

C. Collision Type

As shown in Table III, 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.

D. 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 IV 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 man oeuvre 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:

- Negligence of pedestrians;
- Over speeding, unsafe overtaking;
- Alcohol and drug abuse;
- Driver negligence, poor driving standards;
- Vehicle overload;
- Poor maintenance of vehicles;
- Bad roads;
- Improper parking/Moving from parking;
- 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.

E. Road Crash Deaths by Road User Types

Table V 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 facilities of pedestrians decrease after expressway constructed the figure is large which indicates that poor safety behavior of road users and lack of pedestrians facilities and driver disrespect for pedestrians.

TABLE III
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	9.4	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	3.8	1	3.85	3	2.67
	Over	2	2.99	9	8.78	10	5.69	8	10.55	4	15.38	12	12.33
	Turning												
	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	2.2	2	2.53	1	3.85	2	1.67
	To vehicle	3	3.21	1	1.02	2	1.3	3	3.8	0	0	3	3
	To object	2	1.92	2	2.04	2	1.2	2	2.53	0	0	1	1.33
	To rail	2	2.24	2	2.04	2	1.3	2	2.53	1	3.85	1	1.33
AVERAGE TOTAL		78		99		169		79		26		100	

TABLE IV
CAUSES OF ROAD TRAFFIC CRASHES IN ADDIS ABABA TO ADAMA OLD ROAD, 2001-2009

Cause of Traffic Crash	Traffic crashes (2001-2006)		Traffic Crashes (2007-2009)				
	Total crash	%	Total crash	%	Causes	%age	%age
Influence of alcohol or drug	21	0.912	10	1.481			
Failure to respect right hand rule	218	9.47	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	Human error	93.745	93.481
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			
Driving without attention	17	0.738	3	0.444	Human error		
Improper parking/Moving from parking	55	2.389	13	1.926			
Over loading	18	0.782	5	0.741			
Failure in Vehicle	32	1.39	9	1.333	vehicle factor	1.39	1.333
Defective Environment	15	0.652	6	0.889	Environmental factor	0.652	0.889
Pedestrian error	28	1.216	4	0.593	Human error		
others	32	1.39	9	1.333		2.606	1.926
unidentified	17	0.738	10	1.481			
Failure to respect traffic police order	32	1.39	12	1.778	Human error		
Total	**2302**	100	675	100			

TABLE V
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	3.1	43	9.53	29	6.43
2003	71	9	2	25	5.54	37	8.2
2004	79	3	0.67	31	6.87	45	9.98
2005	76	7	1.55	32	7.1	37	8.2
2006	65	4	0.89	39	8.65	22	4.88
Total	451	54	11.97	205	45.45	192	42.57
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	14.1	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

TABLE VI
TRENDS IN SEVERITY OF TRAFFIC CRASHES IN ADDIS ABABA-ADAMA ROAD

Year	Type							
	Fatal Crashes	%Fatal Crashes	Slight Injury	% Slight Injury	Heavy Injury	% Heavy Injury	PDO	% PDO
2001-2006(Total crash=2302)								
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	3.3	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	6	0.89	12	1.78	91	13.48
Avg	75.67	11.21	6.67	0.99	18	2.67	124.7	18.47
Total	227	33.63	20	2.96	54	8	374	55.41

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.

1) Data Source: Traffic Police Commission Annual Report, 2001 – 2009. Table VI 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.
2) Chart: 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.

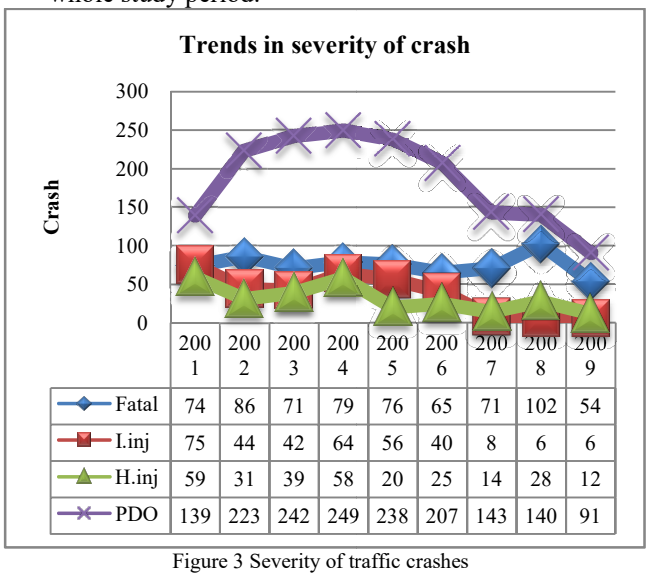

Figure 3 Severity of traffic crashes

F. Independent Categories Variables

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.

1) The three indicators are:
• Number of Crashes by each level of a variable

TABLE VII

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	2.4	14	2.5	36	1.6	9	4	1	1.4	44	6.5
	Between 18-30	241	53.4	283	51.2	1344	58.4	119	52.4	44	59.5	325	48.2
	Between 31-50	161	35.7	201	36.4	739	32.1	89	39.2	25	33.8	262	38.8
	Above 51	38	8.4	55	10	183	8	10	4.4	4	5.4	44	6.5
Total		451	100	553	100	2302	100	227	100	74	100	675	100
Average		112.8	25	138.3	25	575.5	25	56.75	25	18.5	25	168.8	25

• Number of deaths by each level of a variable
• Number of Injuries by each level of a variable

2) 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.

3) 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 VII. 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.

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.

4) Crash by Driver Licenses:

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

TABLE VIII

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 license

were3rd, 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.

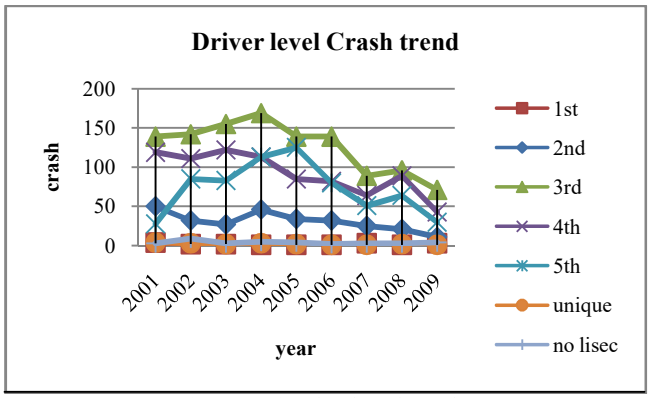

Figure 4 Driver level crash trends

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.

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

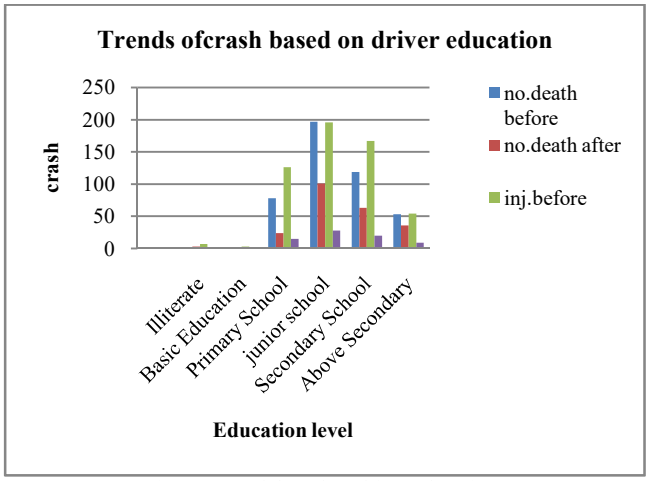

Figure 4 Crash based on driver education

TABLE IX
DEATH, INJURIES, % OF DEATH AND % OF INJURIES BY DRIVER'S EDUCATION, 2001-2009

		2001-2006				2007-2009			
Variable	Levels	Total Number of Death	% of Total Death	Number of Injuries	% of Total Injuries	Total 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	2	2.7
	Primary School	78	17.3	126	22.78	24	10.57	15	20.27
	Junior School	197	43.7	196	35.44	101	44.49	28	37.84
	Secondary School	119	26.4	167	30.2	63	27.75	20	27.03
	Above Secondary	53	11.8	54	9.76	36	15.86	9	12.16
	Average	75.17	16.7	92.2	16.67	37.83	16.67	12.3	16.67
	Total	451	100	553	100	227	100	74	100

6) Driving Experience:

Table IV to X 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.

TABLE IV TO X
DEATH, INJURIES, TOTAL CRASHES AND PERCENT OF INJURIES/DEATH PER CRASH BY DRIVING EXPERIENCE, 2001-2009

		2001-2006 (Before)						2007-2009 (After)					
Variable	**Levels**	**Average Number of Death**	**% of AV. Death**	**Average Number of Injuries**	**% of Av. Injuries**	**Total Number of Crashes**	**% of Total Crashes**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Av. Injuries**	**Total 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	24	32.4	31	32.97	657	35.32	31	40.8	10	38.46	123	40.86
	or equal to 5 year												
	Greater than5 year or less than	24	32	23	24.91	771	41.45	21	27.6	5	20.51	79	26.25
	or equal to 10 year												
	More than 10 years	10	12.9	11	12.2	63	3.39	5	6.58	3	9.62	20	6.64
	Total	75		93		1860		76		26		301	

TABLE IV TO XI
DEATH, INJURIES, TOTAL CRASHES AND PERCENT OF INJURIES/DEATH PER CRASH BY DRIVING EXPERIENCE, 2001-2009

		2001-2006						2007-2009					
Variable	**Level**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Average Injuries**	**Total Number of Crashes**	**% of Total Crashes**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Average Injuries**	**Total 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	12	6	5.9	87	8.7	6	7.7	1	5.1	22	7.3
	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	31.1	283	28.2	20	26.1	7	25.6	81	26.9
	Truck	32	42.1	36	37	405	40.3	35	44.9	7	28.2	127	42.2

	station wagon	2	3.07	3	2.95	31	3.09	1	1.28	1	3.85	3	1
	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	2	0.66
	Gari	1	1.6	2	2.1	10	1	2	1.9	2	6.4	8	2.7
TOTAL		76		96		1004		78		26		301	

TABLE IV – XII
DEATH, INJURIES, TOTAL CRASHES AND PERCENT OF INJURIES/DEATH PER CRASH ROAD JUNCTION TYPE, 2001-2009

		2001-2006						2007-2009					
Variable	**Levels**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Average Injuries**	**Total Number of Crashes**	**% of Total Crashes**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Average Injuries**	**Total Number of Crashes**	**% of Total Crashes**
Crash place	School	3	3.9	7	7.4	59	5.9	4	4.8	2	7.7	18	6
	Industrial area	12	16	8	8.33	120	12	18	21.4	3	10.3	62	20.6
	Religious place	5	5.8	4	4.7	53	5.3	6	7.5	2	9	26	8.6
	Market	3	3.9	3	3.6	38	3.8	7	8.3	2	7.7	13	4.3
	Entertainment	24	30.5	29	31.7	316	31.5	16	19.4	8	32.1	74	24.6
	Hospital	3	3.5	2	2	17	1.7	5	6	2	7.7	7	2.3
	Organization	16	20.6	21	23	222	22.1	14	17.1	3	12.8	53	17.6
	Residence	12	15.2	18	19.8	179	17.8	13	15.1	3	12.8	48	16
	Total	78		92		1004		83		25		301	

TABLE IV – XIII
DEATH, INJURIES, TOTAL CRASHES AND PERCENT OF INJURIES/DEATH PER CRASH ROAD JUNCTION TYPE, 2001-2009

		2001-2006						2007-2009					
Variable	**Levels**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Average Injuries**	**Total Number of Crashes**	**% of Total Crashes**	**Average Number of Death**	**% of Av. Death**	**Average Number of Injuries**	**% of Average Injuries**	**Total Number of Crashes**	**% of Total Crashes**
Type of junction	Mid-block/no junction	66	82.9	74	78.1	838	83.5	66	81.9	18	63.1	252	83.7
	"Y" junction	3	4.1	7	7.4	51	5.1	6	7.4	2	7.4	8	2.7
	"T" junction	4	4.8	6	6.5	50	5	5	6.2	3	9.3	15	5
	Roundabout	1	1.3	1	1.3	6	0.6	0	0	0	0	0	0

	Four leg junction	3	4.22	6	6.49	57	5.68	4	4.94	5	17.3	26	8.64
	Five leg junction	2	2.5	0	0	2	0.2	0	0	0	0	0	0
	Total	79		94		1004		81		28		301	

TABLE IV - XIV
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	68.39
2002	24785	384	>>	82.31	
2003	30335	394	>>	69	
2004	38390	450	>>	62.27	
2005	30898	390	>>	67.06	
2006	34557	337	>>	51.81	
Total	178817	2302			
Average	29803	384			
2007	23449	236	>>	53.47	51.54
2008	23600	276	>>	62.13	
2009	22522	163	>>	38.45	
Total	69571	675			
Average	23191	225			

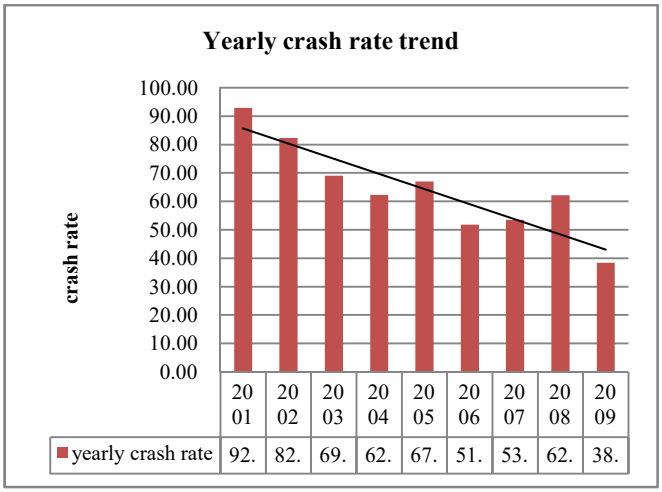

Fig VI Yearly Crash Rate

TABLE IV - XV
JUNCTION CRASH RATE

2001-2006				2007-2009		
Year	AADT	CRASH	Crash Rate	AADT	Crash	Crash Rate
Mid-block/no junction	29803	838	1283.9	23191	252	992.35
"Y" junction	29803	51	78.14	23191	8	31.5
"T" junction	29803	50	76.61	23191	15	59.07
Roundabout	29803	6	9.19	23191	0	0
Four leg junction	29803	57	87.33	23191	26	102.39
Five leg junction	29803	2	3.06	23191	0	0

TABLE IV - XVI
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
	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
	25-30	19	63.33
	Above 30	4	13.33
	total	30	100
Experience	less than 5	7	23.33
	5_10year	15	50
	11and above	8	26.67
	Total	30	100

VI. CONCLUSION AND RECOMMENDATIONS

A. 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 3rd level and by 0.83% in 5th level license after expressway constructed. But driver whose 4th 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.

B. 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, color, 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 Behavior and Licensing:

As it is perceived from the respondents, there is ineffective and inappropriate driving behavior 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 k chat, 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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