Fatal Injury Crash Data Analysis and Directions to Reverse the Growing Rate of Road Traffic Related Fatality in Addis Ababa

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Abstract

Road traffic injury has become one of the major world health problems. Each year 1.2 million people are killed and 50 million people are injured in road traffic crash. According to Addis Ababa Police Commission report, on average 391 people have lost their life each year in Addis Ababa streets for the past 3 years. Based on World Health Organization (WHO) estimate for Ethiopia, the actual number of road traffic related fatalities in Addis Ababa could be much higher that the reported amount, by about 6.4 times, as it also considers the people died after the scene and underreporting. This makes the number of fatalities in Addis Ababa around 2502, in a year. It has shown 6 percent increase on average during the past 6 years.

In order to tackle this problem, it requires understanding the contributing factors by studying the crash history of the City to provide evidence based solution. However, the crash data of the City doesn't provide important information about the crashes that can be used to solve the problem. In this study, it is tried to fill the gap by carefully analysing the available information to find out the major causes of crash and its countermeasures.

It is found that 86percent of fatalities are pedestrians. Majority of the fatal crashes are caused by a vehicle moving at high speed striking a pedestrian at road segments (out of junctions). About half of fatal crashes happen on major median divided roads. More than half of fatalities were caused by light vehicles.Based on the findings of the analysis, it is concluded that the main contributing factors for road traffic fatal crash in Addis Ababa City are speeding, lack of the necessary pedestrian facilities and drinking and driving.

Therefore, to reverse the growing rate of road traffic fatalities in Addis Ababa City, speed and blood alcohol content (BAC) control; and provision of pedestrian facilities that assure safety of pedestrians must be given prime attention. In order to assist concerned bodies,tackle the road traffic crash strategically, a map that shows high fatal crash frequency locations is prepared for Addis Ababa City by using ArcGIS software. Specific location descriptions given by traffic police for each fatal crash locations are used to extract geographical coordinates from Google Earth. At the end, focus areas and directions to improve road traffic safety are provided for the City based on the data analysis results.

Keywords—*Road traffic injury, accident black-spot, victims of road traffic fatal crashes, speeding, pedestrian safety, major roads, Addis Ababa City.*

Introduction

A. Background information about Addis Ababa City

Addis Ababa is a Capital of Federal Democratic Republic of Ethiopia and a seat of Regional Government of Oromia. The City is also a seat of African Union. Some call the City, a political capital of Africa. As a result, many international and governmental organizations are situated in the City. Addis Ababa is not only the political Capital but it is also country's commercial hub.

B. Economic growth and its impact

During the past decade, Ethiopia has shown rapid economic growth. Being the economic and political capital of the country, Addis Ababa has also shown enormous growth in all perspectives. Even though Addis Ababa has low population of vehicles compared to Cities in developing countries with equivalent population size, it has high rate of motorization. From 2012/2013 to 2014/2015 (2005 to 2007 Ethiopian Calendar (E.C.)), each year motor vehicle population has shown an increase of 4.5% on average. To gear up the economic growth and to cope with the motorization rate, many new roads have been constructed and the existing roads have been upgraded. According to Addis Ababa City Road Authority (AACRA) the road coverage in Addis Ababa City reached more than 20%. All of the above mentioned combined, has posed transport problems to the City. These problems could be road traffic injury, traffic congestion and environmental pollution. Focus of this paper is road traffic injury in the City.

C. Pedestrian issues

In spite of the fact that walking makes the highest mode share in Addis Ababa City, pedestrians are not well considered during planning, design, construction and maintenance of the roads. On most of roads in the City pedestrians lack the necessary facilities. On the majority of local roads, pedestrian and motor vehicle traffic are not well segregated. Pedestrian walkways are blocked by road side utilities (electric and tele poles, drainage manholes) and street vendors and roadside businesses. One can see walkways demolished to berry utilities left open or not reconstructed to the required quality level. Pedestrians share space with motor vehicles which increases their risk of injury as the roads do not allow the vehicle to reduce speed.

On major roads constructed for mobility, enough crossings are not provided. Pedestrian bridges are put as far as 2 km apart at some locations on the ring roads. The fencings are not effective as pedestrians could climb to cross the road. Drivers do not expect pedestrians on this kind of roads. Hence if a crash happens, it usually results either fatal or serious injury.

Most of the old and the new roads are designed and constructed primarily for vehicles. The newly constructed roads allow the fast movement of vehicles in dense pedestrian traffic without enough facility that segregates pedestrians from motor vehicles. That is why most of the newly constructed roads are also the new accident blackspots.

At intersections pedestrian demand is not considered enough. The pedestrian crossings and walkways do not satisfy pedestrian demand. As a result, pedestrians make risky illegal crossings such as crossing through circulatory lane in roundabouts. Most of the intersections in Addis Ababa City are uncontrolled intersections.

On the majority of the streets the pedestrian and traffic road markings and signs are non-existent or not in good condition. This affects the behavior of pedestrians and drivers particularly at crossings.

D. Road traffic crash status of Addis Ababa City

All of the above mentioned problems resulted high pedestrian crash in Addis Ababa City. According to Addis Ababa Police Commission report, on average 413 people have lost their life each year in Addis Ababa streets during the past 3 years. World Health Organization (WHO) estimate for Addis Ababa is higher than the police report by about 6.4 times, as it also considers the people died after the scene and under-reporting. Assuming WHO estimate correct, the number fatalities in Addis Ababa each year due to road traffic crash is about 2502, on average. The data also shows that it has increased by 6 percent on average during the past 6 years. Therefore, it has become a big concern to citizens and responsible bodies.

E. About this study

This study analyzes a fatal crash data of the City in order to find out the major contributing factors so as to provide important information for road safety improvement planning. In this study:

- Fatal crash data of Addis Ababa City has been thoroughly analysed
- Major causes of crash and contributing factors has been identified
- Locations in the City with high frequency of fatal crash are identified and mapped
- Finally, focus areas and directions for improvement of road traffic safety in Addis Ababa City are provided.

II. Literature Review

A. Pedestrian traffic situation in Addis Ababa

Report from Addis Ababa Police Commission shows that on average 86% of road traffic fatal crash victims in a year are pedestrians for the past three years. If the City intends to improve road traffic safety it is obvious than pedestrian safety must be given a top priority.

Study made on Kazanchis area revealed that the vehicle composition of traffic in streets of Addis Ababa during afternoon peak hour is found to be 73%, 22%, 2%, 1.6% and 1.2% for cars, minibuses, buses, trucks and motorcycles respectively [1]. The same study has revealed that even though cars constitute 73% of traffic it serves only 22% of the trips. 76% of the population travel by minibuses and buses. 48% of travel in the City is made using minibus taxi. In contrary to other low income countries, the modal share of motor cycle is very low. We have to recognize that the study result of Kazanchis area may not apply to the whole of the City. But is believed that the variation will not be high. In the absence research results for the City, we have no

other choice than relying on this result.

Most of the public transport (76% of travellers) users are at some point pedestrians, at least at the end and start of their journey. Therefore, the exposure of pedestrians to road traffic injury is expected to be high.

Conventionally roads are designed to serve the needs of vehicles, ignoring the needs of other vulnerable road users including pedestrians (2, 3&4). As a result, most of the existing roads lack appropriate pedestrian facilities such as walkways and crossings. This caused pedestrians to share space with fast moving vehicular traffic which create crash risk (5, 6&7).

International Road Assessment Program (iRAP) made assessment of 114 km roads in Addis Ababa and found that most of the road sections assessed are not safe for pedestrians. iRAP rates roads sections from 1 to 5 based on their safety provision for different road users. 5 is the safest whereas 1 is the most dangerous road. Out of the 114km roads assessed 50% of the road sections have got 1 star rating for pedestrian whereas only 17% of the road sections have got 1star rate for vehicle occupants (8). This is an evidence for Addis Ababa City that the needs of pedestrians are not well considered.

B. Pedestrian crash risk factors and intervention methods

A manual prepared by World Health Organization (WHO) for pedestrian safety improvement puts speed, alcohol, lack of pedestrian facilities in roadway design and land-use planning and inadequate visibility of pedestrians as major risk factors for pedestrian traffic injury (9).

Many studies revealed that speed is a key risk factor for road traffic crash risk and injury severity (9, 10&11). Traffic injury is a result of energy interchange (9&10). As energy is directly proportional to a mass and square of velocity, smaller change in speed results higher change in energy. Studies show that the probability of a pedestrian being killed if hit by a vehicle moving at speed of 30km/hr is 10%. On the other hand, a pedestrian has 80% probability of being killed if hit by a vehicle moving at speed of 50km/hr (12&13). Hence there is high risk of pedestrian fatalities if pedestrians are forced to share space with fast moving motorized traffic.

Another important factor that increases the risk of crash and its outcomes is alcohol impairment of drivers and pedestrians. Studies revealed that the relative risk of crash involvement starts to increase significantly at blood alcohol content (BAC) of 0.04 g/100ml (14). A driver that has 0.1g/100ml BAC has 5 times crash risk relative to driver with 0 g/100ml blood BAC.

Hence, in order to improve pedestrian safety, it requires to provide the necessary pedestrian facilities, to segregate pedestrians and motor vehicles, to control speeding and to enforce safe blood alcohol level for drivers.

III. methodology of the study

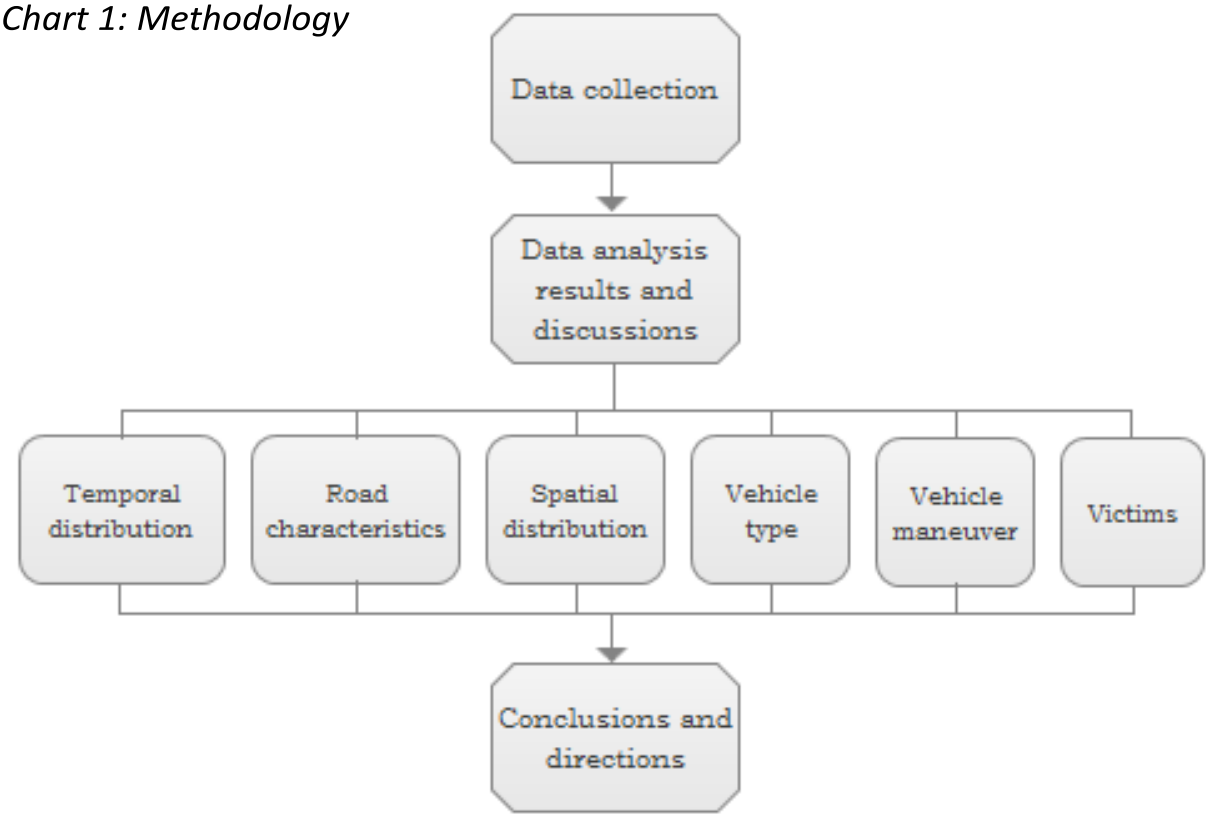
A. Data Collection

For this study fatal crash data obtained from Addis Ababa Police Commission is used. Two types of data are collected. One is an aggregated data that the police commission uses for official reporting of road traffic crash at the end of each year. For

reporting purposes,the commission summarizes the necessary information in tabular form. This kind of yearly reports are collected for further analysis.

The seconddata is an informationon individual crashes. For each crash, traffic police provide detail information such as location, time, date, cause, vehicle type involved, vehicle maneuver, road condition and other necessary information. An important information that cannot be extracted from aggregated data is obtained from this data. To get reliable results 3 consecutive years' data is used for this study.

Chart 1: Methodology



B. Data Analysis and discussions

The data obtained are thoroughly analysed to answer questions such as:

- What are the major causes of fatal crash in Addis Ababa?
- What kind of roads in the City have the highest risk of crash?
- Which road user is most affected by traffic crash?
- Where are locations at which fatal crashes frequently occurred?
- What kind vehicles are involved in fatal crash frequently?
- At which time of a day and on which day fatal crashes frequently happen?

To answer the above basic questions and other necessary information the crash data has been investigated.

C. Conclussion

Based on the analysis results, important conclusions are drawn. These conclusions are used to provide focus areas and directions to improve road traffic crash in Addis Ababa City.

D. Focus areas and directions to improve road traffic safety

Based on the identified major causes of road traffic crash and its contributing factors, main focus areas

(risk factors) and directions to improve road traffic safety in the City is provided.

The methodology of the study is provided with flow chart as follows.

IV. Data Analysis Results and Discussions

A. Temporal distribution

Information on time of a day, days of a week and months of a year during which road traffic crashes frequently occur are important to plan road safety improvement activities. Knowing critical times of crash helps to efficiently utilize scarce resources to get maximum result for a given effort. Furthermore, an information on the growth rate of road traffic crash may alert policy makers and concerned bodies to respond to the situation.

a. Time of a day

Different times of a day have different traffic crash risk depending on activity of the people, the traffic situation, the condition of road users and work time rules, among the others. During day times people are active on the streets. Hence conflict between road users is expected that might result crash. In afternoon and night times, mental and physical ability of people decreases as a result of work in the morning and/ or drug consumption. A time on which employees be on the streets depends on the work time rule of the City. The density of traffic on the streets also affects average vehicle speed and hence, prevalence and outcome of crash. During day time density of traffic is high. As a result, speed becomes low. Hence, higher number of conflicts and crashes can happen. But many of them may not result fatal and serious injuries. Another factor that increases pedestrian crash risk during the night times is invisibility of pedestrians to a driver due to lack of enough lightings at pedestrian crossings.

Figure 1 depicts percentage of average daily crash that happened during different hours of a day. The safest times in the City associated with road traffic crash was from 5 a.m. to 12 a.m. In the evening, from7 p.m. to 8 p.m., the streets were relatively safe.

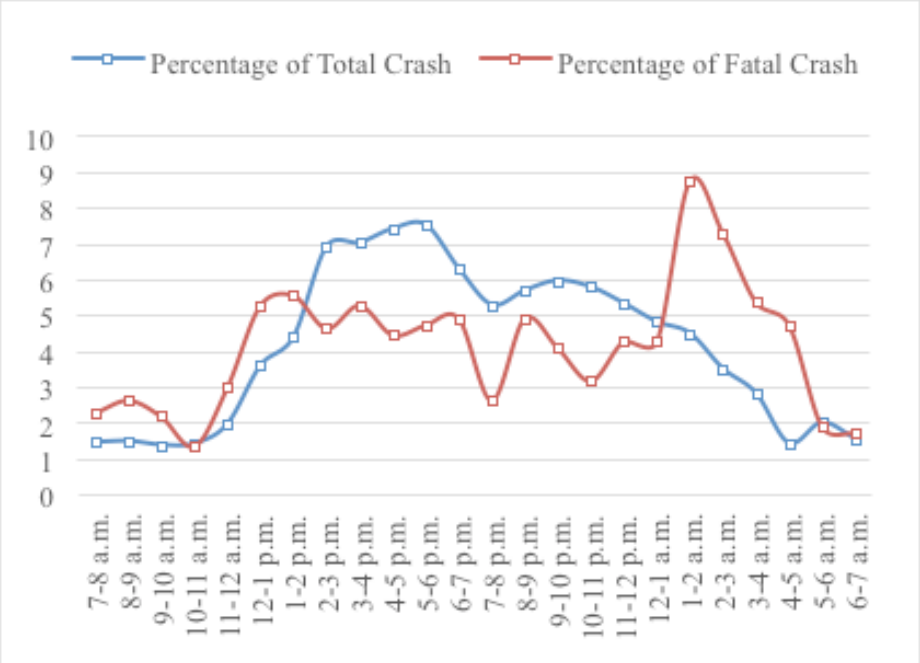


Figure 1: Hourly variation of total and fatal crash in an average day

Total number of crash peaked between 2:00p.m. and 6:00 p.m. Number of fatalities on the other hand peaks between 12 p.m. and 5 a.m. The highest number fatalities happened between 1:00 a.m. and 2 a.m.

The reason for higher amount of crashes in the afternoon could be:

- The road user's physical and mental ability decrease in the afternoon due exhaustion from work in the morning. It determines their response speed and quality.
- The goods moving and passenger transport vehicles that originates from other locations in the Country arrives in the afternoon.
- Some of the road users be drank in the afternoon.

After midnight, the number of vehicles on the streets are light. Hence, number conflicts are expected to decrease and so does the number of crashes. But if a crash happens, it usually results fatal injury since the drivers drive at their desired speed without any friction on the street. The speed of vehicles at night is only limited by road condition and vehicle's operational capability. Other factors that increase the crash risk during the night times are the conditions of the road users. Most of road users are tired and/or drank during the night time. Therefore, the combined effect of speeding and decreased ability of the road users makes the crash risk in the night time high. Friday, Saturday and Sunday are days on which higher number of fatalities were recorded between 1 a.m. and 5 a.m.

b. Number of fatality by days of a week

Different days of a week have different crash record due to various reasons. Daily distribution of number of fatalities for Addis Ababa City is given in Figure 2 below. The highest number of road traffic fatalities happened on Saturday, followed by Monday. Saturday is non-workday for most of government and private offices. As the following day is also a rest day, Saturday is used by most of the people for purchasing, to socialize with their loved ones and to enjoy without a limit. Drinking on Saturday is a habit for most of the residents of the City. Traffic on the streets of the City is also relatively light on the weekends. Therefore, the average speed on the streets are high. As a result, there is higher risk of fatal traffic crash on Saturdays.

Monday is a starting of work days. People do not want to stay at home on Mondays. As a result, the streets in Addis Ababa are congested on Mondays particularly during rush hours comparing with other work days. Hence higher number of crash is expected on Mondays. Road traffic crash is found to be relatively lower on Tuesdays and Wednesdays.

But the variation of number of fatal crash between the days of the week is not significant to focus on some days of a week for road traffic safety intervention,disregarding the others.

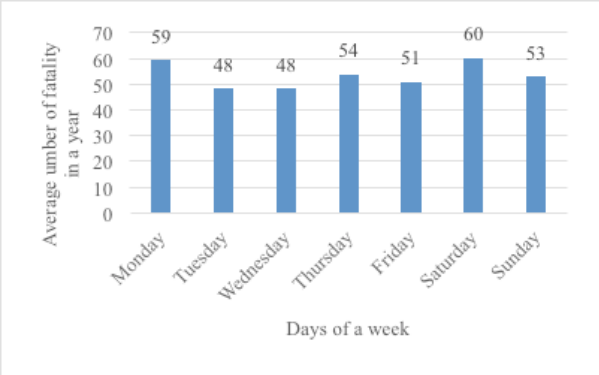


Figure 2: Daily distributionof fatal crash

c. Fatalities by months of a year

Figure 3 below gives average number of fatalities in each months of a year. On average 31 number fatalities were recorded in a month. April and May are months with highest number of fatalities when

the mean monthly fatalities were exceeded by about 9. The two months lies in spring season, a transition to winter season of Ethiopia. To know the reason why road traffic fatalities in these two months are higher than average, require further research.

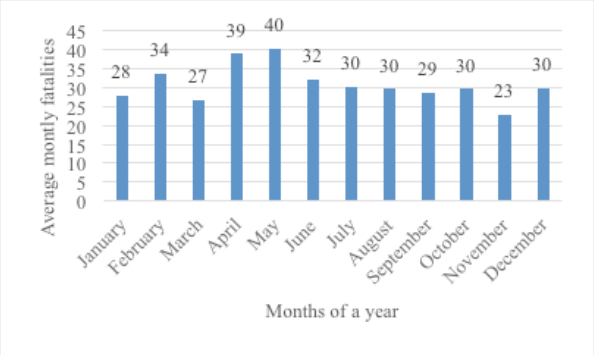


Figure 3: Distribution of fatalities by months of a year

d. Fatal crash trend

The growth of road traffic fatality for the past 6 years is shown in the Figure 3. It is tried to forecast the number fatalities in the future based on the graph assuming nothing new will be done to reverse the growth rate. The future number of fatality can be determined using the following equation.

Y=19.11X+298.89

Where X=1, at year 2002 and increases by one for one year increase from 2002 (e.g., at 2003, X=2)

Which indicates that each year road crash fatality is increasing by about 19. Accordingly, the number of fatality in 2012 E.C. (2020, Gregorian calendar) is estimated. It is found that in 2012, 509.13 residents will lose their life as a result of road traffic crash in Addis Ababa streets. This figure is much higher (by about 7.8 times, based on WHO estimation) if underreporting and number people dies after the scene are considered.

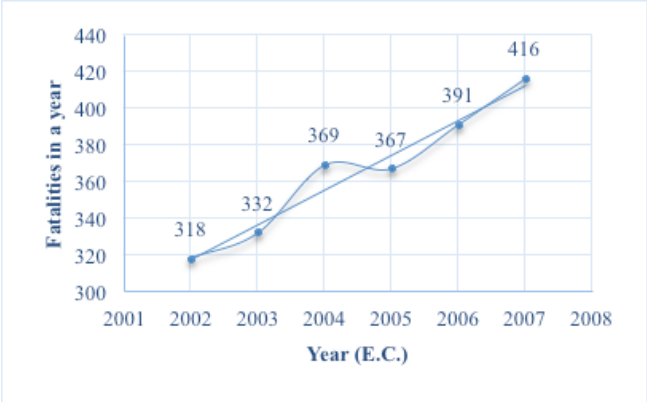


Figure 3: Fatal crash growth rate

B. Road characteristics

Characteristics of a road where a crash frequently happen is important for road traffic safety improvement planning. In this section road divider type, condition of pavement, and junction type of locations where crashes happened are discussed.

a. Road divider type

The percentage of total fatality at different divider types are given in Figure 4. 45 percent of fatalities happened in roads that are physically divided by median. Physically divided roads are major roads that are constructed for vehicle mobility. According to AACRA geometrical design manual, primary and secondary arterial roads must have median. On this kind of roads speeds are usually high. In principle, on such roads, the pedestrian and motorized traffic must be segregated by separating their right of way either in space or time. The victims of road traffic fatality crash on major physically divided roads are pedestrians as conflicts between vehicles are minimized by design.

31 percent of the roads where fatal crashes happened were undivided roads two-way roads. Fewer number of fatalities were recorded on two-way roads divided with line markings. This does not imply that line divided roads are much safer than undivided roads. Rather it shows two-way undivided

streets in the City lacks markings. But it is obvious that streets with appropriate road markings better regulate traffic and hence expected to be safer.

The crashes on one-way streets are caused due to, among the others, high speed vehicular traffic, one-way violations and not expecting the risk of conflict from opposite vehicle by the drivers when driving on one-way street.

As the proportions of roads in the City that are divided with median, line markings or undivided is not known, it is not possible to conclude which road type has high risk of fatal crash. But one can conclude that highest proportion of fatal crashes happen on major roads.

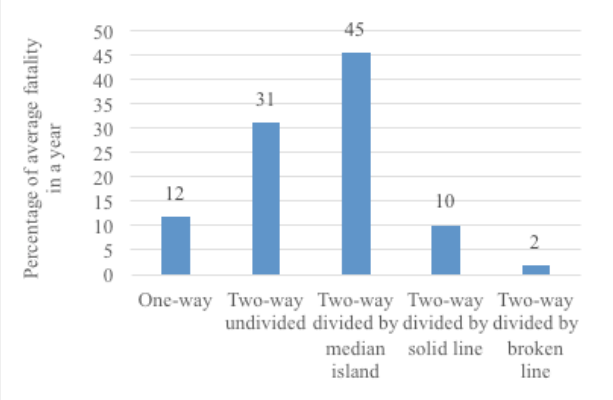


Figure 5: Percentage of fatalities at different road divider type

b. Junction type

Table 1 below provides junctions types at which the fatal crashes happened. 73 percent of crashes were happened at mid-blocks locations without junction. At the mid-block vehicle speed is expected to be high and victims of these kind of crash are expected to be pedestrians. Comparing intersections, at T intersections higher number of crashes were happened.

For this analysis there is a doubt on the reliability of 2006 crash data.Hence, it is not used.

Table 1: Junction type where the traffic crash incidents happened

Junction type	Year						Average
	2002	2003	2004	2005	2006	2007	
No junction	264	265	303	280	37	209	264
Y	1	8	7	11	35	41	14
T	32	29	18	29	89	58	33
O	7	14	4	13	83	68	21
+	14	13	14	26	42	19	17
X	-	3	23	1	19	4	6
Railway crossing	-	-	-	-	-	-	0
Other	-	-	-	7	86	17	5
Total							360

c. Pavement condition

Pavement condition is one of contributing factors to speeding of vehicles and hence, road traffic crash. 84 percent of fatal crashes happened on asphalt roads with good pavement condition.

Table 2: Pavement condition of roads at which fatal crashes happened.

Pavement type	Year			Average	Perce-ntage
	2005	2006	2007		
Good condition asphalt	333	307	352	331	84
Old, broken asphalt	1	21	18	13	3
Gravel	28	44	29	34	9
Cleared way without gravel	5	19	17	14	3
Total				391	100

C. Spatial distribution

Locations where road traffic crash frequently occurs, commonly called ‘black spots’, are used to tackle road traffic crashes which are caused due to conditions specific to that location. The conditions might be road geometrical characteristics, pavement condition, road side activities, traffic conditions and others that increases a risk of crash. Identification of locations with high number of crashes helps to take the necessary countermeasures. This measures can

be road improvement, enforcement or education. Information on these locations is important for City wide road safety improvement planning as it provides where to focus to bring maximum impact.

The fatal crash map in Addis Ababa City is prepared and given in Figure 5. As the exact geographical coordinates of locations of fatal crashes were not provided by the traffic police, it is extracted from google earth based on the description of the locations where the crashes happened.ArcMap is used to prepare the map.

In the figure, the red and orange colors depict locations where more than two persons died in a year on average. It can be observed from the map that most of these locations are on major roads. Out of 10 red spots (with average fatalities more than 2.5) 5 are on the ring roads. Which implies that 50% of the worst road crash locations are on the ring roads. Considering both orange and red colors (with average fatalities more than 2), almost all of them are on major roads. Out of which 36 % are on the ring roads.

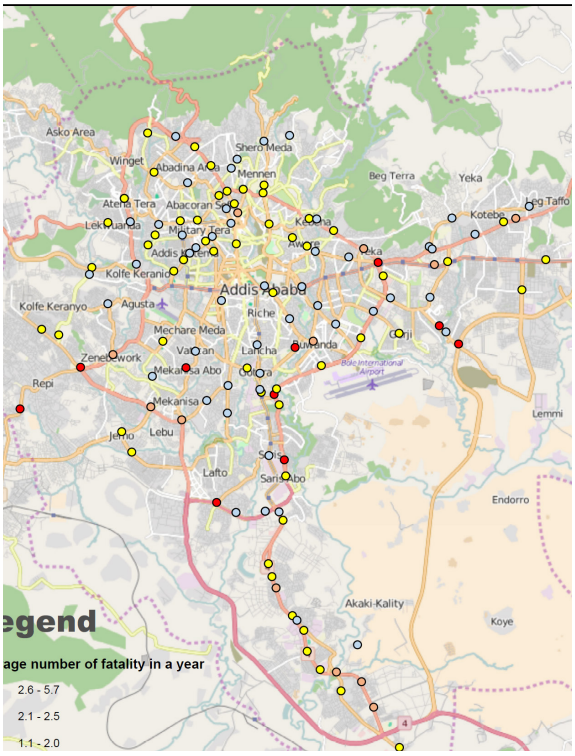


Figure 4: Addis Ababa City fatal crash map

D. Vehicle type

Table 3 provides average number of vehicle types involved in fatal crashes in a year. The vehicles types are ranked according to their crash involvement. Vans, automobiles and pick-ups are ranked to be the first, second and third, respectively, according to their crash involvement all of which are light vehicles.

Table 3: Percentage of vehicles involved in fatal crash

No	Vehicle type	Year			Average	percent of fatal crash
		2005	2006	2007		
1	Vans	23	69	77	56	14
2	Automobile	47	54	40	47	12
3	Pick-ups	43	34	39	39	10
4	Taxi	64	5	36	35	9
5	MGMV	21	37	35	31	8
6	Stationwagen	21	27	37	28	7
7	HGMV	29	28	20	26	7
8	Mid buses	26	27	18	24	6
9	Buses	13	27	14	18	5
10	Others	33	55	60	49	13
11	Unknown	47	28	40	38	10
Total		367	391	416	391	100

Note: Vans = minibuses up to 12 passenger capacity

Pick-up = up to 10 quintal carrying capacity MGMV = Medium goods moving vehicle (41-100 quintal carryingcapacity)

HGMV = Heavy goods moving vehicle (11-40 quintal carrying capacity)

Mid buses= 13-45 passengers carrying capacity

Buses = more than 46 passengers carrying capacity

Figure 5 further provides the percentage of crash recorded by vehicle category. The vehicles are categorized as follows:

- light vehicle include automobile, stationwagen, pick-ups and vans
- Goods moving heavy vehicles (GMHV) includes goods moving vehicles with carrying capacity of 11-40 quintal and 41-100 quintal, truck with trailer and shower truck
- Buses include buses and mid buses

More than half of fatal crashes were caused by light vehicles. Goods moving heavy vehicles takes the second rank which account for the 17 percent of the total fatality in the City.

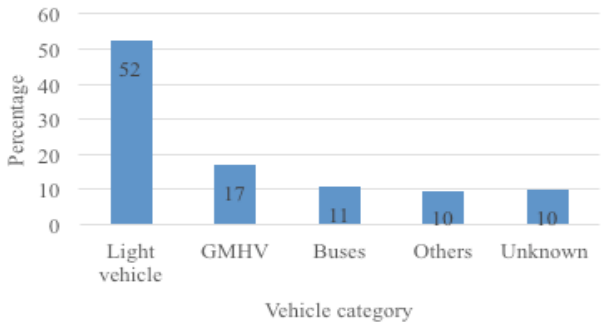


Figure 5: Percentage of vehicle classes involved in crash

E. Vehicle maneuver

Table 4 shows the maneuver of culprit vehicle driver at the time of crash. More than half of fatalities were happened when culprit vehicles were moving street forward. Where 11 percent of the crashes happened when taking over another vehicle. The two maneuver types combined resulted more than 67 percent of fatalities. These kind of maneuver takes place at mid-block locations and the vehicles are expected to be at high speed. Victims of the crash are always pedestrians.

Table 4: Maneuver of culprit vehicle at the time of crash

Vehicle maneuver	Year			Average	Perce-ntage
	2005	2006	2007		
Moving forward	291	192	177	220	56
Taking over	-	49	84	44	11
Unknown	33	28	36	32	8
Right turning	5	34	41	27	7
Left turning	12	48	12	24	6
Turning to another street	-	13	19	11	3
Interring an intersection	-	5	25	10	3
Reverse driving	15	9	4	9	2
Others	9	6	1	5	1
Interring cross road	-	2	8	3	1
exiting from house	1	4	2	2	1
U turning	-	1	5	2	1
Stopping	1	-	2	1	0
Total	367	391	416	391	100

F. Victims of road traffic fatal crash in Addis Ababa

86 percent of the victims of the road crash in Addis Ababa are pedestrians. Out of the City dwellers who had lost their lives in the streets of Addis Ababa, more than 60 percent of them were in the range of 18 and 50 years old. Therefore, the road traffic crash is affecting the economy of the country by killing the most productive class of the society. From the data, it is found that 10 percent of the victims of road fatality in Addis Ababa were below age 18. Table 5 below gives victims of road traffic crash in the City.

Table 1: Victims of road traffic fatal crash

Victims	Age level	2005	2006	2007	Average	Percentage of victims
Drivers	below 18	0	9	0	3	
	18 to 30	14	13	10	12	
	30 to 50	7	5	3	5	
	above 50	1	2	6	3	
Total		22	20	19	20	5
Pedestrians	below 7	9	6	8	8	
	7 to 13	16	15	13	15	
	14 to 17	13	14	8	12	
	18 to 30	103	129	149	127	
	31 to 50	89	86	122	99	
	above 51	99	86	107	97	
Total		329	336	407	357	86
Passengers	below 7	0	0	0	0	
	7 to 13	0	8	0	3	
	14 to 17	1	11	2	5	
	18 to 30	15	19	9	14	
	31 to 50	6	13	6	8	
	above 51	1	11	5	6	
Total		23	62	22	36	9
Grand total		374	418	448	413	100

V. Conclusions and Directions to Reverse the Growing Rate of Road Traffic Crash in Addis Ababa

A. Conclusions

Based on the results of data analysis the following conclusions are drawn:

- Road crash fatality rate is rising sharply with an increase of 19 fatalities per year on average.
- Pedestrians are the most affected road user. Among the road users killed during past 3 years, 86 percent of them were pedestrians. Furthermore, more than 60 percent of the victims of road traffic fatal crash are the productive part of the society (between age 18 and 50).
- Majority ofthe fatal crashes are caused by a vehicle moving at high speed striking a pedestrian at road segments (at mid-block where there is no junction). (This conclusion is drawn from the location of crash and the maneuverof culprit driver when the crash happened.)
- About half of the crashes were happened on roads that are median divided. Median divided roads are mostly major roads. Out of the locations with worst fatal crash record (more than 2.5 average fatalities in a year), 50% of them are on the ring roads. Almost all of crash spots where more than 2 average fatalities happened in a year are located on main roads; specifically, on primary arterials and ring roads.

Hence, major roads have high frequency of fatal crashes.

- The fatal crash that happen on undivided two-way roads are also significant (43 %).
- Morning is the safest timeof a day, while late-night is the most unsafe time.
- The drivers and/or pedestrians in tired and/or drank condition contributed to the crash risk. In addition, speeding is another contributing factor as there is few number of vehicles in the streets in the late nights which allows drivers to drive at their desired speed.
- Comparing days based on their road traffic fatality, Saturday recorded highest number of fatal crashes, followed by Monday. The combined or unilateral effects of speeding and drinking and driving are the major causes of crash on Saturdays. Number of crash on Mondays is higher than other work days due to the reason that there is higher activities and hence higher number of conflicts on Mondaysas it is a starting of work days.
- In contrast, Tuesday and Wednesday recorded lower number of fatal crashes.
- Road traffic related fatality is the lowest in November. April and May record higher number of fatalities with 9 fatalities above the average monthly fatality. Both the lowest and the highest number of fatal crashes happened in Ethiopian spring season.
- More than half of fatal crashes are caused by light vehicles. This is because of their accelerating and speeding capability. Vans are involved in highest number of fatal crashes, comparing vehicle types.

B. Directions

Road traffic crash is getting attention from concerned bodies and the society at large at the moment. A lot of efforts are being made hoping to reverse the growth rate of the road traffic crash and to reduce the fatal crash by 75% at the end of GTP 2. But if it is intended to achieve the goal, the concerned bodies must plan activities, projects and programs strategically, based on available evidences.

Once the road safety improvement solutions are implemented, it requires evaluation of its impact using selected performance measures. Efforts that haven't bring the intended result must be dropped, focus has to be made on the existing and new programs that have positive impact on the road traffic safety.

1. Available evidences

a) Most affected road user

Among the total number of people killed by road traffic crash in a year, 86 percent of them are pedestrians. More than 60 percent of the victims of road traffic fatal crash are the productive part of the society (between age 18 and 50).

Hence, the *safety of pedestrians* must be the primary objective of road safety improvement efforts.

b) Road related evidence

Characteristics of locations with high crash record:

- Major roads
- At mid-block (out of junctions)

At this kind of locations, traffic speed is high.

The cause of crash:

- Pedestrians in conflict with high speed vehicular traffic.

The fatal crashes that happen on undivided two-way roadways are also significant. These crash locations have the following characteristics:

- Pedestrians and vehicular traffic shares streets as pedestrian walkways are blocked by street utilities and road side parking; or they are either completely damaged or not provided.
- Pedestrian crossings are either not provided or have no markings
- Speed of vehicles are not controlled

The cause of crash:

- Unsegregated vehicular and pedestrian traffic
- Uncontrolled vehicular speed

C) Vehicle related evidence

More than half of fatal crashes are caused by light vehicles. These type of vehicles have high accelerating and speeding capability.

The cause of crash:

- Pedestrians in conflict with high speed vehicular traffic.

D) Evedence from vehicle maneuver

Two third of the fatal crashes happened while the culprit vehicles are moving straight forward or taking over another vehicle. This reveals:

- Majority of the victims are pedestrians
- It happened not at turning points (intersections)
- Hence, the vehicles were at high speed when the crash happened.

The cause of crash:

- Pedestrians in conflict with high speed vehicular traffic at mid-block sections.

Evidence from times and days of fatal crash

Most of fatal crashes happen during afternoon and night times. It peaks in the late-night time. Highest number of fatal crash happen on Saturday.

The cause of crash:

- Exhausted or drug (such as alcohol) impaired pedestrians in conflict with vehicle being driven by exhausted or drug impaired driver.
- Higher traffic speed during night times and on weekends as density of traffic is lower.
- Lack of enough lightings at crossings during the night time.

2. Directions to improve road traffic safety

1. Identify locations in the City where road traffic crashes frequently happen and improve. To improve safety one or more of the following measures can be taken based on the specific problem identified:
   - Engineering measures to improve road features
   - Enforcement of rules and regulations
   - Awareness creation to bring behavioural change
2. Review speed limits on the streets of the City and enforce to improve overall road traffic safety in the

City. Activities include:

- Review the existing speed limit
- Set new speed limit for the main roads
- Enforce the speed limit

3. Improve pedestrian facility on the main roads to remove any conflict between high speed motorized traffic and pedestrian. Where it not possible to separate pedestrians and motorized vehiclein space or time, the speed on the major road at the conflict point must be reduced to the tolerable speed for pedestrian. This requires assessment of the main roads to identify the availability and conditions of pedestrian crossings and walkways in order to make the necessary improvement.
4. Improve safety of undivided two-way asphalt roads by taking the following actions:
   - Segregate pedestrian and vehicular traffic by providing clear and obstacle free walkways, pedestrian crossings with appropriate markings and street lights for better visibility and
   - Control speeds by applying speed calming techniques
5. Improve pedestrian visibility and security by providing enough lightings at crossings and on walkways
6. Enforcing drinking and driving by giving focus to afternoon and night times. Special focus must be given to late nights.
7. Review and enact reasonable working time rules for drivers.

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VII. References

[1] Traffic Safety and Management Division, Addis Ababa City Transport Programs Management Office, Kazanchis area road network improvement: Data analysis report, Addis Ababa, March 10, 2016.

[2] Hook W. Counting on cars, counting out people: a critique of the World Bank's economic assessment proceduresfor the transport sector and their environmental implications, New York, Institute for Transportation andDevelopment Policy, 1994.

[3] Mohan D. Traffic safety and city structure: lessons for the future. SaludPública México, 2008, 50: S93–S100.

[4] Khayesi M, Monheim H, Nebe J. Negotiating "streets for all" in urban transport planning: the case forpedestrians, cyclists and street vendors in Nairobi, Kenya. Antipode, 2010, 42: 103–126.

[5] Peden M et al., eds. World report on road traffic injury prevention. Geneva, World Health Organization, 2004.

[6] Elvik R, et al. The handbook of road safety measures, 2nd ed. Bingley, Emerald Group Publishing Limited, 2009.

[7] Ernst M, Shoup L. Dangerous by design: solving the epidemic of preventable pedestrian deaths and making greatneighbourhoods. Washington, D.C., Transportation for America, 2009.

[8] iRAP, Star Rating Roads for Safety: Addis Ababa Report, April, 2016.

[9] World Health Organization, Pedestrian safety:A road safety manualfor decision-makersand practitioners, Geneva, Switzerland, 2013.

[10] Gibson JJ. The contribution of experimental psychology to the formulation of the problem of safety: a brief for basic research. Behavioural Approaches to Accident Research, New York, 1961, 77–89.

[8] Haddon W Jr. Energy damage and the ten countermeasure strategies. The Journal of Trauma,13 (No.4) 321–331, 1973.

[9] World Health Organization, Pedestrian safety:A road safety manualfor decision-makersand practitioners, Geneva, Switzerland, 2013.

[10] Gibson JJ. The contribution of experimental psychology to the formulation of the problem ofsafety: a brief for basic research. Behavioural Approaches to Accident Research, New York, 1961.

[11] De Haven H. 'Mechanical analysis of survival in falls from heights of fifty to one hundred andfifty feet'. War Medicine, 1942

[12] OECD/ECMT Transport Research Centre: Speed Management report, Paris, 2006.

[13] Tingvall C, Haworth N. Vision zero: an ethical approach to safety and mobility. Paper presentedto the 6th Institute of Transport Engineers International Conference on Road Safety and TrafficEnforcement: Beyond 2000, Melbourne, 6–7 September 1999

[14] Crompton RP et al. Crash risk of alcohol-impaired driving. In: Mayhew DR, Dussault C, eds.Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety, Montreal,4–9 August 2002. Montreal, Société de l'assurance automobile du Québec, 2002.

[15] OECD/ECMT Transport Research Centre: Speed Management report, Paris, 2006.

[16] Tingvall C, Haworth N. Vision zero: an ethical approach to safety and mobility. Paper presentedto the 6th Institute of Transport Engineers International Conference on Road Safety and TrafficEnforcement: Beyond 2000, Melbourne, 6–7 September 1999