

Contributing Factors of Traffic Accident and Their Possible Countermeasures in Debre Berhan Town, Ethiopia

Yeserah Gebeyehu Asegie*

Department of Civil Engineering, Debre Birhan University, Debre Birhan, Ethiopia

*Corresponding author: yeserah@gmail.com

Received July 05, 2018; Revised August 08, 2018; Accepted August 17, 2018

Abstract Transportation is responsible for the development of civilizations from very old times. However road traffic accident is in a state of rise and recognized as a major socio-economic concern facing Ethiopia as the country. So, this study was conducted with an objective of assessing the traffic safety issue of Debre Berhan town on main highway which serves for the town and cross country traffic. The study followed a methodology of visual investigation of traffic accident location; and speed, traffic volume and traffic accident data collection. According to the data analysis, traffic accident in Debre Berhan was in increasing trend year to year with major accident characteristics of overturning followed by pedestrian accident. In addition, the primary causes of traffic accident in the town are investigated as speeding followed by failure to give way for pedestrian. Minibus and medium bus were responsible for more than 50% of all traffic accident recorded from all categories of vehicles. Around 50% of traffic accidents were contributed from age group of 18 – 30 years that need a primary concern; and the rates of accident on farmers are in alarming rate respect to other victims. Finally, appropriate engineering measures, police enforcement, training and education are recommended to solve the safety problems of the town. The main engineering measures for different location proposed include painted rumble strip to alarm the driver; speed limit sign provision; alternative pedestrian route; restrict parking on some locations that narrow the road and restrict passing; and others. The police enforcement may include on controlling of speeding and assuring the effectiveness of traffic law. A focus on training for young drivers seeking driving license was another recommendation in reduction of traffic accident. In addition, traffic safety education is recommended for students, public workers and farmers for significant reduction of traffic accident.

Keywords: *traffic, accident, causes, characteristics, safety, countermeasure*

Cite This Article: Yeserah Gebeyehu Asegie, “Contributing Factors of Traffic Accident and Their Possible Countermeasures in Debre Berhan Town, Ethiopia.” *American Journal of Civil Engineering and Architecture*, vol. 6, no. 5 (2018): 187-192. doi: 10.12691/ajcea-6-5-3.

1. Introduction

Transportation is responsible for the development of civilizations from very old times by meeting travel requirement of people and transport requirement of goods [1]. In today's world, road and transport has become an integral part of every human being. However road traffic accident is in a state of rise and recognized as a major socio-economic concern facing Ethiopia as the country known as having one of the highest accident record in the world-about 136 fatalities per 10,000 motor vehicles in 2003 [2,3]. Individuals from low-income households usually use walking as a primary mode of transportation as they have financial constraints that prevent them from better alternative modes of transportation, and spend more time along the roadway and crossing roadways to access properties [4]. This implies greater exposure to pedestrian crash risk, which is borne out in crash statistics. As a

result failure to give way for pedestrian in combination to speeding accounted for 40% of all fatal accidents [2]. Every month, around 400 people are killed or hospitalized by road accidents in Ethiopia. An estimate by a Study reveals that, in addition to the above fatality rate, road accidents cost the Ethiopian economy between 350-430 million birr per year.

Road traffic crashes claim the lives of more than 1.2 million people and at least 50 million people are injured on the roads every year worldwide. Recent studies indicate that road traffic deaths in low income countries (LICs) are a burden on the most economically active section of society, with wide repercussions for their dependants and family. Road traffic crashes typically costs from 1 to 3 percent of a country's GDP [5,6,7]. This problem, in Ethiopia, is increasing from year to year at alarming rate accompanying the rapid increase of population and the number of vehicles. Compared with international risk figures, the country is the one of the worst examples in terms of fatality rate per vehicle [6].

The trend of accident is not in a state of declining; but rather has continued to rise enormously. The continued steep increase in the number of crashes and fatalities indicates that these losses are undoubtedly inhibiting the economic and social development of the country and adding to the poverty and hardships of the community at large.

With the road infrastructure development and expected increase in mobility, road traffic accidents will continue to be a major drawback for the road transport in Ethiopia. More often, a combination of circumstances plays a role in traffic accident, in which human, vehicle, road and environment are of importance [4]. In relative terms, however, road users take most of the blame. Young drivers, particularly males, are at significantly higher risk of being involved in a road traffic accident compared to other age groups, according to research conducted in various nations. This means that the greatest potential for accident reduction rests on influencing human behavior [1]. In developing countries like Ethiopia, influencing human behavior by other means could be an expensive and time consuming process. Controlling the roadworthiness of vehicles is less feasible. The road engineering solution to safety problems, as experienced in developed countries, however, has generally proven to be cost effective and easy to implement and evaluate. Although safety education and enforcement play vital roles, the experience of developed countries indicates that proper road design and facilities, which guide road users to comply with traffic rules and regulations, are also crucial to prevent human errors in the traffic [8]. This is achieved through improving the existing roads and incorporating safety elements in design standards for new roads.

Road traffic accident was in an increasing trend country wide [9]; as a result in this study, traffic accident situation in Debre Berhan was investigated to identify the characteristics and causes of road traffic accident for provision of alternative safety countermeasures. The road section in Debre Berhan consists of high gradient and sharp horizontal curve at the edge of gorge around Teacher College; and highly populated commercial center. Even if the operating speed in the town is restricted to 30 km/h, most of the drivers maneuvering with high speed that may lead to overturning exactly at the gate of the college. Several accidents were occurred on areas around pedestrian facility, highway junctions, straight road sections, taxi terminals and on others which leads fatality and serious injury especially on productive age groups.

The main aim of this research was to assess the traffic safety condition of Debre Berhan town on main highway which serves for the town and cross country traffic. Specifically investigating the accident record on Debre Berhan town road section; analyzing the traffic and speed trend in this road section; and recommending safety countermeasure on this road section in reducing operating speed.

2. Methodology of the Study

The study area was in Debre Berhan on main road section through the entire town; and the locations for Industrialization Park and future expansion that are

considered a part of the town. The road consist of a median divided dual carriage way, 3 lanes in one direction for the town section and two way two lane un divided single carriageway in rural section. A descriptive design was used in this study. Quantitative data was collected using document reviews and primary data of traffic, speed and visual observation. It was attempted to collect data from the traffic police records to evaluate the frequency and severity of accident based on different controlling variables.

To achieve the stated objectives, literature review on previous studies of traffic accident related studies was conducted and relevant location specific data was required. The data that was collected for this study include:

- Current vehicular traffic data;
- Visual assessment of road condition and its environment data;
- Average travel speed of vehicles in different segment; and
- The type, causes and characteristics of traffic accident data.

The above sets of data were gathered mainly from primary sources (directly by visualization and testing) and/or secondary sources. The primary sources of data were collected by assigning a crew directly counting vehicular traffic flow and speed recording. Whereas the secondary sources such as traffic accident data were collected entirely from police records for the year 2012/13 to 2014/15 that were collected and compiled by police officers. Some cumulative data were taken from 2011/12 for traffic trend analysis.

3. Data Analysis

In order to characterize the populations of accidents, simple numerical analysis was done to determine the characteristics of traffic accident in Debre Berhan. MS Excel was used for analysis, correlation and graphic representation of data analyzed in this study. Civil survey software was used for determination of horizontal curve elements. The requirements were curve length determination, superelevation computation, stopping sight distance computation and finally speed limit computation. The traffic accident analysis and road element analysis was finally used to propose for engineering countermeasure to minimize the road traffic accident in the town and surrounding.

4. Results and Discussion

The trend of accident year to year is increasing at all degree of severity especially in previous two years. According to the data recorded by Debre Berhan town police officers, the five year data were summarized in Table 1 and generally, the severities of accidents were increasing year to year.

As the trend of accident indicates, overturning and pedestrian accident are the major accident characteristics to be recognized as shown in Table 3. The head – tail vehicle collision is another accident characteristic that need attention. Overturning accidents are responsible for

around 60% of injured accident severity. The highest number of accident was recorded on Saturday as shown on Figure 1, which is market day for Debre Berhan and huge movement of vehicle, packed animal, farmers and the town residents for product exchange. As a result, the number of conflict between vehicles; and vehicle with

people increased. In addition, the recorded data indicates that, the higher proportion of injury accident victims were farmers with less exposure than other road user groups. It was investigated that farmers are more exposed to traffic accident on market day, Saturday. The primary accident contributors were a driver with age group between 18 and 30.

Table 1. Trend of accidents in recent five years

Severity of Accident	Year				
	2010/ 11	2011/ 12	2012/ 13	2013/ 14	2014/ 15
Fatal	6	8	10	9	11
Serious	16	15	14	21	30
Slight	32	8	16	30	36
Property Damage	11	30	20	22	36
Total	65	61	59	82	113

Table 2. Accident distribution based on work type

Job	Percent Victim, injury accident			
	2011/ 12	2012/ 13	2013/ 14	2014/ 15
Student	22.22	26.09	23.08	22.03
Worker	70.37	39.13	61.54	28.81
Farmer	7.41	34.78	15.38	33.90
Job less				10.17
Unknown				5.08
Sum	100	100	100	100

Table 3. Characteristics of Traffic Accident in Debre Berhan (2014/15)

S. No.	Type of Accident	Fatal		Serious		Slight		Damage only		Total Injury Accident	
		No.	%	No.	%	No.	%	No.	%	No.	%
1	Pedestrian	4	36.4	14	46.7	6	16.7	3	8.3	24	31.2
2	Overturning	7	63.6	10	33.3	29	80.6	9	25	46	59.7
3	Head on			2	6.7			3	8.3	2	2.6
4	Head – tail			4	13.3	1	2.8	18	50	5	6.5
5	Right Angle collision							1	2.8		
6	Collision with stationery object							1	2.8		
7	Unknown							1	2.8		
	Total	11	100	30	100	36	100	36	100	77	100

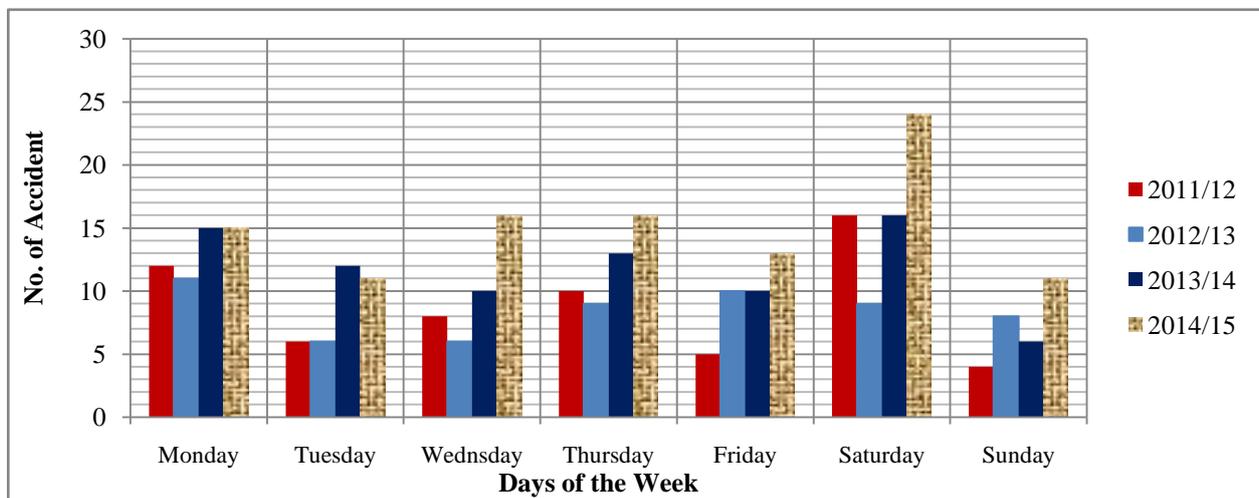


Figure 1. Accident distribution in days of a week

The accident types, indicated in Table 3, are due to different causes and are mainly due to speeding, failure to give for pedestrian, follow too close, improper overturning and improper crossing behavior of pedestrians which leads to 76.11% of total accident as summarized in Table 4. In addition, speeding is basically the primary cause of overturning; failure to give way for pedestrian is for pedestrian accident; and follow too close is belongs to head – tail collision. 61.9% of the total accidents are due to a combination of these parameters, summarized in Table 5. These indicates that, more attention shall be given for overturning, pedestrian accident and vehicle head – tail collision characteristics with their primary causes i.e., speeding, failure to give way for pedestrian and follow too close respectively. For instance, the spot speed study indicated that the operation speed is much beyond the permitted.

According to the data analysis of accident frequency by vehicle type, minibus (<13 seat) accounted the largest share of traffic accident and medium bus (13 - 45 seat) follow it. Most serious accidents including fatality are a combination effect of these vehicle types and the driver with less of 32 years' age. In addition, trucks have a significant role in traffic accident occurrence. The three wheel motors (locally named as Bajaj) are also a considerable vehicle type specially on pedestrian accident occurrence, failure of give way for pedestrian. The traffic volume study indicates that the proportion of Bajaj is high

with respective to other vehicle types, in excess of 60%. The involvement of station wagon in traffic accident is in alarming increments that need considerable attention. Due to economic growth, increment of living standard, suitability for investment and urbanization development; the population of station wagon may increase and as a result the frequency of traffic accident may rise.

Accident locations were identified from the three years road traffic accident records and most frequent accident was found on areas with less controlling device provided and physical measurement. Many of the locations are on straight road and some of accidents are on curve roads such as on area around teachers training college and Agricultural research center. In consideration of agricultural research center which is in rural part on approach of the town; the stopping sight distance required for posted speed limit (80km/hr) was 143m and the actual stopping sight distance provided was 98.8m. The location did not satisfy the stopping sight distance requirement as primary criteria of safe maneuvering. Even if the road did not satisfy the stopping sight distance requirement for 80km/hr; greater than 28% of vehicles operate beyond the allowable speed according to spot speed test. Operating speed greater than 62km/hr at this location may result serious accidents. From the speed data analysis, it can be concluded that greater than 82.5% of vehicle travel on dangerous condition, the road did not allow traveling at their respective speed.

Table 4. Possible causes for road traffic accident in Debre Berhan (2014/15)

No	Causes of accident	Degree of Severity				Total	%
		Fatality	Serious Injury	Slight Injury	Property Damage		
1	Failure to give way for pedestrian	3	12	4	3	22	19.47
2	Failure to give way for vehicle			2	1	3	2.65
3	Following too close		2		9	11	9.73
4	Speeding	6	9	21	10	46	40.71
5	Improper overtaking		4	1	2	7	6.19
6	Driving without respecting right hand rule				2	2	1.77
7	Driving skill				4	4	3.54
8	Vehicle Failure			4	1	5	4.42
9	Unknown	2	3	4	4	13	11.50
	Total	11	30	36	36	113	100

Table 5. The characteristics of primary accident with their major causes

No.	Characteristics of Accident	Causes of Accident	Freq. of accident	Degree of Severity				Sum
				Fatality	Serious injury	slight injury	Property damage	
1	Head-Tail collision	Follow closely	6		2	0	9	11
2	Overturning	Speeding	4	6	7	20	4	37
3	Pedestrian	Failure to give way for pedestrian	16	3	12	4	3	22
	Sub total		26	9	21	24	16	70

Table 6. Major Traffic Accident contributor vehicle category

Vehicle Type	Number of Traffic Accident			
	2011/12	2012/13	2013/14	2014/15
Minibus	8	13	31	36
Medium Bus	12	11	9	21
Medium Tuck	11	9	5	8
Large Truck	7	7	10	11
Sum	38	40	55	76
Percentage*	62.30	67.80	67.07	67.26

Note: * It is computed with respect to total accident recorded by all vehicle groups as in Table 4.

5. Recommended Counter Measures

The counter measures are more concentrated on traffic crash prevention and traffic crash reduction mechanism for each identified causes and nature of traffic accident. Speeding, failure to give way for pedestrian and following closely are identified as the major cause of traffic accident in Debre Berhan town; and the countermeasures are primarily in consideration of such causes; and young age group of male drivers. It was investigated that all drivers responsible to traffic accident are male drivers and 18 – 30 years' age group need considerable attention. Generally, on all locations, special attention should be given to control traffic on Saturday, since it is a market day.

5.1. Engineering Counter Measures

Since speeding is the primary cause for traffic accident, speed limiting countermeasure should be implemented in the town as well as the surrounding approach. As a result a speed limit sign (30 km/hr) should be placed to alert inattentive drivers in the town and; painted rumble strips should be furnished to reduce speed and alert drivers for safe maneuvering before the zebra cross. In addition, at Agricultural research center, a speed limit 62km/hr should be posted to satisfy stopping sight distance requirement. The town administration should also consider

- separate taxi parking for loading and unloading around the town center;
- appropriate crossing facility on divided carriageway sections (step is recommended with safety consideration);
- provision of separate track for animal drawn carts since they play a vital role on contribution of traffic accident on two lane road section
- in reducing exposure of pedestrian from vehicular traffic by providing raised structure at edge and median of the road which prohibit for easily crossing at every location instead of zebra cross. This approach may enforce the pedestrian to use a zebra cross rather than illegal crossing.

5.2. Police Enforcement

Traffic laws by themselves often are not sufficient; the key factor in the effectiveness of a traffic law is motorists' perception that they run a high risk of being detected and punished for violating the law. Laws work because it is possible to convince motorists that they face a considerable risk of punishment if they violate the laws. So, police enforcement is vital in reduction of traffic accident on which violating the law. Accidents due to speeding beyond the posted speed limit, failures to give way for pedestrian and vehicle, follow closely without appropriate gap, driver failure to respect right hand rule, drunk driving and others can be controlled by appropriate police enforcement especially on market days. In addition the risk after crash can be reduced by enforcing the driver as well as the passenger using seat belt, banning cell phone and using helmets. Random inspections are needed on high frequent accident locations for police enforcement. In addition, special attention should be given on inspection of

minibus, medium bus and truck drivers since they are responsible for many fatal traffic accidents.

The enforcement is not limited to the vehicular driver but also on motorist, cyclist, animal drawn carts and pedestrians since all groups may not obey the traffic law. In addition, regular inspection and enforcement should be needed to assure traffic safety to increase the awareness and attention of all individual groups for safety.

5.3. Education and Training

Education: The summarized analyzed traffic data indicates that school children, farmers and workers are all victims of road traffic accident. So, continuous education should be delivered to such individuals to aware the severity of road traffic accident, on appropriate road using and obeying traffic rules on different media, like, school, religious worship place and public meeting.

Training: The summarized data indicated that driver age group of 18 – 30 years were responsible for most serious road traffic accidents in Debre Berhan i.e. young drivers have the highest rate of motor-vehicle injuries and fatalities. Researches and collected data indicated that young drivers put themselves and others at risk by tending to speed, follow vehicles too closely, make illegal lane changes, and weave through traffic. So, the driving license school should focus on attitude how to use car appropriately, social effects, psychological, and behavioral on aggressive and risky driving characteristics of young drivers.

For the current condition to reduce the rate of accident due to this age group; the transport office should provide extensive training on attitude, psychological and behavioral changes with collaboration of psychologist. For long term solutions, the responsible government body should study the driving license methodology and delivering system especially for young driver. The school curriculum especially for young trainee should be revised to achieve attitude, psychological and behavioral changes.

6. Conclusion

The main objective of this study was assessing the causes and characteristics of traffic accident in Debre Berhan and it was tried to propose remedial measure for the investigated traffic accident. As a result a wide range of road environment and traffic accident data were collected to achieve the stated objectives. Traffic accident data was collected and summarized from police record and reports.

According to the traffic accident situation investigation in Debre Berhan, it was tried to summarize the accident data based on different variables. Traffic accident on pedestrian, overturning and head – tail collision are the most frequent traffic accident with the major causes of failure to give way for pedestrian, speeding, follow too close without appropriate gap and improper overtaking. In 2014/15, the above three frequent accident accounted 92% of the total accident and 62% of total accident is accounted with respect to their primary causes i.e. follow too close for head – tail collision, speeding for overturning and failure to give way for pedestrian for accident of pedestrian. Male drivers were responsible for all traffic

accident in Debre Berhan since the populations of male drivers are more or less high in numbers with respect to female drivers; and the young age groups take the lion share responsibility. In general, it was known that males have more risk taking characteristics than females including drivers; that may also another reason for all traffic accident made by male driver.

With respect to day of the week, on Saturday, high accident is recorded since it is market day, there is high movement to market and high exposure to traffic. The recent year record indicated that the shares of farmer victims are increasing and becoming leader. In respect to drivers, the 18–30 age groups were involved in the highest number of accidents of attention should be given to this age group of drivers by the policy makers. Accidents by minibus accounted for the largest share and of course it was becoming worst fatal accident in recent years. In addition, in consecutive three years, greater than 67 per cent of the total accidents were contributed from minibus, medium bus and trucks. In terms of fatalities and injuries, these vehicle groups contributed the highest number of casualties.

The main causes of the accidents at the locations of high frequent accident were speeding and violation of speed limit, failure of drivers' to give way for pedestrians, follow too closely and improper overtaking due to lack of awareness of traffic rules and regulation. So, appropriate

measures like engineering solutions, enforcement to obey the traffic law and education and training should be given to control the problems.

References

- [1] Elena C., Panayiotou G., Konstantinou N., Loutsiou-Ladda A., and Kapardis A., Risky and aggressive driving in young adults: Personality matters. *Journal of accident analysis and prevention, Elsevier Ltd.* 2011.
- [2] Mohammed M. (2011) Costing road traffic accidents in Ethiopia. MSc Thesis, Addis Ababa University.
- [3] Elvik R., Høy A., Vaa T and Sørensen M, *The Handbook of Road Safety Measures, 2nd ed.* Oslo, Norway, 2009.
- [4] Tulu G.S., Washington S., King M. J., Haque Md. M. (2013) Why are Pedestrian Crashes so Different in Developing Countries? A Review of Relevant Factors in Relation to their Impact in Ethiopia. *Australasian Transport Research Forum 2013 Proceedings 2 - 4 October 2013*, Brisbane, Australia.
- [5] ERA, Road Safety Audit Manual, Addis Ababa, Ethiopia, 2004.
- [6] Berhanu G., "Effects of Road and Traffic Factors on Road Safety in Ethiopia", *PhD dissertation*, Trondheim, Norway, 2000.
- [7] Roess R.P., E.S. Prassas and WR McShane, *Traffic Engineering*, Pearson Education International, USA, 2004.
- [8] Tulu G.S., "Causes of road traffic accidents and possible counter measures on Addis Ababa – Shashemene roads". MSc Thesis, Addis Ababa University, 2007
- [9] Hailu F. and Teshager S., Road traffic accident: The neglected health problem in Amhara National Regional State, Ethiopia: *Ethiop. J. Health Dev.* 2014; 28(1): 3-10.