Road Accidents of Arba Minch town in Ethiopia: an Empirical Study

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Abstract:

Road accidents are unexpected incidents which took place in the urban areas very frequently that leads to lot of property damages, injuries and deaths. Due to various commercial and business activities, the vehicles in the urban areas will maintain high speed and too much over takings, resulting more number of accidents in short span. Moreover, the rapid urbanization, Industrialization and migration along with other social changes have resulted in increasing necessity for travel across all age groups in the entire country. With poor public transportation systems and inability of people to afford cars, the personal modes of transport have increased across the Ethiopian country and in rural areas. Road deaths are growing in Ethiopia day by day with lack of road safety.

The various factors associated for the collision of vehicles are due to over speed, overtaking, vehicle condition, poor road Geometric design, driver skills, negligence and behavior, absence of street lights, violation of traffic rules and regulations, etc. The present study is aimed to analyze the traffic accidents in Arba Minch town of Ethiopia from the data collected at various traffic police stations in the jurisdiction of Arba Minch.

A multiple regression equation is developed to analyze the rate of accidents in Arba Minch with various influencing parameters such as poor geometric design, vehicular defects, over takings, violation of traffic rules and environmental factors. It was observed that the rates of accidents are more predominant with traffic violations and over takings of vehicles.

Keywords: *Rate of accidents, Age group, Human factors, over takings, Geometric design elements, Speed of vehicles, Driver behavior, Road safety*

Abbreviations:

P.D= Property Damage, vio = Traffic violations, over = Over takings, road = Road defects, veh = Vehicular defects, env = Environmental factors.

Introduction

Ethiopia is one of the fastest growing countries in the world in different sectors. Road and Transportation is one of the important sectors where the government of Ethiopia has put lot of efforts to increase the safety and efficiency of traffic and transportation. The total number of population in Ethiopia as per data is 103,232,590 in which 20.3% of population are living in the urban areas. The number of registered vehicles of all categories are 394,001.

Arba Minch is one of the principal towns in Southern part of Ethiopia and is located at a distance of 450 Kms from Addis Ababa. The total population in the town is 1, 42,900 with almost all equal ratio of male and female. The average growth rate of population is 4.8%. The number of vehicles registered as per data are 4431, with motor cycles (66.6%), tricycles (3.4%), passenger cars (19.5%), taxis (6.9%) and other vehicles (2.84%). The town is located in the East African rift-valley and surrounded by hill and mountains. The average number of accidents per year is 108 with more number of major and minor accidents followed by deaths.

Survey-Analysis with Random observational study was conducted by using standard survey questionnaire form with a focus of road safety awareness, traffic rules and regulations, driver skills and use of seat belts and helmets during driving on main and Street Roads. Drivers/passengers/pedestrians were randomly selected to participate in face-to-face interview including Arba Minch traffic police to ascertain the reasons for the occurrence of accidents in Arba Minch town.

Literature Review:

and Elaheh Ainy, Ali Khorshidi, Ayad Bahadori Monfared, Hamid Soori and Mashyaneh Haddadi (2016) conducted a study on Epidemiological pattern of Road Traffic injuries among occupants' vehicles in 2012 and concluded that the risk of death among the

injured aged 30-59 years and 60+ were 1.20 and 2.23 times more than 30 years respectively. Risk of death among injured in highways, main roads and rural roads was 2.84 times more than in urban roads.

Md. Mahmud Hassan (2012) conducted a study on the effect of traffic parameters on road hazard using Classification Tree Model. He considered three parameters in the analysis such as traffic, weather and accident record and found that weather conditions did not have significant impact on road accidents where as the traffic flowvehicle speed are the significant parameters that cause for road accidents.

Paulina Brozova (2011) analyzed the occurrence of road accidents in Czech Republic using the analysis of accident frequency. He concluded that the safety of road transport is influenced not only by characteristics of a utilized vehicle, personality characteristics and knowledge of a driver, but also by a selected transport route.

Background of the Problem:

Every year road traffic injuries take the lives of 1.2 million people around the world. Nearly three quarter of deaths are resulting from motor vehicle crashes in the developing countries.

Table 1. Average Rate of Accidents in Arba Minch Town Per Year

Age in Years	Major	Minor	Death	P.D	Total
Below 18	2	-	-	-	2
18-30	20	29	7	14	70
31-50	5	10	7	8	30
Above 51	1	1	3	1	6
Total					**108**

Source of data: Traffic Police station, Arba Minch, Ethiopia

Out of 108 average victims recorded in Arba Minch, 64.81% of victims were between the age group of 18-31 years, 27.77% of victims were between the age group of 31-50 years, 5.55% of victims were above the age of 50 years with a minimal percentage of victims below the age group of 18 years. Maximum road accidents occurred during the day time in the morning peak hours between 9 A.M. to 12 P.M. and evening peak hours between 4 P.M. to 7 P.M. Moreover the involvement of Pedestrians and Cars are observed to be less.

In order to assess the level of traffic accidents and the governing factors for the accidents in Arba Minch town, an inventory study is conducted by making interviews with different participants like drivers, pedestrians, passengers and traffic police. This will help the transportation planners to improve the traffic and transportation infrastructures to reduce the rate of accidents.

Objectives of the Study:

- To collect the data related to various types of accidents in Arba Minch town
- To study the various causes of accidents and vehicles involved
- To analyze the data for understanding the trend of accidents
- To develop a multiple non- linear regression equation for evaluating the rate of accidents in Arba Minch

Data Collection:

In the present study, the accident data is collected from different traffic police stations in the jurisdiction of Arba Minch town for the years 2010 to 2015. The opinion of some of the pedestrians and vehicular drivers in and around Arba Minch is also collected as a part of data collection. The data collection includes the type of accident, reasons of accident occurrence, vehicles involved, Speed of the vehicles, age group of the people, etc. As per the data collected, more number of accidents are recorded at Sikala bus station, Secha intersection, Arba Minch university main campus road and Nachisar round about.

Observations

The data reveals that most of the accidents are occurring in the mid day of the week with involvements of various types of vehicles such as Bajaj auto with passenger bus, Motor bike with pedestrians, Bajaj auto with taxi, Bajaj auto with motor bike, Taxi with bus, etc. The rates of accidents with involvement of pedestrians are observed to be less.

Table 2. Day Wise – Annual rate of accidents in Arba Minch

Day	Average Annual rate of accident
Monday	14
Tuesday	21
Wednesday	14
Thursday	18
Friday	10
Saturday	18
Sunday	13
Total	**108**

Source of data : Traffic Police station, Arba Minch, Ethiopia

It is observed that many accidents are due to Bajaj auto, Taxi and Two wheelers as compared to other types of vehicles. As per the data, out of total

number of accidents, 21.42% of accidents are caused due to the violation of traffic rules, 22.44% of accidents are due to over takings, 13.26 % of accidents are due to pedestrian involvement, 8.16% of accidents are due to vehicular defects, 7.14% of accidents are due to poor road geometrics, 4.08% of accidents are due to environmental factors and the rest are due to some other unknown factors. The property damage due to various accidents reveals that the damage is increasing at a higher rate every year.

Table 3. Estimated Property Damage Due to Accidents

Year	Property damage in ETB
2010-11	460693
2011-12	1928267
2012-13	962605
2013-14	1494065
2014-15	1665337
2015-16	2741400

Source of data: Traffic Police station, Arba Minch, Ethiopia

Limitations of the Study:

The data is collected from the respective traffic police stations in Arba Minch with overall causes of accidents and vehicles involved. Due to the restrictions in the collection of data from the police stations, the causes and vehicles involved for each individual accident is not disclosed and hence is not collected. The study is limited to analyze the rate of accidents in the periphery of Arba Minch town neglecting the highway routes.

Methodology :

In the study, six enumerators are selected for the collection of traffic accident data in Arba Minch. The data is collected manually for the years 2010 to 2015 in which the enumerators visited different traffic police stations in Arba Minch with a designed format. The data collected is sorted out to extract the various causes of accidents and the vehicles involved.

Analysis of Accident Data :

The data collected is analyzed to evaluate the rate of accidents in Arba Minch by considering the various influencing parameters for the accidents such as road geometrics, over takings, violation of traffic rules, vehicle defects and environmental factors. In order to estimate the influence of each variable, a multiple non linear regression equation is developed from the data collected by correlating all the influencing parameters. Table 4 indicates the influence of various parameters for the occurrence of accidents.

Table4. Rate of Accidents vs. Influencing Parameters

Violation	Overtakings	Road defects	Veh defects	Env factors	Rate of Accidents
10	11	3	7	3	17
6	10	2	5	3	13
9	9	3	4	4	15
3	6	2	4	2	7
6	6	2	5	3	11
2	4	3	4	2	8
4	5	2	4	3	8
8	7	2	4	4	10
3	4	2	3	2	5
1	2	2	1	2	1
3	3	2	2	2	4
1	3	2	2	2	3

Development of Multiple Non Linear Regression Modal :

Multiple Regression is a well known statistical technique which fits a relationship between dependant and independent variables. The causes of accidents can be analyzed with more focus by using the above technique. In the study, Rate of accidents is taken as a dependant variable and all other influencing factors such as traffic violations (variable 1), over takings (variable 2), road defects (variable 3), vehicular defects (variable 4) and environmental factors (variable 5) are taken as independent variables. A Multiple Non Linear Regression equation is developed by using the above dependant and independent variables.

The following is the Multiple Non Linear Regression equation:

$$\text{Accident Rate} = -0.115654 + 0.177818 * e^{vio} + 0.079743 * e^{over} + 0.368725 * e^{road} + 1.043611 * e^{veh} + 0.276805 * e^{env}$$

$R^2 = 0.9697$; $R = 0.9847$; $F = 38.488$; $P = 0.000175$

Table 5. Results of Multiple Non Linear Regression Modal

Parameter	t- ratio	P- level
Intercept 1	-0.717874	0.499819
Variable 1	0.856787	0.424455
Variable 2	0.228793	0.826629
Variable 3	1.079387	0.321883
Variable 4	3.790882	0.009064
Variable 5	0.684281	0.519339

Results of the Analysis of Multiple Non Linear Regression Modal :

From the Multiple Non Linear Regression modal developed, analysis is carried out to estimate the rate of accidents for various influencing parameters.

Fig 1. Graph Showing Rate of Accidents (y-axis) vs. Influencing Parameters (x-axis)

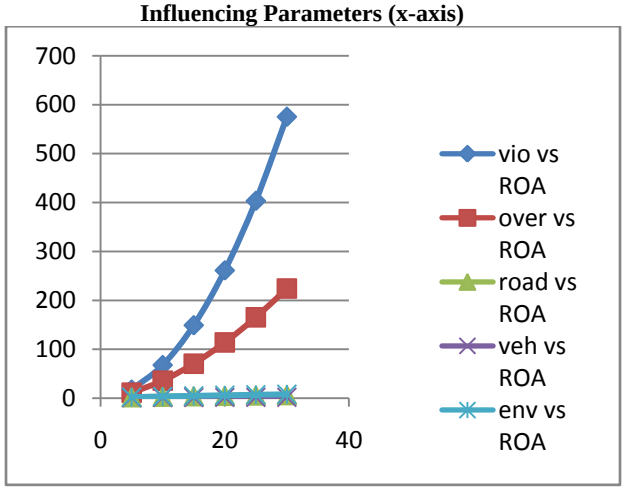

Fig 1 clearly indicates the influence of each parameter on the rate of accidents. It is observed from the graph that the influence of traffic violations and over takings are more predominant in occurrence of the accidents in Arba Minch town followed by defects in road geometrics. The influence of other parameters such as vehicular defects and environmental factors is minimal in occurrence of road accidents.

Summary and Conclusions :

The study is conducted to analyze the rate of accidents in Arba Minch town of Ethiopia. A detailed survey is conducted to collect the accident data for the years 2010 to 2015. As a part of survey, the accident data is collected with day wise, date wise and year wise. The involvement of different types of vehicles along with causes of accidents and the locations of accidents are collected from different traffic police stations in the jurisdiction of Arba Minch town. The data collected is sorted out in different forms to understand the severity of the accidents in different locations of the town. It is observed that more number of accidents occurred with the age group of 18-30 years followed by the age group of 31-50 years. More number of accidents is recorded in the mid day of the week and in the morning peak hours between 9 A.M. to 12 P.M. and in the evening peak hours between 4 P.M. to 7 P.M. The occurrence of accidents are more at Sikala, Secha and Arba Minch University main campus road with involvements of Bajaj autos, Taxis and Two wheelers.

A Multiple Non Linear Regression equation is developed to estimate the influence of each parameter on the occurrence of accidents. Rate of accidents is taken as a dependant variable and the influencing parameters such as traffic violations, over takings, road defects, vehicular defects and environmental factors are taken as independent variables. From the analysis, it is concluded that the influence of traffic violations and over takings are more predominant in occurrence of accidents in Arba Minch followed by road defects. The influence of vehicular defects and environmental factors is minimal.

From the survey analysis, it was concluded that the dominating factors for accidents in the town are human factors (67.25%), incorrect geometric design elements (9.55%), lack of traffic controlling devices (18.45%), vehicular defects (3.5%) and environmental factors (1.25%).

Recommendations :

High rate of traffic accidents can be significantly reduced through a little attention just by means of educating the people about severity and misery of the accidents. Hence changing the road user behavior through training the drivers, creating awareness about road safety problems and keeping stringent traffic rules and regulations for drivers and educating the pedestrians can significantly reduce the accident rate in Arba Minch town.

REFERENCES

[1] Dinesh Mohan, " Road safety in less motorized environments : Future concerns", International Journal of Epidemiology 31, No.3 (2002) 527-32

[2] P. Shruthi, V.T. Venkatesh, B.Viswanath, C. Ramesh, P.L. Sujatha, I.R. Dominic, "Analysis of Fatal road traffic accidents in a Metropolitan city of South India", Journal of Indian Acad Forensic Medicine, October- December 2013, Vol. 35, No. 4

[3] Gururaj G, Aeron Thomas A & Reddi M.N, " Underreporting of road traffic injuries in Bangalore- Implications for road safety policies and programs", in proceedings of the 5th world conference of injury prevention and control, 2000, New Delhi, Macmilan, India Ltd

[4] Harnam Singh, A.D. Agarwal, " Fatal Road traffic accidents among young children", Journal of Indian Acad Forensic Medicine, Vol 32, No.4

[5] Elaheh Ainy, Ali Khorshidi, Ayad Bahadori Monfared, Hamid Soori and Mashyaneh Haddadi, " Epidemiological Pattern of Road Traffic Injuries among Occupants' Vehicles in 2012", Journal of Transportation Technologies, volume 6, page 277-285, 2016

[6] Md. Mohmud Hasan, " Investigation of the effect of Traffic parameters on road hazard using Classification Tree Model", International Journal for Traffic and Transport Engineering, Volume 2, No. 3, Page 271-285, 2012

[7] Pavlina Brozova, " Problem of Transport dangerous matters by Road Transport in terms of Road Safety in Czech Republic", International Journal of Traffic and Transport Engineering, Volume 1, No. 1, Page 48-53, 2011

[8] ERA, Ethiopian Roads Authority, Geometric design manual 2002

[9] Arba Minch town traffic accident record office manual[secondary traffic accident data from 2010-2015]

[10] Ashfaq A, Shahzad AK et al. Injury Prevention and Control: National Action Plan for NCD Prevention, Control and Health

[11] A.A. Hyder, H. Waters, T.Phillips and J.Rehwinkel, Exploring the Economics of Motorcycle Helmet Laws – Implications for Low and Middle-Income Countries, Asia Pac JPublic Health 2007; 19; 16.

[12] Mohan D. Traffic safety and health inIndian cities. J Transport and Infrastructure 2002; 9: 79–92.

[13] Sharples PM, Storey A, Aynsley- Green A, Eyre JA, "Causes of fatal childhood accidents involving head injury in northern region 1970-86, BMJ 1990; 301(6762); 1193-7

[14] Margie Pedan and Adnan A Hyder, " Road traffic injuries are a global public health problem", British Medical Journal 324, No. 7346 (2002) : 1153

[15] Ahmed Y, Anjum Q, Usman Y, QureshiAF, Importance of Health Education in injury prevention among children,J Pak Med AssocJul 2004;54(7):390-1.

[16] Hakim KA, Zawar HK, Khalid A. Medical and socioeconomic aspects of road traffic accidents, Ann King Edward Med CollJune 2006;12(2):310-1.

[17] Junaid SK,Naureen I, Javed RG. Pattern of visceral injuries following blunt abdominaltrauma in motor vehicular accidents, J CollPhysicians Surg Pak Oct 2006; 16(10):645-7.

[18] Mohammad AA, Rao ARK, Saeed AM, Syed IHR, Khalid A.A study of road traffic injuries inflicted to pedestrians in the urban limits of Bahawalpur City, J Fatima Jinnah Med Coll Lahore June 2007; 1(1-2):2-6.

[19] Www.website- Google.com/ population and vehicles in Ethiopia and Arba Minch