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Analysis of factors that affect road traffic accidents in Bahir Dar city, North Western Ethiopia

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Abstract: Traffic accident is increased from time to time in alarming rate and it is a serious problem throughout the globe, particularly, in developing countries like Ethiopia. In this study our aim was to identify the major factors that affect the occurrence of traffic accidents at Bahir Dar city, North Western Ethiopia. The drivers were selected using simple random sampling methods and descriptive statistics, Chi-square and Binary logistic regression methods have been used for data analysis.The Hosmer and Lemeshow test showed that the model fits the data very well. And from the result we have seen that drivers giving priority stated by the law, pedestrian's manner while crossing the road, drivers usage of seat belt have statistically significant impact for the occurrence of traffic accidents in the city. Pedestrian's manner while crossing the road is one of the significant variable for the occurrence of road traffic accidents in Bahir Dar city. Therefore, the traffic polices or concerned body should give trainings for pedestrians about traffic accidents. To minimize the road traffic accidents, the government should set the rules to use the seat belt so that the drivers should apply it.

Keywords: Traffic Accidents, Binary Logistic Regression, Odds Ratio

1. Introduction

1.1. Backgrounds

Itis difficult to conceive of a situation where transport does not play a major role in the life of an individual.Itisanacceptedfactthatofallmodesoftransportation,roadtransportisthe nearest to people. And its major advantage compared with others is its flexibility, which allows it to operate from door-to-door over short distances at the most competitive prices [1]. In Africa over 80 percent of goods and people are transported by roads,where as in Ethiopia road transport accounts for over 90 percent of all the inter-urban freight and passenger movements in the country [2]. Transportation is one of the basic requirements for the proper functioning of societies as its demand is highly related to the movement of people from one place to an other.Therefore,transportation has a direct impact on the day-to-day activities of people, especially in large cities where the distance to be traveled is too far to cover on foot or by bicycle within a reasonable time. Cities in the developing nations are not only showing a rapid population growth,but also a change in their residents'wayof life.This obviously implies that there is a need for a corresponding expansion of infrastructures and services.But due to inadequate road networks, slow road construction and maintenance, rapid traffic growth, shortage of parking space in the narrow streets, as well as ineffective traffic management and enforcement, there is rapid growth of road trafficaccidents.This problem is mainly manifested in most of thecities ofAfrican nations [3].

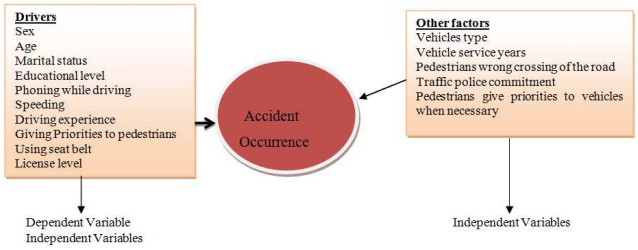
Sinceeveryactivityofhumankindhasitsownconsequences, positiveornegative, transportisnotanexceptiontothis fact.The constraints associated with transport include the risk of traffic congestion, traffic accident, pollution, noise, and the like [4].

Serious injuries and mortality in road collisions are a public health problem with consequences similar to those of major diseases such as cancer and cardiovascular disease.

Worldwide, about 1.2 million persons were killed on the roads and an additional 20–50 million were injured, road traffic injuries were the 11thleading cause of death and accounted for 2.1 percent of all deaths [5].

High income countries reduced fatalities from road traffic accidents by more than 25percent during 1968 -1998, and another drop of 30 percent will be recorded by 2020. While in low and middle income countries,where 81 percent of the world's population live and own about 20 percent of the world's vehicles, and the annual deaths and disabilities from road traffic accidents will rise considerably by 2020 [6].

1.2. Conceptual and Analytical Framework



1.3. Objectives

1.3.1. General Objective

The general objective of the study was to assess the major contributing factors that affect road traffic accidents in Bahir Darcity, North Western Ethiopia.

1.3.2. Specific Objectives

The specific objectives of the study are to:

1. identify the major causes and contributing factors of road traffic accidents in Bahir Dar, Ethiopia;
2. identify the socio-demographic factors for road traffic accidents in Bahir Dar City, Ethiopia;
3. explore pedestrians impacts for road traffic accidents in Bahir Dar City, Ethiopia;

1.4. Significance of the Study

RoadtrafficaccidentprobleminEthiopia,especiallyin the main city,isnowamajor concern of the government, its organizations and other institutions concerned with road safety as well as the public in general [7].

As can be seen from the CSA(central statistical agency of Ethiopia)data, (1994 and 2007) the main towns and cities of Ethiopia is becoming populous from time to time; and also the number of vehicles running in these cities is increasing at an alarmingly faster rates than ever before. The infrastructural arrangements in the city are also increasing both in quantity and quality; new asphalt roads and cobblestone works are being built. But the increase in infrastructural setups compared with the increase in the number of population and vehicles is not proportionate. Some roads are narrow and one way, others are without pedestrian way, and we can observe that almost all roads are without appropriate traffic signs and signals. Thus these situations coupled with the low levels of understanding of the people about road safety makes the road traffic accidents worse than before. So, the findings of this study will: enrich the road traffic accident literatures, make practitioners be aware of the problems and take appropriate measures, show readers the severity of the problem so that they will save their lives and livelihoods from loss and destruction, serve as a clue for those researchers who is interested in conducting further studies in the area and finally enable policy makers to design appropriate strategies so that practitioners and other concerned bodies take preventive as well as counter measures and monitor road safety problems.Generally, the results obtained and recommendations made will benefit all members of the community of the city.

Figure 1.1. *Sample situations of traffic accidents in Ethiopia*

2. Methods

2.1. Description of Study Area

Bahir Dar is special zone and capital city of Amhara National Regional State (ANRS), which is located approximately 578 km north-west of the Capital of Ethiopia, Addis Ababa, having a latitude 11°36'N and longitude of37°23'E[8]. The average daily temperature is 19℃ and the daily rain fall is variable extending from 3mm in the month of February to 438mm in the month of July [8].

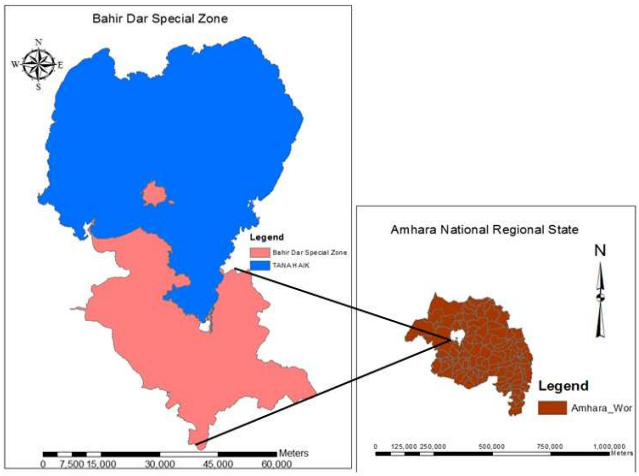


Figure 2.1. *Maps of Bahir Dar City Administration and Amhara National Regional State[11].*

Bahir Dar, one of the main cities of Ethiopia and is the capital city of the Amhara National Regional State. Its location along the main roads, the tourist sites of monasteries

within the islands of Lake *Tana* and*Tis Issat* Fall of Blue Nile are additional factors for the growth of the city. The city is also interconnected to other cities of the country through a very long asphalt roads; which runs people's socio-economic activities using different vehicles such as taxis, privately owned cars, governmental cars, bus (city and intercity), Bajaj 1 , and cycling (both motor and bicycle).The most common and convenient way of traveling in the city is using bicycle. Taxis and Bajaj[1] also provide efficient transportation services [9]. Intercity bus service is provided by the Selam Bus Line Share Company and Sky Bus Transport System which operates daily to and from the city [10].

2.2. Sample Size Determination

Sample size determination is the foremost task prior to conducting a research work based on a sample of the parent population. In order to have an optimum sample size, objective of the study, design of the study, cost (budget) consideration, appropriate use of statistical analysis, degree of precision required for justifications and level of confidence used for conclusion has to be taken into consideration. In view of the above issues, there are several formulas developed for sample size calculation that conform to different research situations. Accordingly, the sample size determination formula adopted for this study is: $n_0 = \frac{z^2_{\alpha/2} p(1-p)}{d^2}$, as the sample was from a finite population the sample size calculated as: $n = \frac{n_0}{(1+\frac{n_0}{N})}$ [12]. Based on the formula the sample size is calculated to be 100, these 100 sampled drivers were selected based on simple random sampling method and well-structured questionnaire was distributed to these sampled drivers.

2.3. Data Analysis Methods

The basic aim of modeling is to derive a mathematical representation of the relationship between an observed response variable and a number of explanatory variables, together with a measure of the inherent uncertainty of any such relationship. Statistical models are essentially descriptive and, in as much as they are based on experimental or observational data, may be described as empirical data [13]. In this study Descriptive statistics (percentage), Chi-square test of association and Regression (Binary logistic regression) were used to analyze factors affecting the occurrence of traffic accidents at Bahir Dar City, Ethiopia.

The equation for computing the Chi-Square value is given as: $\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$, where O_{ij} is observed frequencies and E_{ij} is expected frequencies and it is compared with the chi-square tabulated value of df (r-1)(c-1) at alpha value of 0.05.The binary or binomial logistic regression is the type of regression which is used when the dependent variable is a dichotomous and the independent variables are of any type. The same logistic regression model can be written in different ways and it predicts the log odds of the dependent event (odds and odds). The "event" is a particular value, the dependent variable. By default the event is one for binary dependents coded 0 and 1, and the reference category is 0. The oddsthat shows what function of the probabilities results in a linear combination of parameters is: $ln\left\{\frac{\text{Prob (event)}}{1 - \text{Prob(event)}}\right\} = \beta o+\beta_1 x_1+\beta_2 X_2+\beta_3 X_3+\ldots+ \beta_k X_k$. The quantity to the left of the equal sign is called a logit. It is the log of the odds that an event occurs. These methods permit researchers to rank the relative importance of independent variables; to assess interaction effects; and to understand the impact of covariate control variables. Therefore, Binary logistic regression model was used to analyze the relationship between multiple explanatory variables and the occurrence of traffic accidents.

3. Result and Discussions

3.1. Descriptive Statistics

Table 3.1 showes that 85% of the sampled drivers were males and 91.1% of the accident was caused by male drivers.About 51% of drivers aged below 30 years and the majority (55.5 %)of the accident was also due to those age group drivers,while 8% of them were aged above 50 years. About 13% of drivers have primary and below primary educational level and the majority (64%) of them have secondary school.Most accidents (68.9%) were caused by drivers whose educational level is secondary. Among the sampled derivers about 37%, 8%,12% and 43% had Code1[1], code2[2], code3[3]and code4[4] [2] deriving license levels. Furthermore, most of the accidentswere due to drivers who had license code 4. The majority (67%) of sampled vehicles gave service years between 2 and 5 years and the rest gave service years less than 2 years. Table 3.1, revealed that 42.2% of the accidents were because of the vehicles that gave long year services.About 53% of drivers gave priorities for pedestrians while they are crossing the road sometimes and the rest 47% of them gave priorities for pedestrians while they are crossing the road always. Moreover, most of the accidents in the city (69.8%) were due to drivers that didn't give priorities for pedestrians to pass first as required by law.The habit of sampled derivers used seat belt while deriving vehicles were 35%, 40% and 25% always, sometimes and never ever used respectively. And 55.6% of the accidents drivers that used seat belt sometimes.

The majority (51%) of the sampled drivers talk on phone while driving the vehicle, 37% of them stopped when they used phone and only 12% never talk on phone while driving the vehicles. As table 3.1 revealed that 57.8% of the accidents were caused by drivers using phone while driving vehicles.

The proportions of traffic police who have poor, good and very good commitments on their work were 52%, 43% and 8% respectively.From table 3.1 assured that 62.2% of the

1Bajaj: Indian two wheeler and three wheeler manufacturing company. Bajaj auto manufactures and sells motorcycles. It is derived from the Indian industrialist, philanthropist and independence fighter, Jamnalal Bajaj (1884-1942)

[2] Code1-motor bike, bajaji, taxi; [2]Code2- automobile; [3]Code3- public buses, ISUZU; [4]Code4-governmental and NGO vehicles and special vehicles (tractors & ex-cavaters)

accidents were happened because of polices who have poor commitment on their works.The majority (66%) of sampled drivers didn't trust on the current driving training and testing situation. Most importantly, the majority (53% +13%) of pedestrians were crossed wrongly the road.

Table 3.1. *Association of traffic accidents with different contributing factors at Bahir Dar city.*

		Have you ever faced road traffic accidents while you are driving in the town?		Total (%)	p-value
		Yes (N, %)	No (N, %)		
Educational level	primary and below	8 (17.8)	5(9.1)	13	0.079
	secondary	31(68.9)	33(60)	64	
	above secondary	6(13.3)	17(30.9)	23	
Sex	male	41(91.1)	44(80)	85	0.122
	female	4(8.9)	11(20)	15	
Age	less than 30 years	25(55.6)	26(47.3)	51	0.605
	31-50 years	16(35.6)	25(45.5)	41	
	>50 years	4(8.8)	4(7.2)	8	
Marital status	unmarried	19(42.2)	20(36.4)	39	0.550
	married	26(57.8)	35(63.6)	61	
License level you have	code 1	18(40)	19(34.5)	37	0.471
	code2	2(4.4)	6(10.9)	8	
	code3	7(15.6)	5(9.1)	12	
	Code 4	18(40)	25(45.5)	43	
How long have you been driving in Bahir Dar?	less than 2 years	9(20)	12(21.8)	21	0.836
	2-5years	19(42.2)	20(36.4)	39	
	above 5 years	17(37.8)	23(41.8)	40	
How many total years did the vehicle you drive give service?	less than 2 years	13(28.9)	20(36.4)	33	0.429
	2-5years	32(71.1)	35(63.6)	67	
What is your approximate average driving speed in the town?	less than 30km/hr	0(0)	2(3.6)	2	0.196
	30-40km/hr	45(100)	53(96.4)	98	
How often did you give priorities to pedestrians to pass first as required by law?	always	14(31.1)	33(60)	47	0.04
	sometimes	31(68.9)	22(40)	53	
How do you rate pedestrians' manner in giving priorities to vehicles where necessary?	very good	2(4.4)	11(20)	13	0.000
	good	15(33.3)	34(61.8)	49	
	poor	28(62.2)	10(18.2)	38	
How do you perceive the level of road traffic accident problems in Bahir Dar?	big problem	15(33.3)	23(41.8)	38	0.680
	moderate problem	24(53.3)	26(47.3)	50	
	not a problem	6(13.3)	6(10.9)	12	
How often do you use seat belt?	always	10(22.2)	25(45.5)	35	0.011
	sometimes	25(55.6)	15(27.3)	40	
	I never use	10(22.2)	15(27.3)	25	
How do you use your phone while You are driving?	I simply use with it	26(57.8)	25(45.5)	51	0.459
	I stopped the vehicle and use it	14(31.1)	23(41.8)	37	
	I never use phone	5(11.1)	7(12.7)	12	
How do you rate the traffic police commitment to their duties and responsibilities?	very good	0(0)	5(9.1)	5	0.044
	good	17(37.8)	26(47.3)	43	
	poor	28(62.2)	24(43.6)	52	
Do you trust the current drivers training and testing situations?	yes	11(24.4)	23(41.8)	34	0.068
	no	34(75.6)	32(58.2)	66	
Have you ever got on work education/ training about road safety?	yes	13(28.9)	15(27.3)	28	0.858
	no	32(71.1)	40(72.7)	72	
How many of the pedestrians you observed use wrong crossing of the road?	all of them	12(26.7)	1(1.8)	13	0.000
	most of them	24(53.3)	29(52.7)	53	
	some of them	9(20)	25(45.5)	34	

3.2. Binary Logistic Regression Analysis

The major decisions involved in constructing the Binary logistic regression models were deciding what explanatory variables to include in the model equation that would be the best fit to the data set. Because the binary logistic regression models are used based on assumptions, and any departures from this assumption might result in the incorrect analysis and conclusion [14]. Therefore, binary logistic regression models that satisfying assumptions and having model fitting statistic were chosen.The Husmer and Lamshow test result from table 3.2 at the third step (χ^2 = 8.178 with df 6, and p = 0.225) indicated that the fitted binary logistic regression model was statistically significant and possible interpret the model further.

Table 3.2. *Hosmer and Lemeshow Test*

Step	Chi-square	df	Sig.
1	0.000	1	1.000
2	5.873	6	.438
3	8.178	6	.225

3.2.1. Results of Binary Logistic Regression

The result of Binary logistic regression analysis was given in Table 3.3. The table showed that the coefficients, their standard errors, the Wald test, associated p-values (Sig.), the odds and the 95% confidence interval of the coefficients. And the subsequent interpretations and discussion in the section below revealed to the table.

To give interpretation about the coefficients of the predictor variable, compare p-value with 0.05-level of significance and if the p-value is less than 0.05, then at least one categories of the predictor is significantly associated with the response. Therefore, the table is revealed that the p-values for giving priorities to pedestrians based on the law, pedestrians' manner in giving priorities to vehicles where necessary, and used seat belt while driving was less than 0.05 in the model. But the p-values of Sex, Educational level of derivers, license level of derivers, traffic police commitments and pedestrians wrong crossing were greater than 0.05 and not included in the binary logistic model and researchers conclude that there is no statistical evidence to say were factors for the occurrence of traffic accidents. Thus, there were enough statistical evidence to conclude that the relationship between road traffic accidents with giving priorities to pedestrians based on the law, pedestrians' manner in giving priorities to vehicles where necessary, and use seat belt while drivingwere significant.

Table 3.3. *Variables in the Binary Logistic Regression Model*

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	pedsetrianmanner			18.951	2	.000			
	pedsetrianmanner(1)	2.734	.852	10.290	1	.001	15.400	2.897	81.866
	pedsetrianmanner(2)	.886	.829	1.144	1	.285	2.426	.478	12.317
	Constant	-1.705	.769	4.918	1	.027	.182		
Step 2[b]	pedsetrianmanner			20.256	2	.000			
	Pedsetrianmanner(1)	2.944	.935	9.903	1	.002	18.986	3.035	118.758
	pedsetrianmanner(2)	.407	.900	.204	1	.651	1.502	.257	8.772
	seatbelt			11.610	2	.003			
	seatbelt(1)	.583	.669	.759	1	.384	1.791	.483	6.643
	seatbelt(2)	2.177	.661	10.829	1	.001	8.815	2.411	32.228
	Constant	-2.616	.922	8.045	1	.005	.073		
Step 3[c]	prioritypedestrian(sometimes)	1.046	.540	3.756	1	.05	2.848	1.00	8.210
	pedsetrianmanner			19.278	2	.000			
	pedsetrianmanner(Poor)	2.783	.895	9.662	1	.002	16.160	2.795	93.420
	pedsetrianmanner(Good)	.254	.889	.082	1	.775	1.290	.226	7.358
	seatbelt			9.477	2	.009			
	seatbelt(Never used)	.122	.728	.028	1	.867	1.130	.271	4.705
	seatbelt(Sometimes used)	1.872	.678	7.636	1	.006	6.504	1.723	24.547
	Constant	-2.803	.877	10.202	1	.001	.061		

a. Variable(s) entered on step 1: pedsetrianmanner.
b. Variable(s) entered on step 2: seatbelt.
c. Variable(s) entered on step 3: prioritypedestrian.

3.2.2. Interpretation of the Odds Model

The estimated odds of drivers give priorities to pedestrians to pass first as required by law sometimes was 2.848 and it indicates that the odds of gives priorities to pedestrians sometimes is 2.848 times to the occurrences of accidents than that ofgives priorities to pedestrians always (the reference category). Controlling for the other explanatory variables, the estimated odds of 16.16 for poor pedestrians' manner in giving priorities to vehicles where necessary indicates that 16.16 times of very good (the reference category) pedestrians' manner in giving priorities to vehicles when necessary more likely to the occurrences of traffic accident than that of poor pedestrians' manner in giving priorities to vehicles where necessary. While good pedestrians' manner in giving priorities to vehicles where necessary is not statistically significant, that indicates there is no statistical difference between good and very good (the reference category) pedestrians' manner in giving priorities to vehicles when necessary to the occurrences of traffic accident. Keep all other independents constant and the estimated odds of 6.504 for derivers used seat belt sometimes while deriving is more likely 5.759 times to the occurrences of traffic accident than that of derivers used seat belt always while deriving.

4. Conclusion and Recommendation

4.1. Conclusions

The aim of this study was to identify the major factors that affect the occurrence of traffic accidents at Bahir Dar city, North Western Ethiopia based on 100 samples of drivers. Methods of data analysis were descriptive statistics, Chi-square and Binary logistic regression and researchers were concluded the following based on the results of the study.

The majority (55.5 %) of accidents were occurring by drivers whose age is less than 30 years and the minimum (8%) accidents were occurring by drivers whose age is greater than 50 years old. The researchers concluded that as age of drivers increase the occurrence of accidents will minimize. Most accidents (68.9%) were caused by drivers whose educational level is secondary and this indicted that the more the drivers educated the less the occurrence of the accidents. About 55.6%

of the accidents occurred at Bahir Dar City were by drivers who used seat belt sometimes and this indicated that as drivers used seat belt while driving vehicles, the occurrence of accidents at Bahir Dar will decrease. The majorities (36%) of accidents at Bahir Dar City were due to pedestrian's wrong crossing of the road and researchers concluded that awareness should make for the communities by the responsible body to decrease accidents at city.

Poor pedestrians manner in giving priorities to vehicles where necessary was statistically significant factors for the occurrence of road accidents at Bahir Dar city and researchers concluded that there is better to make awareness for pedestrians to minimize the traffic accident in the area. Using seat belt sometimes while driving was statistically significant for occurrence of accidents at Bahir Dar City and this showed that awareness for drivers to use seat belt always is necessary to minimize the occurrence of accidents.

4.2. Recommendations

Based on the results of the study the following points can be recommended.

The government should create awareness for drivers, traffic polices and pedestrians about traffic accident and the rules and regulations.

The result showed that as age of drivers increased, the occurrences of traffic accidents were decreased. Therefore, the concerned body should give priorities for age categories while giving driving license.

Drivers should not violate the rules and regulations stated by law, like giving priority for pedestrians.

Pedestrian's manner while crossing the road is one of the significant variable for the occurrence of road traffic accidents in Bahir Dar city. Therefore, the traffic polices or concerned body should give trainings for pedestriansbout traffic accidents.

To minimize the road traffic accidents, the government should set the rules to use the seat belt and the drivers should apply it.

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