EFFECT OF NON-BEHAVIORAL FACTORS ON ROAD TRAFFIC ACCIDENTS

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ABSTRACT

In Ethiopia, road crashes are among the leading causes of death and injury. Road crashes cannot be absolutely eradicated. The behavior of derivers plays a role in the occurrence of road traffic accidents. So, it is important to figure out the role of the non-behavioral factors in road crashes. The study considered data from a total of 5,251 road traffic accidents from 2011 to 2014 in Yeka suburb, Addis Ababa, Ethiopia. In order to assess the effects of non-behavioral factors the study used frequency analysis, negative binomial and a logit regression model. Based on most frequency analysis non-behavioral factors which caused road traffic crashes in the suburb was day time and light, straight path, good asphalt and weather, and dry surfaces. In addition to that, roads without median and intersection, populated non business districts also played a vital role. The study shows that road traffic accidents have significant positive relationships with non-behavioral factors like road surface conditions, lighting conditions and maneuvering conditions. As a result; the study suggests that non-behavioral factors have an effect on road traffic accidents.

Keywords: Logit; Negative Binomial; Non-Behavioral; Road Crash; Road Traffic Accident

1. INTRODUCTION

A road traffic accident is defined as any vehicle accident occurring on a public highway which happens due to a collision between vehicles and vehicle, vehicle and animals, vehicles and pedestrians or vehicles and fixed objects [1]. Getu outlined that road traffic accidents are a rare, random, multi-factor event always preceded by a situation in which one or more road users have failed to cope with the road environment [2]. Several road crash incidences occur throughout the world at any given time in the day. It adds a burden to the whole society, such as medical emergency services, hospitalization, traffic congestion, social welfare, and insurance systems in the long term, which may negatively influence the productivity and competitiveness of a society as stated by [3].

Road traffic accidents are common events all over the world that cause on average 3,287 deaths per day [4]. More than half of all road traffic deaths occur among young adult ages between 15 to 44 years. Different researchers argue that unless remedial action is taken road traffic accidents will become the most common causes of death by 2030 [5]. In a developing country like Ethiopia, Road Traffic crashes were also among the leading cause of death and injury. According to the World health organization, in 2014 the death toll in Ethiopia reached 15,015 or 2.5% of total road traffic accidents [6]. Due to the continuous increase in automobiles and many other reasons, the number of traffic accidents in Addis Ababa city is increasing alarmingly[7] [6]. The study focuses on non-behavioral factors that contribute to road traffic accidents in Yeka Suburb administration, Addis Ababa, Ethiopia. To be more meaningful the study used four years of road traffic accident data.

Different researchers argue that factors contributing to road crashes include inappropriate driver behavior, congested traffic flow, unanticipated roadway geometrical changes and

adverse weather conditions etc. [8]. The driver's behavior plays a crucial role in the occurrence of a crash. But, it is important to figure out the role of the non-behavioral factors in traffic accidents [9]. Non-behavioral factors have their own significant effect on the occurrence of road traffic accidents. As a result, road traffic accidents have direct relationship with the number of road lanes, traffic volume, shoulder lane, lane widths etc. However, the occurrence of road crash has no consistent relationship with geometric parameters [10].

According to Getu, 2015; non-behavioral factors causing road traffic accidents in Ethiopia, resulted in property damage and injury on straight sections of road in 82.67% of cases and 17.33% of cases respectively; and on non-straight sections resulted in injury in 17.61% of cases and caused property damage 82.39% of cases [11]. In addition to that; Segni also stated that the high occurrence of crashes in these areas may be explained by the complexity of the road environment, mixed traffic and built-up property along these roads that attracts mixed road users with variation across time and location [12]. Ackaah, 2009; mentioned that roads with good asphalt are found to have lower crash and severity rate than similar roads that have poor asphalt [10].

Regression models are very accurate tools for predicting the expected total accident experience for a location, but they have not proved satisfactory in isolating the effects of individual geometric or traffic control features [13] [12]. In order to define the relationship between road traffic accidents and non-behavioral factors includes geometric characteristics of the road, environmental factors and traffic conditions; the study assesses different statistical regression models. Thus identification of non-behavioral related factors which contribute towards a total number of crashes was the main goal of this study. So, negative binomial and logit models were used in this study to estimate the effect of the statistically significant non-behavioral factors on the occurrence of road traffic accidents.

A different study revealed that a negative binomial regression model performed better regarding statistical properties and prediction of expected crashes [14] [15] [16]. In addition to that, a negative binomial regression model is widely used in vehicle accident analysis for rural highways, arterial roadways, urban motorways, and rural motorways [17]. Logit regression is a type of probabilistic statistical classification model used to predict a binary response from a binary predictor, used for predicting the outcome of a categorical dependent variable based on one or more predictor variables. Where the number of available predictor variables is more than two categories logit regression was preferable [18].

2. MATERIAL AND METHODS

Yeka suburb is located in the north-east of Addis Ababa. This study area was selected due to the convenience of transportation and the high number of road traffic accidents registered in the suburb. Based on availability of data the study considers four year road traffic accident data from 2011 to 2014. The selection of study area was applied to this study was a convenience selection approach which saves costs and time. For further analysis the study used secondary data of road traffic accidents from Yeka suburb police commission. In order to have a meaningful result the study considers the six basic data quality improving characteristics in road traffic accidents. Those are data accuracy, completeness, validity, timeliness, coverage and availability [11].

In order to define non-behavioral factors that contribute to a road crash identifying dependent and independent variables was a concern of the study. The study defines the dependent variable used in this study as the road traffic accident; while, the independent variables are variables related to road traffic accident severity involved in the crash. So fatality, serious injury, slightly injury and property damage were considered by different

researchers to be independent variables. An independent variable sometimes called an experimental or predictor variable, is a variable that is manipulated in an experiment in order to observe the effect on a dependent variable. The statistical software named Statistical package for social science (SPSS) version 23 was used to analyse determinant effects of non-behavioral factors on road traffic accidents. The reason why the study used SPSS was that it estimates a parameter with a significant value of 95% confidence level (p-value less than 5%). In order to outline the effects of non-behavioral factors on road traffic accidents the study considered the following independent variables categorically:

i. **Weather Condition related variable:** - under this circumstance the study considered cloudy ®, chilly (CH), drizzle (D), hazy (H), good weather (GW), cold weather (CW) and heavy rain (HR) as weather condition related independent variables.
ii. **Crash related variables: -** the study considered overturning (OT), vehicle to inert (VTI), vehicle to pedestrian (VTP), vehicle to vehicle (VTV), vehicle to vehicle to inert (VTVI), vehicle to vehicle to inert to pedestrian (VTVIP), vehicle with parked vehicle (VTS), vehicle to vehicle to parked vehicle (VTVSV), overturning to passenger (OTP) and undefined (UD) as Crash related independent variables.
iii. **Defendant Vehicle Maneuvering Condition related variables: -** the study considered backward movement (BM), during stopping(DS), entrance to diverging road (EDR), local exit (LE), entrance to junction /merging road (EJR), U-turning, entrance to square road (ESQR), left turning (LT), right turning (RT), straight through (ST), maneuvering (MA) and undefined (UD were considered as defendant vehicle maneuvering condition related independent variables.
iv. **Crash Hour related variables: -** based on a three hour classification the study considered mid-night (MN), dark (DA), late morning (LM), morning (MO), noon (NO), afternoon (AN), evening ®, night (N) and undefined (UD) as crash hour related independent variables.
v. **Road Junction (Intersection Type) related variables**: - the study considered midblock/without intersection (WOI), Y-junction (YS), T-junction (TS), roundabout ®, four-leg Junction (SQ), five-leg junction (FLJ), and rail crossing (RC) and others (O) as road junction (intersection type) related independent variables.
vi. **Days of the week related variables: -** the study considered Monday (M), Tuesday (TU), Wednesday (W), Thursday (TH), Friday (F), Saturday (SA) and Sunday (SU) as day of the week related independent variables.
vii. **Lanes/Medians (Road Type) related variables**: - the study considered one-way (OW), undivided two-way (TW), island (IS), separated two-way by broken line (SBS) and two-way divided with solid lines road marking (SLS) as lanes/medians (road type) related independent variables.
viii. **Road Alignment (Road Geometry) related variables**: - the study considered tangent road with flat terrain, tangent road with mild grade and flat terrain, Tangent road with mountainous terrain and escarpment, tangent road with rolling terrain, gentle horizontal curve, and steep grade upward with mountainous terrain as road alignment related independent variables. Furthermore, road alignment was treated as straight ahead (Flat) (SA) and non-straight ahead(Rolling) (SUD) which include straight with slightly sloping (SSS), straight with up and down (SUD), straight with highly slopping (SHS), slightly zigzag (SZ), highly zigzag (HZ), downward (DW) and upward (UW).
ix. **Illumination Condition related variables: -** the study considered daytime with sufficient daylight, twilight, sun rise, night with sufficient light, night with insufficient light, Night without light as illumination condition related independent variables. Furthermore, illumination/lighting condition was treated as day light (DL) and darkness

which include sun rise (SR), sunset (SS), a night with poor road light (NPRL), a night without road light (NWRL) and night with a good light (NGRL).

x. **Road Pavement Condition related variables: -** the study considered good asphalt condition (GA), distressed/poor asphalt condition (PA), gravel road condition (GR), and earth road condition (ER) as road pavement condition related independent variables.

xi. **Location related variables**: the study considered organization/around office (AO), around industry (AI), around resident (AR), around market (AM), around religious (AR), around entertainment (AE), around school (AS), around hospital (AH) and Others (O) as location related independent variables.

2.1. Negative Binomial Regression Model

The negative binomial, which is a discrete distribution, provides an alternative model to deal with over-dispersion in count data such as accident frequencies. For negative binomial models, the regression coefficients were estimated by the method of maximum likelihood. The statistical software (SPSS) provides a procedure to estimate the regression coefficients by specifying the appropriate type of distribution and link function. The negative binomial technique relaxes the assumption of equality of the mean and variance, by adding a gamma-distributed error term and the model form is given below [19].

$$\boldsymbol{E(Y) = e^{\sum \beta_i x_i + \varepsilon_i}} \quad (1)$$

Where $\boldsymbol{\varepsilon_i}$ an error is term, and $\boldsymbol{e^{\varepsilon_i}}$ was gamma-distributed error term with mean 1 and variance α2. The addition of $\boldsymbol{\varepsilon_i}$ makes the variance to be different from the mean as follows: The ratio of variance over expectation of the negative binomial model is greater than 1.

$$\boldsymbol{VAR(y_I) = E(y_I)[1 + \alpha E(y_I)]} \quad (2)$$

Where α is also called the dispersion parameter, which plays an important role in the determination of negative binomial regression model. When α is significantly different from zero, the distribution was under-dispersion or over-dispersion and the negative binomial model is appropriate. When α approaches zero, the variation was almost equal to the mean, and the distribution cannot modeled by the negative binomial technique. The form of negative binomial probability distribution is given as:

$$\boldsymbol{\Pr(y_i) = e^{-\lambda_{i*} e^{\varepsilon_i}} (\frac{-\lambda_{i*} e^{\varepsilon_i})^{y_i}}{y_i!}} \quad (3)$$

2.2. Logit Regression Model

The methods employed in an analysis using logit regression follow the same general principles used in linear regression analysis. In any regression analysis, the key quantity is the mean value of the response variable given the values of the independent variable [20]. The specific form of the logit regression model was:

$$\boldsymbol{\pi(x) = E(Y/x) = \frac{e^{\beta_0 + \beta_1 x_i}}{1 + e^{\beta_0 + \beta_1 x_i}}} \quad (4)$$

The transformation of the $\pi(x)$logistic function is known as the logit transformation:

$$\boldsymbol{g(x) = \ln\left[\frac{\pi(x)}{1 - \pi(x)}\right] = \beta_0 + \beta_i x_i} \quad (5)$$

2.3. The Significance of Variables

The study considers Pearson's correlation to define the significance of the variable for regression analysis. In this study, thirteen variables have been tested for inclusion. Eleven of them were categorical variables. Pearson's correlation analysis for aggregate data was processed to find out the linear relationship between every two independent factors.

Table 1:- Pearson's Correlation Matrix

Pearson's Correlation											
	CH	**D**	**LU**	**RT**	**RG**	**IT**	**PC**	**RC**	**LC**	**WC**	**MC**
CH	**1**	.075	-.017	-.012	-.027	-.008	-.015	.009	.010	-.005	.008
D	.075	**1**	.012	.025	-.001	-.013	-.012	.016	-.009	-.004	-.015
LU	-.017	.012	**1**	.008	-.007	.010	-.007	-.023	.014	-.018	.005
RT	-.012	.025	.008	**1**	.025	.119	.001	-.070	.007	-.001	.017
RG	-.027	-.001	-.007	.025	**1**	.060	.036	.115	.033	-.008	.001
IT	-.008	-.013	.010	.119	.060	**1**	-.038	.068	.110	.001	-.025
PC	-.015	-.012	-.007	.001	.036	-.038	**1**	-.019	.002	-.074	.047
RC	.009	.016	-.023	-.070	.115	.068	-.019	**1**	.189	-.091	-.010
LC	.010	-.009	.014	.007	.033	.110	.002	.189	**1**	-.021	.019
WC	.005	-.004	-.018	-.001	-.008	.001	-.074	-.091	-.021	**1**	.094
MC	.008	-.015	.005	.017	.001	-.025	.047	-.010	.019	.094	**1**

Source: *Own Calculation*

Where:- CH -Crash Hour, D -Days, LU - Land use, RT – Road type, RG -Road Geometry, IT –Intersection type, PC -Pavement Condition, RC -Road Condition, LC – Lighting Condition, WC -Weather Condition, MC -Maneuvering Condition

From table 1 shown above; relative to other variables day of the week highly correlates with crash hour; while other variables have low correlation with each other. Different researchers and economists agree that if the correlation value is more than 80% and above one of the stated variables should be eliminated. So, based on Pearson's correlation value all variables used for the analysis of the effects of non-behavioral factors on road traffic accidents are shown on the table 1 above.

3. RESULTS AND DISCUSSION

The study considered a total of 5251 road traffic accidents. The data and analysis of the study concentrate on Yeka suburb, Addis Ababa, Ethiopia. To make the analysis more meaningful the study used the road traffic accidents rate in the suburb over four years from 2011 to 2014. In this study, two dependent variables were considered which include an ordered dependent variable (severity level) and an unordered dependent variable (occurrence of crash). The dependent variable considered in this study for the case of the logit model was the level of severity which divided into two categorical levels: no injury (property damage only) and injury (slight injury, serious or fatal injury).

The explanatory variables (independent variables) were categorical. Since, some of the categorical variables had several levels as described in the methodology part a collection of design variables (dummy variables) was needed to represent the data. The SPSS 23 software package was used for coding design variables/dummy variables. It was more convenient to have as few levels of design variables as possible in order to simplify the model interpretation and to avoid difficulties while running the model processing in SPSS.

3.1. Frequency of explanatory variables

Due to the complexity of the occurrence of crashes which were target variable, multiple factors were considered and applied. Those factors treated as explanatory variables include road geometry, intersection type, road type, road surface condition, land use characteristic, and environmental conditions such as lighting and weather conditions; and the statistics of some attributes were described below on table 2. Most injury and property damage only crashes which occurred in and around central business districts were 32.39% and 27.19% residential areas. Populated non-business districts like school, hospital, office and praying rooms are also crash prone areas, second to central business districts at 31.08%. The study also indicated that 17.52% injury and 82.48% of property damage only occurred in central business districts, and 18% injury and 82% property damage in residential areas. The findings of this study are consistent with another study which was carried out in Addis Ababa (Schneider, et al., 2008a) as explained by [2].

Table 2:- Frequency of Explanatory Variables

Explanatory Variable		**Accident Frequency in No.**		**Accident Frequency of in %**		**Maximum Frequency of Accident Observed in %**
Item	**Parameter**	**Injury**	**PDO**	**Injury**	**PDO**	**Total**
CR	DT	622	3048	16.95	83.05	69.89% DT
	NT	290	1291	18.34	81.66	
CT	VTI	67	592	10.17	89.83	
	VTV	498	3247	13.30	86.70	71.32% VTV
	VTP	328	422	43.73	56.27	14.28% VTP
	OT	19	78	19.59	80.41	
LUP	ABD	286	1346	17.52	82.48	31.08% ABD
	AFI	44	162	21.36	78.64	
	ANBD	285	1416	16.75	83.25	32.39% ANBD
	AR	257	1171	18.00	82.00	27.19% AR
	O	40	244	14.08	85.92	
LC	DL	702	3615	16.26	83.74	82.21% DL
	DN	210	724	22.48	77.52	
MC	ST	411	2980	12.12	87.88	64.58% ST
	ELI	67	138	32.68	67.32	
	DT	317	451	41.28	58.72	14.63% DT
	MA	99	550	15.25	84.75	12.36% MA
	UD	18	220	07.56	92.44	
PC	GA	890	4222	17.41	82.59	97.35% GA
	PA	22	117	15.83	84.17	
OI	WI	222	1442	13.34	86.66	
	WOI	690	2897	19.24	80.76	68.31% WOI
OM	MS	497	1946	20.34	79.66	
	WOM	415	2393	14.78	85.22	53.48% WOM
RA	SA	791	3773	17.33	82.67	86.92% SA
	NSA	121	566	17.61	82.39	
RSC	DR	796	3695	17.72	82.28	85.53% DR
	WE	116	644	15.26	84.74	
WC	GW	880	4139	17.53	82.47	95.58% GW
	BW	32	200	13.79	86.21	

Source: *Own Calculation*

Where: - CH-Crash hour, CT-Crash type, LUP-Land use pattern, LC-Lighting condition, MC-Maneuvering condition, PC-Pavement condition, OI-Occurrence of intersection, OM-Occurrence of median, RA-Road alignment, RSC-Road surface condition, WC-Weather condition, DT-Day time, NT-Night time, VTI-Vehicle-to-inert, VTV-Vehicle-to-vehicle, VTP-Vehicle-to-pedestrian, OT-Overturning, ABD-Business districts, AFI-Industry/factory, ANBD-Populated non-business district, AR-Residential area, O-Others, DL-Daylight, DN-Darkness, ST-Straight Path, ELI-Entering/leaving intersection, DT-During turning, MA-Maneuvering, UD-Others/undefined, GA-Good asphalt, PA-Poor asphalt, WI-With intersection, WOI-Without intersection, MS-Median separated, WOM-Without median, SA-Straight ahead, NSA-Non-straight ahead, DR-Dry, WE-Wet, GW-Good weather, BW-Bad weather.

As shown in table 2 above, the study shows that around 54.48% of crashes resulting in injury occurred on undivided roadways. While median separated roads accounted for 20.34% and 79.66% of injury and property damage only crashes respectively. This implies that the absence of median strips or barriers has a significant effect in increasing crashes. Concomitantly the variation in road traffic crashes occurs due to variation in the time of day. As shown in Table 2 above, 68.89% of road traffic accidents occurred in the daytime of which 83.05% caused property damage and 16.95% caused injury. As a result the study revealed both the occurrence of accident and the level of severity are higher during daylight hours in the Yeka suburb.

Pavement surface conditions were important in maintaining the stability of vehicles when a vehicle left the road. But the results shown in table 2 above showed 82.59% of property damage and 17.41% of injuries occurred on good asphalt, while 31.69% of crashes occurred around an intersection which was not consistent with the previous findings by Williams. This implies that occurrence of crash increases with an increase in access density.

Generally, in Yeka suburb the study shows that road traffics happen not only due to driver behavior but also due to non-behavioral factors. Those factors indicated that day time, day light, straight path, good asphalt, good weather and dry surface were some of the factors causing road traffic accidents in Yeka suburb. In addition to that roads without median and intersection, populated non business districts also play a vital role for the occurrences of road traffic Accidents.

3.2. Negative Binomial Regression

This model relaxes the assumption of equality in mean and variance, by adding a gamma-distributed error term. Using all variables negative binomial regression was fitted to the data. The results of the full model showed some independent variables to be statistically significant at the 5 percent significance level and others not to be. As shown in table 3 below occurrences of median, occurrence of intersection, road condition, lighting condition, pavement condition and maneuvering condition were found as significant explanatory variables; and on the other hand land use patterns, weather conditions, crash times, days of the week and road alignment were found to be insignificant in the full model.

Table 3:- Output for Negative binomial regression (Tests of Model Effect)

Parameter	Wald Chi-Square	df	Sig.
Intercept	1.102	1	.294
PAC (Pavement condition)	10.102	1	.001
CRH (crash hour)	1.514	1	.218
DAY (Days of the week)	8.521	6	.202
LAU (Land use pattern)	2.925	3	.403

ROT (Occurrence of median)	1.815	1	.178
ROG (Road geometry)	3.856	1	.050
INO (Intersection occurrence)	0.009	1	.924
ROC (Road condition)	8.557	1	.003
LIC (Lighting condition)	4.882	1	.027
WEC (Weather condition)	2.668	1	.102
MAC(Maneuvering condition)	87.054	4	.000

Source: *Own Calculation from SPSS*

As shown in table 3 above; non-behavioral factors like pavement, road geometry, road lightening and maneuvering conditions had significant effects on the occurrence of road traffic accidents with a p-value of less than 0.5. Therefore, the effects of non-behavioral factors like pavement condition, road geometry, road condition, lightening condition and maneuvering conditions play a great role in the occurrence of road traffic accidents in Yeka suburb.

3.3. Binary logit model

Logit models are among the most widely used members of the family of generalized linear models in the case of binary dependent variables. Logit regression was applied to accident-related data collected from traffic police records in order to examine the contribution of several variables to accident severity. Accident severity (the dependent variable) in this study is a dichotomous variable with two categories, Injury and non-injury (property damage only) as described above.

As shown in table 4 below; based on logit regression model occurrences of median, crash type, occurrence of intersection, road condition, lighting condition and maneuvering condition were found to be significant explanatory variables; and on the other hand land use pattern, pavement condition, crash hour, days of the week, road alignment and weather condition were found to be insignificant.

Table 4:- Tests of Model Effect in case of the Logit regression model

Parameter	**Wald Chi-Square**	**df**	**Sig.**
Intercept	11.163	1	.001
ROC (Road Condition)	5.067	1	.024
LIC (Lightning Condition)	12.947	1	.000
DAY (Day of the Week)	7.928	6	.243
LAU (Land Use Pattern)	0.996	4	.910
WEC (Weather Condition)	1.530	1	.216
CRT (Crash Type)	485.115	3	.000
INO (Intersection Condition)	17.341	1	.000
MAC (Maneuvering Condition)	411.799	1	.000
PAC (Pavement Condition)	1.654	1	.198
ROG (Road Geometry)	0.110	1	.740
ROT (Occurrence of Median)	38.819	1	.000
CRH (Crash Hour)	0.163	1	.687

Source: *Own Calculation*

3.4. General Crash Analysis

As shown in table 5 below from 2011 up to 2014, a total of 5252 total accident occurred in Yeka suburb. The Yeka suburb alone accounted for more than 12% of all road traffic

accidents in Addis Ababa. The trend seems to be linear incremental with a 0.943 coefficient of determination as shown in the table 5. The four year data was used to analyse the effect of non-behavioral factors on road traffic accidents.

Table 5:- Number of road traffic accident in the past four year

Year	2011	2012	2013	2014
Total accidents in Yeka suburb	781	1007	1626	1838
Total accidents in Addis Ababa	11529	15815	17904	17732

Source: *Yeka suburb police commission*

i. **Road surface condition vs. occurrence of a crash:-** Ninety percent (90%) of total road traffic accidents occurred on dry road surfaces as opposed to 10% which occurred on wet road surface conditions. Most personal injury crashes occurred on dry road surface condition. This implies that wet road surface condition has a significant negative relationship with the occurrence of an accident.

ii. **Land use pattern vs. occurrence of a crash: -** the number of accidents was higher in populated districts like populated-business districts (entertainment, market), and populated non-business districts (school, hospital, church, organizational office etc.) compared to residential areas. It was observed that over two-third (70%) of all road traffic accidents in Yeka suburb occurred in the central business districts. This shows land use pattern was a significant non-behavioral variable in the occurrence of road traffic accidents.

iii. **Road type vs. Occurrence of crash:- i**n this study road type was found as statistically significant with positive estimated model parameters in case of one-way roads and with negative estimated model parameter in the case of two-way division.

4. CONCLUSION AND RECOMMENDATION

In this study road traffic crashes in Yeka suburb were analyzed and statistical models assessed to identify the effects of non-behavioral factors on the rate of road traffic accidents. The selection of the study area was based on convenience. The study used the data from 5,251 road traffic accidents registered in the past four year from 2011 to 2014. In order to define probable factors the study used negative binomial and a logit regression model. Early on in the study a decision was made to focus on developing relationships between accidents and sets of explanatory variables. Variable sets include all collected non-behavioral variables. The dependent variable used in the study was road traffic accidents.

In Yeka suburb road traffic accidents happen due to non-behavioral factors. Day time, day light, straight path, good asphalt, good weather condition and dry surfaces were causes for the occurrences of road traffic accidents in Yeka suburb. Also roads without median, intersection and populated non business districts play a vital role for the occurrences of road traffic crash. As a result road traffic accidents were dependent on non-behavioral factors that cause road traffic accidents in Yeka suburb.

Negative Binomial regression models results revealed that road types, land use patterns, road surface conditions, lighting conditions and maneuvering conditions were significant explanatory variables that influence the prediction of crashes in the Yeka suburb. This indicates that non-behavioral factors have an effect on the occurrence of accidents. While; in logit regression model occurrences of median, crash type, occurrence of intersection, road surface conditions, lighting conditions and maneuvering conditions were found to be significant explanatory variables. Based on negative binomial and a logit regression model; road surface conditions, lighting conditions and maneuvering conditions were significant

factors causing road traffic accidents in Yeka suburb. Therefore, the study reaches the conclusion that road traffic crashes were dependent on no-behavioral factors in Yeka suburb.

Road transport is a system in which human, vehicle; road and its environment intermingle with each other. In order to improve the efficiency and safety of road traffic, it is important to relate accident frequency and severity to the causative variables. In this study accident prediction model relating the occurrence of road traffic accidents to non-behavioral factors was developed (which was qualitative). But if the traffic data collecting format is changed (if it includes quantitative parameters like lane width, section length), quantitative research should be performed by relating road and environmental factors with the occurrence of accidents.

In addition to the above, automotive and dynamic engineers should conduct research and develop a predictive model taking into consideration vehicle related factors in order to change road user behavior and attitude. Also; behaviorists and doctors and / epidemiologists should conduct research and develop a predictive model to consider human related factors.

The contribution of the above mentioned research topics will minimize the occurrence of accidents if best fit prediction models are used as a tool for decision making processes and cost effective countermeasure is implemented. In order to use accident prediction models as a tool for the decision making process, a reliable and accurate relationship between the occurrences of road traffic accidents and contributing factors should be developed.

A road traffic accident database is a prerequisite for any traffic accident reduction and prevention measures. It is a vital source of factual information for politicians and administrators, researchers, traffic and road engineers, organizations engaged in driver training, and the police who make the accident reports. Therefore, traffic police officers should be supported by professionals who collect complete information regarding road characteristic features (this should include class of road/road number, carriage type/ no. of lanes, road width, shoulder lane width, section length, speed limit, junction type and the like) and environmental features (which includes light conditions, road lighting, road surface condition (dry, wet, etc.), road surface quality, weather, type of traffic control, road geometry, traffic control devices and the like). These parameters should be included in the daily accident recording sheet.

The last recommendation goes to Addis Ababa police commission statistical officers to use or prepare a standard daily accident recording booklet by not just writing a statement but also by putting a mark or a thick sign. In addition to this; traffic police should be trained at national and local levels or supported by professionals to collect accurate and reliable traffic accident data or there should be three experts (traffic/transport engineer/ expert, automotive/dynamic experts & behaviorist or epidemiologist) during traffic accident data collection. Traffic and transport engineers should prepare a standard road traffic accident data collecting format and record daily accident data themselves. Likewise, automotive or dynamic engineers/experts and behaviorists or epidemiologists experts should prepare their own standard of road traffic accident data collecting format.

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