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The Effect of Human Factor on the Prevalence and Severity of Road Accidents

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ABSTRACT:- The problem of deaths and injury as a result of road accidents is now recognized to be a global phenomenon. Vulnerable road users such as pedestrians and drivers, are vulnerable due to lack of protection in traffic. As a result, authorities in almost all countries of the world are now concerned about the growth in the number of people killed and seriously injured on their roads. The main objective of this thesis study was to determine human factors that contribute significantly to the crash severity. This study applied logistic regression to accident-related data collected from Traffic Police traffic records in order to examine the contributing factors to accident severity. A total of 26263 accident data of the year 2018 were filter and analyzed. The accident severity (dependent variable) in this study is a dichotomous variable with two categories, Fatal or Non-fatal. Among the independent variables Gender, Age, and Alcohol Test were found to be statistically significant. It can be concluded that the accident fatality is higher in females, age 18 to 34 and those who tested alcohol over legal limit. To reduce road accidents, government should aware both pedestrians and drivers about the repercussions of road accidents as well as imposing heavy fines on individuals who breach road rules.

Keywords - Accidents, Factors, Impact, Road

I.   INTRODUCTION

The field of transportation has undergone a massive growth with the immense development that occurred with the industrialization. But as a side effect a huge increase of road accidents can be represented. As a result, the percentage of deaths and injured throughout the world have risen with time (Deepa, 2016). Increase of one's income and the development of living status of people results in the development of the economy. In any region, transportation plays a significant role in economic development of a country. Transportation is important to efficiently carry out official, unofficial and business activities and to develop interpersonal relationships between people (Deepa, 2016). A lot of countries have faced difficulties due to the increase of people and vehicles entering a town as a result of population growth. In developed countries, roads and transportation have been developed with the increase of population.

In developing countries including Sri Lanka there is a rapid growth in the road accidents and resulting deaths and injuries. It is proved from researches like Hammoudi, Karani, & Littlewood (2014), Suriyawongpaisal & Kanchanasut (2010), that for the occurrence of most of the road accidents, there is a major influence in human factors. As a country, due to the growth of road accidents, a lot of social and environmental issues have to be faced. This has become a great obstacle for developing countries like Sri Lanka to reach their development. Therefore, there is a timely importance in finding out the factors which affect road accidents, to get rid of this unfavorable situation.

A total of 2838 people died in Sri Lanka, making an average of eight casualties a day. And some left disabled as a result of road traffic accidents between January 1st and December 31st 2018 (Traffic Police, 2018). It further revealed that totally 35752 accidents were occurred during that time period. The families whose bread winners died in road traffic accidents may be driven into poverty. Human, vehicle and environmental factor's contributing to road traffic accidents in Sri Lanka might be generally known but little has been researched. Human, vehicles and environmental in terms of contributing to accidents and the severity of related injuries, have not yet been researched. A gap therefore exists in this area and more knowledge is needed.

Therefore, this study was done to identify the causes that lead to the severity of road accidents in Sri Lanka. though there are many factors associated with road accidents, this study considered only the human factors which are associated with road accidents.

II. LITERATURE REVIEW

Many research results in road accidents around the world have revealed that human factors have a major impact on accidents. It can be divided into three categories such as negligence, mistakes done by the pedestrians and alcohol (Assum, 1997 and Liyanage, 2019a). Driving under the influence of high speed, sleepless, vehicle overtaking another vehicle, using mobile phones while driving and driving while thinking different things have caused under negligence. According to Libres et al. (2008), road accidents are caused by failure of a correlation between factors such as roads, vehicles and people and the human factor is a major contributing factor to road accidents. Among those factors high speed, driver's negligence and the urge to overtake another vehicle are mainly effected. Among the three major factors that lead to the highest rate of fatalities on the road in Oman, which has the highest rate of fatalities, human factors were the major factor (Plankermann, 2013). Otte, Jänsch, & Haasper (2012), revealed that the lack of helmets and protective clothing have caused to increase the personal injuries in an accident.

According to Suriyawongpaisal & Kanchanasut (2010), the most frequent road accidents have been revealed to be caused by driver's negligence, excessive drugs or alcohol use while driving, using mobile phones while driving. Non-wearing of a helmet, seat belt confirms that unsafe practices have resulted in increased causalities. According to Hammoudi et al. (2014), road accidents in Dubai countries the human factors high speeds, driver's negligence, the urge to overtake another vehicle, use of mobile phones while driving while drunk, violation of road rules have a profound effect. According to the Vogel & Bester (2005), human factors are casual factors of 75.4% of the road accidents in South Africa and most of the accidents (65.8%) are caused by negligence of drivers and pedestrians. It is reviled that 92% of the road accidents in Sri Lanka are caused by the weaknesses of the road users (Galgodalla M. S..,2005). According to Libres et al. (2008), most of the accidents occure due to human factors and driving in high speeds. In Philipine 85% of the accidents have occurred due to errors of human and 18% of them have occurred while overtaking another vehicle and it is reported that 49% of these accidents are fatal accidents and 44% of them are minor accidents. Changing attitudes of road users is often recommended to improve road safety. However road safety research doesn't find a link between road users'attitudes and risk of accidents.

Al-Dah (2010), says that the speed has a major impact on road accidents. It reveals that out of the drivers 26.8% who uses the road 12.6% which is less than half drive at the right speed. In Hammoudi et al. (2014), revealed that high speed is the major contributing factor for the majority of road accidents in Dubai. 73% of male drivers and 55% of female drivers are driving at high speeds, resulting in a large number of accidents and loss of life and property. According to Karjalainen et al. (2012), high speed driving is one of the leading causes of fatal accidents in Finland. It has also been confirmed that most of these accidents are from young people(average age: 35). Van Elslande & Fouquet (2007), says that the majority of road accidents in France have been attributed to sleepwalking while driving. According to a research study conducted on the cause of the road accidents in US during the period from 2005 to 2007 the behavior of the road users is the main cause of the road accidents as well as the sleep while driving also has become a major factor (Singh, 2015).

Many other researchers have revealed that using mobile phones while driving is a major risk in road accidents (Hammoudi et al, 2014; Patten, Kircher et al., 2004; & Suriyawongpaisal & Kanchanasut, 2010). Horberry et al. (2006), shows that misbehavior of pedestrians is also contributing factor in road accidents in Australia. The human factors, walking on the road without using the pavement, crossing the road carelessly, failure to heed road signs have an effect on the increase in accidents.

According to the results of a research done using data on road accidents in India during it is revealed that India is one of the countries with the highest number of road accidents in the world. It has also been revealed that the road users had been drinking drugs and alcohol before the accident. It is also being revealed that between 2% to 33% of the injured and 6% to 48% dead and disabled were drunk before the accident (Das A., 2012).

According to Otmani, Pebayle, Roge, & Muzet (2005), from January 1998 to February 2015 drug driving has been a major factor in the increase in road accidents in France. This has been revealed when investigating accidents comparing alcohol users and non-alcoholic drivers.

III. METHODOLOGY

In this study, traffic crash data for the year 2018 were used. The data were obtained from the MAAP (Micro Accidents Analysis Programmed) database of the City Traffic Police Station, Colombo 1. MAAP traffic crash data are organized into three related files with crash data compiled together by calendar year as a Microsoft Access document. The three files are Attendant Circumstances, Casualty Details and Vehicle Details.

Each of these files contains a variable known as Accident key, which is an important variable that relates records in all three files to their respective crash incidents, that is, each record that share the same crash incident have the same Accident key.

Attendant Circumstances file contains information specific to each crash incident. Information recorded include crash severity, number of vehicles crashed, date of crash, time of crash, name of city, urban or rural where the crash occurred, crash location, type of road, signals of speed, type of weather, day of the week, holiday/normal day, etc. The Casualty Details records file contains information on the in that crash incident recorded in the crash records file. Information recorded in this file includes unit type (e.g., motor vehicle, motorcycle, bicycle, pedestrian, etc.), person type (e.g., driver, occupant, or pedestrian), age, gender, severity of injury sustained by an individual, safety equipment used, etc. The Vehicle Details records file contains information regarding the crashed vehicles such as element type, age of the vehicle, specifications of vehicle etc.

The merging of these files into one file was accomplished by using a single-to-many-merging technique in SPSS software. Due to the dependency of the accident records, data were filled using the variable "driver/pedestrian at fault". Then exported it to Microsoft Excel to obtain better graphical representation and the advanced analysis were carried using SPSS. The final file that contained data regarding the driver/ pedestrian at fault was consisting of 26263 records. And the analysis was done using that file.

Table 1: Variable Description

Variable	Category	Code
Nature of the Accident	Fatal	0
	Non-Fatal	1
Gender	Male	1
	Female	2
Age	Below 18	1
	18 to 34	2
	35 to 50	3
	51 to 70	4
	Above 70	5
Alcohol Test	No alcohol or below legal limit	1
	Over legal limit	2
	Not tested	3

Variable "Highest Severity", which was divided into four levels, that is, fatal, grievous, non-grievous and damage only was reduced into two levels, Fatal (Fatal and Grievous) and Non-fatal (Non-grievous and Damage Only). The two leveled variable was named as the "Nature of the Accident" and it was used as the dependent variable of the study. This study consists with following independent variables Gender, Age, Alcohol Test, as the independent variables when finding the factors affecting road accidents.

statistical tools using the software SPSS version 21 and Microsoft Excel 2010. Descriptive analysis, Chi-square analysis, and Logistic Regression Analysis were used to analyze data of this study.
Studies done by Liyanage (2019b), Al-Ghamdi (2002), Dissanayake (2004), Pickrell and Starnes (2008), and Dandona et al. (2005) also have used logistic regression to find the factors affecting road accidents. According to Agresti (2007), logistic regression is the most preferred where the independent variables are categorical or mix of continuous and categorical. In this study, we coded y =1 (non-fatal) and y = 0 (fatal).

IV. RESULTS
A preliminary data analysis was done to evaluate the objectives of the research by estimating the human factors that leads to the severity of road accidents in Sri Lanka.
4.1 Nature of the Accident
Figure 1 is drawn to find out the percentages of severity of the accidents which were occurred in year 2018. Theses accident types are divided into four categories as damage only, fatal, grievous injury and non-grievous injury. According to the graph it is depicted that 44% of accidents were grievous while 27% of accidents were fatal. 20% of accidents have only caused damages while a small percentage (9%) of accidents have resulted non grievous accidents.
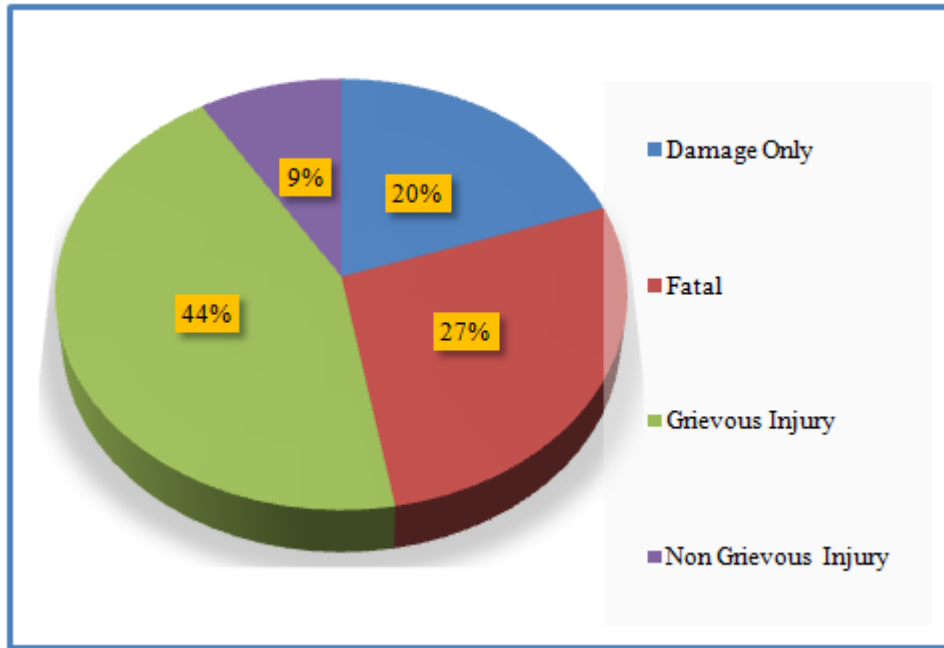
Figure 1: Nature of the accident (Highest severity)

The types of accidents mentioned in Figure 1 were narrowed down to two factors fatal and nonfatal accidents to meet the objective of this research. The accident which results in a death of people and high risk to the health were considered as fatal accidents and the accidents which were non grievous and damage only were considered as nonfatal accidents. As seen in Figure 2, 72% of accidents caused are fatal accidents which are the majority while only 28% of accidents are nonfatal.
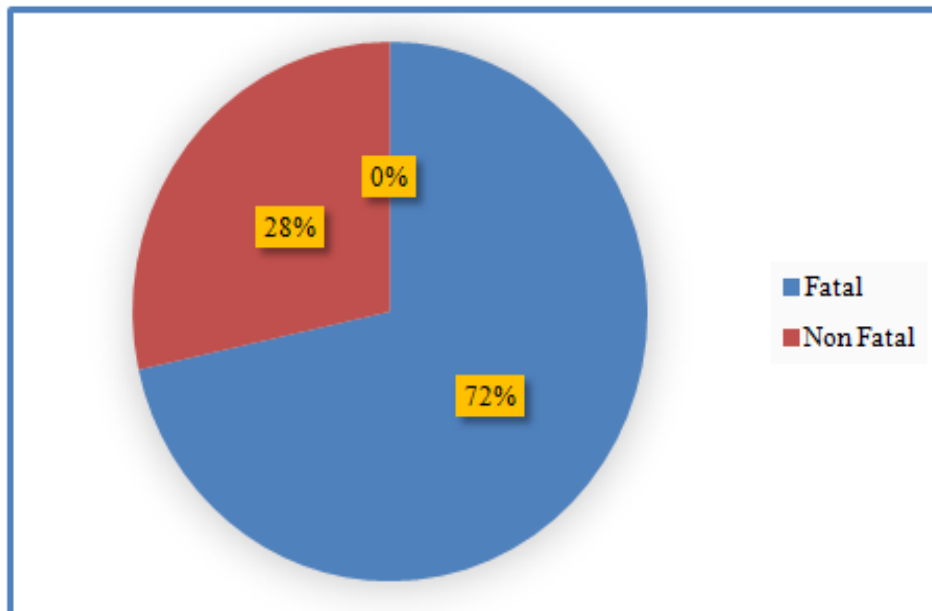

Figure 2: Nature of the accident

4.2 Association between Dependent Variable and Independent Variables

The Chi-squared test ($\chi2$ =3.197, p value = 0.074) conducted between nature of the accident and the gender of the driver at fault concluded that there is no relationship between them. The Chi-Squared test ($\chi2$ =32.083, p value = 0.000) revealed that there is a relationship between age group and the nature of the accident. The Chi-square test ($\chi2$ = 36.049, p value = 0.000) revealed that there is a relationship between the nature of the

accident and the ownership of the vehicle. The Chi-square test ($\chi2 = 68.735$, p value = 0.000) revealed that there is a relationship between the nature of the accident and the limit of the alcohol test.

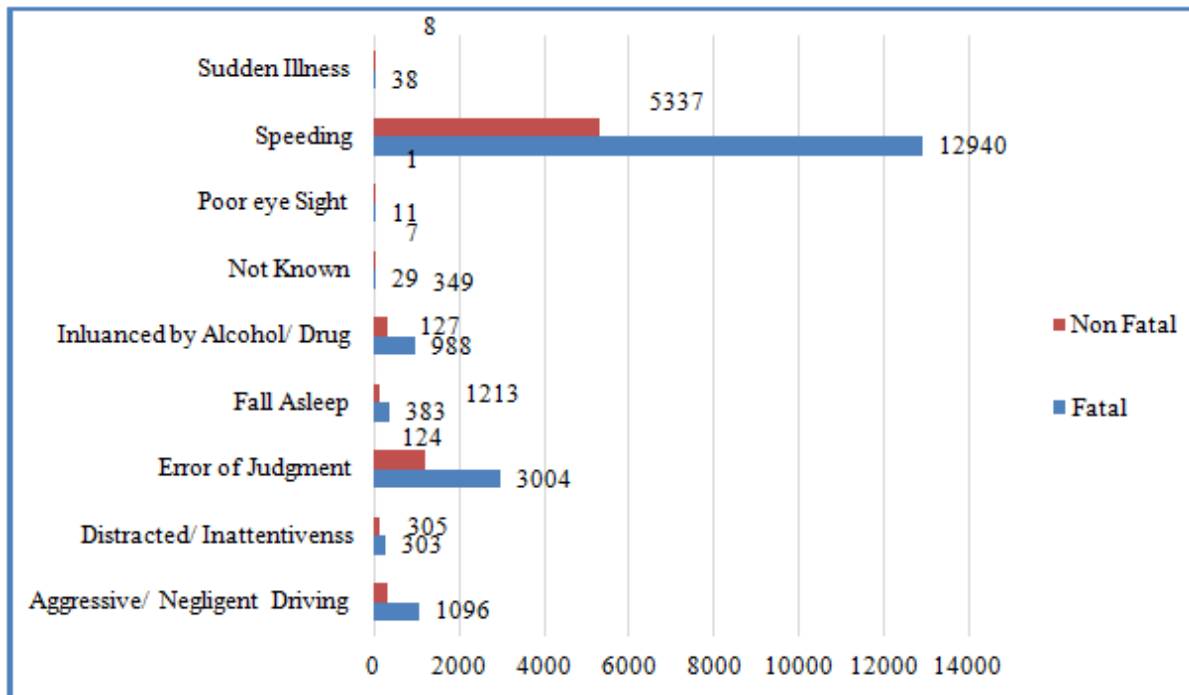**4.3 Nature of the accident Vs Human Crash factor**

Figure 3 Nature of the accident Vs Human Crash factor

Figure 3 shows the relationship between human crash factor and the nature of the accident. According to the graph it can be seen that the most number of accidents (69.6%) have happened when by speeding of the vehicle. Out of the accidents caused by speeding 70.8% are fatal. From the Chi-square test ($\chi2 = 49.405$, p value = 0.000) we can see that there is a relationship between the nature of the accident and human crash factor.

4.4 Logistic Model Interpretation

Three independent variables were selected to use to model the logistic regression. They are Gender of the Driver/ Pedestrian, Age of the Driver/ Pedestrian, and Alcohol Test. Those variables were selected as they are the highest taking factors in the literature review. The entering selection process of logistic regression was followed in this study.

Table 2: Statistics of Logistic Regression

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1ª	DriverPedestrianGender(1)	.194	.096	4.060	1	.044	1.214
	AgeCat			30.962	4	.000	
	AgeCat(1)	-.669	.169	15.663	1	.000	.512
	AgeCat(2)	-.230	.137	2.822	1	.093	.795
	AgeCat(3)	-.214	.137	2.425	1	.119	.807
	AgeCat(4)	-.110	.140	.611	1	.434	.896
	AlcoholTest			68.403	2	.000	
	AlcoholTest(1)	.222	.062	12.921	1	.000	1.249
	AlcoholTest(2)	-.008	.063	.015	1	.902	.992
	Constant	-1.018	.172	35.091	1	.000	.361
a. Variable(s) entered on step 1: DriverPedestrianGender, AgeCat, AlcoholTest.							

From the analysis the following logistic model was derived.

Logit (p) = -1.018 + 0.194 G(1) – 0.669 AgeCat (1) – 0.230 AgeCat (2) – 0.214 AgeCat (3) – 0.110 AgeCat (4) + 0.222 AlcoholTest (1) – 0.008 AlcoholTest (2)

It was however observed that, Age Category (2), Age Category (3), Age Category (4) and Alcohol Test (2) are not statistically significant to the study. Therefore another model was fitted by excluding these variables.

Logit (p) = -1.018 + 0.194 G (1) – 0.669 AgeCat (1) + 0.222 AlcoholTest (1)

The odds of driver's/ pedestrian's (one who at the fault) gender a female being a factor for fatal accident is shown as $e^{0.194}$ = 1.214. Thus, fatality due to driver's/ pedestrian's (one who at the fault) gender a female is 1.21 times higher than to driver's/ pedestrian's (one who at the fault) gender a male. The odds of driver's/ pedestrian's (one who at the fault) age between 18 years and 34 years being a factor for fatal accident is shown as e-0.669 = 0.512. Thus, fatality due to driver's/ pedestrian's (one who at the fault) age between 18 years and 34 years is 0.51 times than driver's/ pedestrian's (one who at the fault) age below 18 years. The odds of driver/ pedestrian (one who at the fault) tested alcohol over legal limit is shown as $e^{0.222}$ = 1.249. Thus, fatality due to driver/ pedestrian (one who at the fault) tested alcohol over legal limit is 1.25 times higher than driver/ pedestrian (one who at the fault) tested alcohol below legal limit or none at all.

V.   CONCLUSION

As the dependent variable is of a binary nature, the logistic regression technique was used to develop the model in this study. On the basis of traffic police accident data, three explanatory variables were used in the model development process. Using the concept of deviance together with the Wald statistic, the study variables were exposed to statistical testing. It can be concluded that the accident fatality is higher in females, age 18 to 34 and those who tested alcohol over legal limit. To reduce road accidents, government should aware both pedestrians and drivers about the repercussions of road accidents as well as imposing heavy fines on individuals who breach road rules.

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