Factors associated with Fatal Motorcycle Accidents (MAs) in Sri Lanka

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Abstract

Motorcycle accidents (MAs) account for nearly 40% of road traffic accidents (RTA) reported annually in Sri Lanka. The main objective of this research was to identify the risk factors associated with MAs in Sri Lanka. The binary logistic regression analysis is used in this study to predict the relative likelihood of fatal Mas happening against the non-fatal MAs, to determine the risk factors associated with RTAs in Sri Lanka by considering the secondary data from 2013 – 2019. Weekday, dry road surface, clear weather, daylight, a night with improper street lighting, roundabout, road with no junction, age of driver being 40-59, age of the driver being 18-39, age of the driver being less than 18, having no valid license, male, typical working day, typical weekday, and rural area were the variables identified from the binary logistics regression model. These proved to have a significant positive influence on the odd ratio of fatal motorcycle accident occurrences. In order to reduce the number of accidents the severity of injuries, by utilizing signalization, building bridges for pedestrians, establishing pavement tunnels to minimize exposure to moving vehicles are prominently recommended.

Keywords: Binary logistic regression, Fatal accidents, Motorcycle, Non-fatal accidents

1. Introduction

Road traffic accidents, though preventable when taken necessary precautions, are a common risk to which anyone, can fall victim (Amarasingha, 2015). The threat of road traffic accidents only seems to be getting bigger and bigger, especially in developing countries, adversely affecting public health and national development. Road traffic accidents or RTAs causey injury and mortality and involve explicit and implicit financial costs (Bai, 2012).

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Pedestrians, cyclists and motorcyclists are often categorized as 'vulnerable road users.' The World Health Organization (WHO) (2018) has declared that this category falls victim to over 50% of the deaths caused by RTAs. The WHO has also found out that the national cost of RTAs among most countries is about 3% of their gross domestic product (GDP). Low- and middle-income countries possess nearly 60% of the world's vehicles, and about 93% of the fatalities caused by RTAs occur in these countries. It has also been found that RTAs are the primary cause of death for children and young adults who fall into the age category of 5-29 (WHO, 2018).

Sri Lanka, a developing nation in South Asia, has an upper-middle-income economy. The nation showcases a concerning number of fatalities and damage caused by RTAs (WHO, 2015). WHO data published in 2018 states that the deaths caused by RTAs have risen to 3,554 and amount to 2.80% of total deaths, whereas the age-adjusted death rate is 16.33 per 100,000 individuals (WHO, 2015). According to the police department the monetary, cost of treating those injured in RTAs and the implicit cost of productivity loss triggered by RTAs amount to nearly 130 billion Rupees annually and this cost caused by RTAs is nearly 1.5% of the nation's GDP (DP, 2018). As per the data of the Police Motor Traffic Division, 8/10 people who are involved in RTAs die, and over 50 citizens are seriously or trivially injured in RTAs every single day. Data from the Census and Statistics report of 2020 indicates that RTAs have become a primary cause of deaths in Sri Lanka. The nation ranks 96th in the world in terms of the age-adjusted death rate (WHO, 2019). In comparison to the other countries in the region, Sri Lanka has the worst road fatality rate. Motorcycles are a common mode of transportation in Sri Lanka, especially among those who belong to the lower middle class, due to the affordability in price, ease of use and convenience in beating the traffic jams in urban areas. According to the Sri Lanka Police traffic statistics, 16,240 motorcycles have been involved in traffic accidents in 2010. Almost 30% of the traffic flow on highways comprises motorbikes. This rise in the usage of motor bikes have invariably led to a rise in motorcycle related RTAs.

This study focused on investigating the risk factors and contributory causes of crashes involving motorcycles using reported data pertaining to accidents obtained from the Sri Lanka Police. Usage of safety helmets has been recognized to be effective in reducing the severity of the injuries caused by RTAs, especially as it prevents injuries to the head. It is mandatory for motorcycle owners to register their vehicles at the Department of Motor traffic and obtain a valid driver's license to operate the vehicles. In essence, the same set of regulations applicable to all vehicles are also applicable to motorcycles. This popular mode of transportation is often used as a family vehicle to commute to work and even to transport goods.

According to a publication of the WHO in 2002, RTAs have killed nearly 1.2 million people and have injured over 50 million around the world. It was found in an analysis of motor vehicle crashes that over 40% of the individuals who died in RTAs have been operating two-wheeled vehicles. Regardless of the apparent danger, the popularity of motorcycles as a mode of transportation seems to be rising steadily. Recent reports have surfaced that a large portion of motorcycle accident (MA) victims are young males. Further, injuries to the head and lower extremity injuries were commonplace in RTAs that involved motorcycles. The low usage of safety helmets, especially in developing countries, was identified as the key contributor to the alarming number of head injuries.

Considering the above facts, it is clear that MA is one of the most prominent public health issues in the world and in Sri Lanka. MA is a controllable public health problem in Sri Lanka compared to other leading causes of death. It is mandatory to take immediate and effective actions to mitigate this risk. Thus, it is critical to identify the risk factors that influence the MAs in Sri Lanka to curtail this consequential public health problem.

1.1 Problem Statement

Statistics of the Sri Lanka Police reveal that motorcycle accidents are a public health hazard that cause a large number of deaths and injuries. The literature associated with MAs is mainly concerned with accidents resulting in loss of life or serious injuries, inadequacies of public infrastructure, defects in vehicles and other environmental or weather factors beyond human control. It is important to have a substantial understanding of these factors to effectively utilize the funds allocated for minimizing MAs. Further, the importance of establishing traffic safety is highlighted at the United Nations Summit on sustainable development, in their new sustainable development agenda dedicated 2 out of 17 goals to address this matter. For instance, goal 3 stated, "ensure healthy lives and promote wellbeing for all at all ages'', where the importance of minimizing RTAs is brought to attention.

Sri Lanka Police puts great emphasis on ensuring that the average user of the transportation system is not at risk of being harmed by motorcycle-related accidents. Moreover, public health personnel are trained in taking actions to minimize the severity of injuries and their occurrence. Multiple explanations have been put forth to explain the obvious reduction in crashes in the recent past, among which rise in the use of safety belts and growth in public funding for infrastructure improvement have been identified as major contributors. However, it is also vital to identify the major risk factors that explicitly affect MAs in Sri Lanka to take immediate action against the loss of human life and mitigate economic and social costs.

Hence the researcher surveys to identify the risk factors associated with MAs using data from 2013 to 2019. Based on the above research question, the derived research objective is to identify the risk factors associated with MAs in Sri Lanka (2013-2019).

1.2 Significance of the Study

The importance of road safety has been acknowledged even by the United Nations at their summit on sustainable development, 2 out of the 17 goals listed in the sustainable development agenda explicitly refer to road safety. For instance, Goal 3 states, "ensure healthy lives and promote wellbeing for all at all ages 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons". Thus, road traffic accidents are a great threat to public health and require sustainable, effective mechanisms to ensure sustainable prevention. Classification of risk factors of MAs produces increased awareness, improves commitment and ensures informed decision-making across the government and other relevant agencies responsible for ensuring road safety. It helps these organizations to adapt and implement strategies that have been scientifically proven to be effective.

It is also mandatory to recognize and highlight the importance of creating effective partnerships among institutions to ensure road traffic safety. These partnerships should be created horizontally and vertically, in other words, between different levels within the government and between government and non-government organizations. This as a whole includes building partnerships and collaborations between sectors like public health, transport, finance and even law enforcement.

1.3 Limitations of the Study

This study was designed to analyze and identify the behavior MAs in Sri Lanka from 2013 – 2019. The data source characteristics are limited to some variables. The demographic characteristics of the injured or dead people and drivers were not considered for the study. Further, there can be many attributes that influence MAs, but this study focuses on the attributes which the Sri Lankan Police identify.

2. Literature Review

2.1 MAs in Global Context

Amarasingha (2021), emphasized that middle-income countries showed no reduction in fatality rates from 2013 to 2016. In South-East Asian countries, about 43% of traffic fatalities were due to motorized two-wheelers or three-wheelers involved crashes, 16% were due to non-motorized two-wheeler crashes, and 14% were due to pedestrian crashes. Motorcycle has become an essential vehicle among the people in those countries for commuting or transporting goods because it is an economical and easy mode to be used for short distances. In South-East Asian countries, relative use and ownership of motorcycles or non-motorized two-wheelers are high. For example, 86% of households in Thailand own at least one motorcycle, which is comparatively higher than that in high-income countries.

2.2 MAs in Sri Lankan Context

Traffic data reveal that 1227 people were killed in 2018; as a result of explicitly or implicitly being involved in motorcycle accidents. This was 39.61% of the total fatalities that occurred in that year. Even though motorcycle accidents seem to have become a major public health hazard, the issue has not received due attention, majorly due to lack of information. Little to no attention has been given to the matter both on a national and provincial level. Unlike most public health hazards, motorcycle accidents are preventable by nature. Thus, proper attention must be given to factors that contribute to motorcycle accidents in order to form effective prevention methods (AlicioDlu, Yalniz, Edkin, & Yilmaz, 2008).

Motorcycles in Sri Lanka usually share the lane with fast-moving vehicles such as cars, buses, and trucks. Motorcycle users are more vulnerable compared to travellers in fast-moving traffic because motorcycles are less visible owing to their smaller size and because they lack protection during a crash. As a result, motorcycle crashes are often reported with severe injuries caused to its users. However, even though the higher risks faced by motorized two-wheeler riders are often documented, the knowledge pertaining to the measures that should be taken to reduce or prevent this high crash risk is incomplete.

There is a positive significant relationship between human factors, environmental factors, legal factors and vehicle factors contributing to motorcycle related accidents. These factors are discussed below.

2.3 Factors identified in Previous Studies

It was revealed in an in-depth investigation of motorcycle accidents that a major proportion of these accidents involved males under 25 years of age (European Association of Motorcycle Manufacturers (EAMM), 2003). A study conducted in Delhi on motorcycle fatalities showed that 93.6% of those involved in motorcycle accidents were males as opposed to female victims, who made up just 6.4%. It was also found that 21- to 30-year-olds (44.67%) were most likely to be involved in motorcycle accidents, and this was followed by the age group 31-40 (27.66%) (Behera, Rautji, Lalwani & Dogra, 2009). Another study also confirmed these findings as it stated that younger males were more likely to be involved in these accidents as opposed to any other demographic group (Ndunguru, 2016).

Training-based interventions are an effective way of minimizing motorcycle accidents. However, imparting the required skills and knowledge in order to ensure maximum control over the vehicle has been found to be a challenging task. The skill set needed to control a motorcycle is much more complicated than the skills needed to handle other vehicles. This is true, especially in an emergency. However, motorcyclists receive relatively less training and supervision when operating on the road. It was found in a scoping study (Elliott et al., 2003) that acknowledging the lack of skill among riders, improving higher-order cognitive skills among riders and educating the riders on risk levels, rules and knowledge needed for safe riding will improve the safety of motorcyclists. Another study (Hurt et al., 1981) discovered that most riders received no formal training; in fact, 92% of the riders were either self-taught or trained by a friend or family member. In the same study, it was discovered that training motorcyclists reduced or minimized their involvement in accidents and injuries.

The environment and the condition of the road and its surroundings are significant factors that contribute to motorcycle accidents. While factors like road surface, furniture and defects explicitly contribute to accidents, road site vegetation and sudden movement of animals too contribute to the occurrence of accidents. A study (Elliott et al., 2003) discovered that grooving the road surface and raised road markings lead to instability, resulting in accidents.

Accident locations can be classified in numerous ways. It has been found that motorcycle accidents are more likely to occur at intersections as other vehicles violate motorcycle rights of way and other traffic controls. Accidents are also quite commonplace in junctions, and 72% of these accidents happen at T-junctions (McCarthy et al., 2007). Road alignment factor plays a vital role in the occurrence of accidents, and a spot study (McCarthy et al., 2007) found that 70% of the accidents occurred on straight sections of roads. Most accidents that occur in a bend are caused by loss of control. Improved road surfaces also play a role in contributing to the occurrence of accidents. Smooth road surfaces lead to increased speeding, raising the risk of crashes and severity of injury. To conclude, Tanzania (Ndunguru, 2016) revealed that motorcycle accidents were more likely to occur on paved roads than on unpaved ones.

Proper enforcement of licensing and registration for motorcycles could effectively minimize crashes. Proper enforcement of licensing and registration for motorcycles could effectively minimize crashes. While the minimum age limit to obtain a license in Sri Lanka is 18, it was found by Devasurendra (2016) that 29% of the riders could not produce a valid driver's license, and 9% were below 18 years old.

There are two types of licenses issued for motorcycle riders in the UK based on motorcycle type. One is, Light motorcycle license, and another is a standard motorcycle license (Huang, 2004). In Sri Lanka such systems are absent. Here, the license is issued under three stages. A learner's permit is issued upon completing a written exam conducted by the Motor Traffic Department. Then once the applicant completed a trial, a probation license is issued, and the applicant receives the permanent license within three months. However, the rising levels of accidents reveal that the Motor Traffic Department should consider alternative mechanisms to access the ability of the applicants to control and operate the motorbikes.

Accident data in Sri Lanka from 2008 to 2012 reveal that nearly 2/3 or 65% of the motorcycles are less than 5 years old and are relatively new vehicles ridden by young riders. Many riders believe that they are competent in performing the necessary repairs on their vehicles as parts are readily available. This leads to poor vehicle conditions and maintenance. Hurt, Ouellet and Thom (1981) revealed that defective maintenance is a leading cause of motorbike accidents.

3. Research Methodology

3.1 Secondary Data

This study consists of panel data of MAs in Sri Lanka, gathered from the Sri Lanka Police Department. All the data are extent the period of 2013- 2019. As mentioned in chapter one, Sri Lanka Police have identified several causes of MAs. The binary logistic regression model will be carried out to derive the risk factors that affect the severity of motorcycle accidents in Sri Lanka as accidents due to various identified factors as mentioned in below mentioned.

3.2 Data Analyzing Methods

The binary logistic regression analysis is used in this study to predict the relative likelihood of fatal MAs against non-fatal MAs to determine the risk factors associated with RTAs in Sri Lanka. The goal of using the binary logistic regression in this study is to describe the association between motorcycle accident severity (fatal/non-fatal) and explanatory variables, which describe the road, human, vehicle, accident, time, and environmental characteristics of MAs by identifying the best-fitted model. Mohammed (2013) claimed that parameters obtained from each explanatory variable in the model is used to estimate the odds ratio. The dependent variable (y) denotes its binary category as 1 and 0.

This study code y = 1 (fatal motorcycle accidents) and y = 0 (non-fatal motorcycle accidents).

Equation of Logistic regression model is as follows:

$$\pi\,(x) = p = \frac{e^{\beta_0 + \sum_{i=1}^{n} \beta_i x_i}}{1 + e^{\sum_{i=1}^{n} \beta_i x_i}} \quad (1)$$

The logit transformation of the odds dependent variable is;

$$logit\,(p) = ln\left(\frac{p}{1-p}\right) = \beta_0 + \sum_{i=1}^{n} \beta_i x_i \quad (2)$$

Where:

β_0 - Model constant

β_i - Parameter estimates for independent variables

x_i - Independent variables ($i = 1,2, \dots \dots n$)

p - Probability ranges from 0 to 1

$ln\left(\frac{p}{1-p}\right)$: The natural logarithm ranges $-\infty$ to + ∞

4. Empirical Findings and Research Analysis

4.1 Association between Severity of Accident and Other Common Factors

In the database, the severity of accident has been classified into fatal and non-fatal, and hence the analysis of the 2-way frequency table was carried out to derive the association between severity of accident and type of the date, condition of the road, light condition of the road, status of weather, the location of the road, age of the vehicle, ownership of the vehicle, gender and age of driver and validity of the license.

As the corresponding p values are less than 5%, it can be concluded with 95% confidence that the sector, day of the week, type of date, alcohol test, condition of the road, light condition of the road, status of weather, the location of the road, age of the vehicle, ownership of the vehicle, gender and age of driver and validity of the license are significantly influential factors on fatal accidents.

The percentage of motorcycle fatal accidents in the rural sector (68%) is significantly higher than that in the urban sector (32%). Rate of occur motorcycle fatal accidents on weekdays (73.2%) is significantly higher than that on weekend (26.2%) Rate of fatal accidents on typical working days (71.8%) is significantly higher than that on normal weekends (26.5%) and holiday (2.6%). The percentage of motorcycle fatal accidents when alcohol test is not tested (89.2%) is significantly higher than no alcohol or below alcohol limit (9.6%) and over legal limit (1.2%). Rate of fatal motorcycle accidents when the road surface is dry (92.6%) is significantly higher than that when the road is wet (7.4%). The percentage of fatal motorcycle accidents during the daylight (53.3%) is significantly higher than that of during night with improper lighting (40%) as well as than that of during night with good street lighting (6.7%). These results were obtained by comparing two binomial distributions separately. Rate of fatal motorcycle accidents in a clear weather (89.2%) is significantly higher than that in a humid weather (8.7%) and other (2.1%). When the location type is a road without a junction (71.4%), the rate is significantly higher when compared to roads with junctions (19.4%), roundabouts (0.7%) and others (8.5%).

The percentage of fatal accidents when vehicle age is less than 10 years (83.4%) is significantly higher than that when the vehicle age is 10-30 years (16.2%) and greater than 30 years (0.4%). When comparing three binomial distributions separately, the percentage of fatal accidents when the driver's age is between 18 - 40 years (78%) is significantly higher than when the driver's age is between 40 - 60 years (17.5%). Moreover, the percentage of fatal accidents when the driver's age is above 60 years (1.8%) is significantly higher than when driver's age falls between 40 - 60 years. Similarly, the percentage of fatal accidents when the driver's age is less than 18 years (2.7%) is significantly higher than that of when the driver's age is more than 60 years.

4.2 Determine the Risk Factors Associated with MAs

Based on the above statistical analyses carried out separately for each variable, it was found that all other categorical variables have a significant influence on the severity of MAs separately. Thus, in order to find the combined impact from the best set of the independent variables out of all the significant variables, binary logistics regression was carried out under the forward stepwise ward method. The results of the final model are shown in table 1. The significance of the Hosmer and Lemeshow test statistic concludes that the fitted model is significant at 5% level.

The results in table 1 indicate that the variable, day of the week (DW), road surface (RS), weather (W), light condition (LC), location type (LT), vehicle age (VA), vehicle ownership (VO), age of the driver (AD), validity license (VL), gender of the driver (GD), type of day (TD) and sector (S) to predict the outcome variable are significantly associated with severity of accidents when all the variables are taken into consideration simultaneously.

Table 1: Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Weekday (DW)	1.046	.046	520.079	1	.000	2.845
Dry (RS)	4.098	.351	135.990	1	.000	60.232
Other (W)			101.193	2	.000	
Clear (W)	1.525	.152	101.193	1	.000	4.594
Humid (W)	-20.166	1332.421	.000	1	.988	.000
Night – Good (LC)			515.245	2	.000	
Daylight (LC)	.357	.057	39.129	1	.000	1.429
Night – Improper (LC)	-.308	.059	26.939	1	.000	.735
Other (LT)			77.368	3	.000	
Roundabout (LT)	-.179	.051	12.179	1	.000	.836
Junction (LT)	.043	.057	.572	1	.449	1.044
Road-No Junction (LT)	.731	.161	20.585	1	.000	2.077
>30 years (VA)			35.356	2	.000	
10 – 30 years (VA)	.118	.221	.284	1	.594	1.125
< 10 years (VA)	.335	.223	2.257	1	.133	1.398
Service (VO)			8.172	2	.017	
Government (VO)	-.205	.206	.993	1	.319	.815
Private (VO)	.510	.336	2.306	1	.129	1.666
>60 years (AD)			566.363	3	.000	
40 – 59 years (AD)	.609	.124	24.204	1	.000	1.838

18 – 39 years (AD)	-.813	.098	68.354	1	.000	.443
<18 years (AD)	-.244	.103	5.628	1	.018	.783
No Valid License (VL)	-2.272	.227	99.928	1	.000	.103
Male (GD)	.107	.032	11.099	1	.001	1.112
Holiday (TD)			312.410	2	.000	
Normal Working Day (TD)	.573	.092	39.099	1	.000	1.774
Normal Weekend (TD)	-.210	.099	4.437	1	.035	.811
Rural (S)	1.155	.031	1358.41	1	.000	3.173
Constant	-2.415	.555	18.955	1	.000	.089

Hosmer and Lemeshow Test Statistic: χ^2_8 = 115.636 (p = .000)

Source: Survey Data, 2022

The overall productivity power of the model is 90.9%. The probability of correctly classifying fatal accidents, given that it is fatal accidents, is .999 against the probability of correctly classifying non-fatal accidents given that it is non-fatal is .155.

The results in table 2 of the Cox & Snell R^2 and Nagelkerke R^2 indicate that the explained variation in the dependent variable based on the model varies from 1.19% to 2.41%. Both statistics indicate the percentage of the variance of the dependent variable is explained by the model. However, various authors have citizen these two indicators.

Table.2: Model summary

-2 Log likelihood	**Cox & Snell R^2**	**Nagelkerke R^2**
37870.49	.119	.241

Source: Survey Data, 2022

Thus, the final model for the log odds ratio of fatal accident can be written as:

$$Log\left(\frac{p}{1-p}\right) = -2.415 + 1.046^{DW.Weekday} + 4.098^{RS.Dry} + 1.525^{W.Clear} - .357^{LC.Daylight} - .308^{LC.Night\ Improper} -.179^{LT.Roundabout} +.731^{LT.Road\ no\ Junction} + .609^{AD.40-59\ years} - .813^{AD.18-39\ years} - .244^{AD.less\ than\ 18\ years} - 2.272^{VL.No\ valid\ license} +.107^{GD.Male} +.573^{TD.Normal\ working\ day} -.210^{TD.Normal\ weekend} + 1.155^{S.Rural}$$

Thus, model for odd ratio can be written as:

$\left(\frac{p}{1-p}\right)$ = .089 + 2.845* DW.Weekday + 60.232 * RS.Dry + 4.594* W.Clear + 1.429* LC.Daylight + .735* LC.Night Improper + .836* LT.Roundabout + 2.077* LT.Road no Junction + 1.838* AD.40-59 years + .443* AD.18-39 years + .783 * AD.less than 18 years + .103* VL.No valid license + 1.112 * GD.Male + 1.774* TD.Normal working day + .811* TD.Normal weekend + 3.173* S.Rural

The probability of fatal accidents can be estimates using

$$p = \frac{XX}{(1+XX)} \tag{2}$$

where XX is the,

$$e^{.089 + 2.845* \text{DW.Weekday} + 60.232 * \text{RS.Dry} + 4.594* \text{W.Clear} + 1.429* \text{LC.Daylight} + .735* \text{LC.Night Improper} + .836* \text{LT.Roundabout} + 2.077* \text{LT.Road no Junction} + 1.838* \text{AD.40}-59 \text{ years} + .443* \text{AD.18}-39 \text{ years} + .783 * \text{AD.less than 18 years} + .103* \text{VL.No valid license} + 1.112 * \text{GD.Male} + 1.774 * \text{TD.Normal Weekend} + 3.173* \text{S.Rural}}$$

The model (2) indicates that variables weekday, dry road surface, clear weather, daylight, nights with improper street lighting, roundabout, road with no junction, age of driver 40 to 59 years old, age of driver 18 to 39 years old, age of driver less than 18 years old, no valid license, male, normal working day, normal weekend and rural area significantly influence positively on the odd ratio of happening fatal motorcycle accidents.

Using the equation (2) the following conclusions can be made,

The odds of fatal motorcycle accidents happening on a weekday is 2.845 times higher than what occurs on a weekend when all other variables in the model are fixed.

The odds of fatal motorcycle accidents happening on a dry road surface is 60.232 times higher than that it occurs in wet road surface when all the other variables are fixed.

The odds of happening motorcycle fatal accidents in clear weather is 4.594 times higher than what occurs in a humid weather when all other variables are fixed.

The odds of fatal motorcycle accidents happening during daylight is 1.429 times higher than what occurs during the night with good street lighting when all the other variables are fixed.

The odds of fatal motorcycle accidents happening in roads with no any junction is 2.077 times higher what occurs in other location types when all the other variables are fixed.

The odds of fatal motorcycle accidents happening when the age of the driver is between 40 to 59 is 1.838 times higher than when the age of the driver is more than 60 years old when all the other variables are fixed.

The odds of fatal motorcycle accidents happening among male are 1.112 times higher than that of among females when all the other variables are fixed.

The odds of motorcycle fatal accidents occurring during a normal working day is 1.774 times higher than during the holidays when all other variables are fixed.

The odds of motorcycle fatal accidents occurring in rural area is 3.173 times higher than in urban areas when all other variables are fixed.

5. Conclusions, Recommendations and Suggestions

A major proportion of fatal motorcycle accidents (68%) happened in rural areas. 73.2% of the accidents occurred on weekdays considered normal working days. Nearly 90% of the motorcyclists had not done the alcohol test. A similar proportion (92.6%) of the MAs occurred on dry surfaces and 53.8% occurred the during daytime. 71.4% of the accidents occurred on roads that did not have a junction. 83.4% of the vehicles involved in crashes were less than 10 years old. 99.3% of these new vehicles were privately owned. Out of the drivers, 76% were males and aged 18-40 with a valid license (97%).

Weekday, dry road surface, clear weather, daylight, a night with improper street lighting, roundabout, road with no junction, age of driver being 40-59, age of the driver being 18-39, age of the driver being less than 18, having no valid license, male, normal working day, normal weekday, rural area were the variables identified from the binary logistics regression model. These proved to have a significant positive influence on the odd ratio of fatal motorcycle accident occurrences.

5.1 Recommendations

1. Pedestrian fatalities and injuries can be prevented by utilizing signalization, building bridges for pedestrians and establishing pavement tunnels to minimize exposure to moving vehicles.
2. Establishment of active signage systems that automatically detect pedestrian movement and warn pedestrians through lighting and other signaling of possible danger.
3. Establishing a separate lane for motorcycles and highlighting the presence of them through wearing prominent upper-torso garments and leaving the headlamp on during daytime.
4. Establishment of interconnected brake systems and developing advance training programmes for cyclists.
5. Maintenance of high collision concentration zones and hazardous roads.

5.2 Suggestions

1. Strict adherence to lane driving and the proper use of signals by drivers.
2. Hold programmes that emphasize on the importance of seatbelt usage and maintaining vigilance when driving.
3. Ensuring that the motor bicycle is in proper functioning condition. Not only the engine and breaks must be checked, but due maintenance should also be done for tires, headlamps, gear and signals.
4. Encourage the habit of checking the bike before using for possible defects.
5. Avoid tailgating and be at least 4 seconds away from the vehicle in the front. Further, have an escape route in mind.

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