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Original Research Article

Identification of risk factors for road traffic accidents using injured drivers: a cross sectional study conducted in Sri-Lanka

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ABSTRACT

Background: Road traffic accidents are a significant cause of morbidity and mortality worldwide and a major cause of sudden deaths in Sri Lanka.
Methods: This study was conducted to assess risk factors for RTAs using 360 injured drivers, admitted to the accident wards in two teaching hospitals in Kandy and Kurunegala using interviewer-administered questionnaires.
Results: The majority of the study population (97%) was male and most drivers were 26-35 years of age. Motorcycles were the most common vehicle (79%) involved in RTAs and 47% of drivers had a driving experience of less than 10 years. The driving speed of 31-45 km/ h was reported in one-third of the RTAs and 76.9% of RTAs occurred on carpet roads mostly on Wednesdays and Fridays. Only 29 (8.055%) vehicles reported technical problems at the time of the RTA. There is a significant association ($p<0.001$) between the speed of the vehicle and the driving experience and the type of the vehicle and the age of the participants. There is an association between the type of the vehicle and the site of injury of drivers and between the speed of the vehicle and the usage of alcohol ($p<0.01$).
Conclusions: Findings revealed that high risk for RTAs was amongst young male drivers, 26-35 years age range, who drove motorcycles. The most potential for RTAs to occur was on Fridays and Wednesdays and are more pronounced after 6 pm. The risk factors of RTAs are a result of a combination of several factors, as opposed to one.

Keywords: Drivers, Injuries, Motorcycles, Risk factors, Road traffic accidents, Vehicles

INTRODUCTION

Road traffic accidents, unintentional and preventable, are a global hazard to human life.[1] The WHO has recognised RTAs as a significant public health concern and as one of the main causes of mortality and injury across the world. RTAs kill around 1.3 million people a year and disable millions more. Most of these fatalities and impairments occur in lower- and middle-income nations.[2]

The RTAs in Sri Lanka have surged in the last decade. An average of six people die each day from RTAs in Sri Lanka where hundreds are severely injured, with life-long issues and impairments.[3] An economic policy was implemented in 1977 that encouraged the importing of automobiles. This resulted in a large influx of motorcycles and three-wheeled taxis, which are exceedingly unstable and liable to being tipped over.[4] Despite this growth in vehicles, the road infrastructure did not grow at the same rate and pace.[4] It is difficult for

Sri Lankan policymakers to affect long-term change since there is minimal road safety research and inadequate statistics on RTAs. Subsequently, RTAs may lead to poverty by inflicting fatalities, injuries, impairments, grief, loss of productivity, and material destruction.[5] Therefore, economic considerations need to be taken into account when analysing the effects of RTA on human life.[6]

RTAs may be categorised into three major contributory factors: human, mechanical (vehicle related), and environmental.[1] RTA is caused mostly by human factors such as age, alcohol intake, sleep difficulties, tiredness, stress, and lack of use of safety measures. Environmental variables include hard terrains, busy seasons, harsh weather, time of day, and absence of signage. Vehicles and their condition and the drivers' fluency in driving the particular vehicle are also associated with RTAs.[2] There are not many accident statistics available in Sri Lanka, so further study is needed to make helpful findings.[7]

Aim and objectives

The aim of this study was to find risk variables that impact RTAs in Kandy and Kurunegala districts in Sri Lanka. Lack of evidence was reported regarding this kind of research at both districts, which are two main populated cities in the country where prominent industrial activities take place. Therefore, the ultimate aim of this study was to identify risk factors of RTAs in populated regions in order to communicate them with respective authoritative bodies. This is vital to prevent RTAs and help reduce the government annual expenditure.

METHODS

A descriptive cross-sectional study was conducted at Teaching Hospitals in Kandy and Kurunegala from September 25th to November 25th, 2018. An interviewer-administered questionnaire was used to collect data which consists of five sections; demographic data, information about the accident, information about the vehicle, human and behavioural factors, and environmental factors. Driver input was sought on how to improve driving safety and increase driver satisfaction. Inclusion criterion for the research was those who were medically approved by a physician to speak with them. Seriously injured persons and deaths of RTAs were taken by interviewing family members or relatives and surveying police reports. People excluded from the research were admitted to the hospital accident wards as a consequence of another accident (excluding RTA), and who weren't drivers.

A pilot study was done on 30 drivers from teaching hospital Kurunegala, three months previous to this investigation and the questionnaire was modified accordingly. 360 drivers were eligible to be interviewed in both hospitals. Questionnaires were coded to avoid the duplication of material using BHT numbers. SPSS 23 was used to do a descriptive analysis of the data. Frequency and percentage distribution were employed to examine variables' distribution. A Chi-square test was performed to examine the relationship among the variables. For further analysis, variables were grouped into subcategories. The variables were age, occupation, family income, driving experiences, time of the accident, injury type, vehicle type, manufacturing year of the vehicle, driving speed, sleeping history of the drivers, type of the road, nature of the road, and condition of the day. The accident victims and car owners' identities were omitted from the data collecting tools for ethical and confidentiality reasons. Consent was taken from the directors, the consultants and ward nurses, and informed verbal and written consent was obtained by all participants. In order to not disturb the patient's treatment plan or psychological condition, extreme care was used. The data will be disposed of after five years.

RESULTS

In the cross-sectional study that was conducted, it was observed that the most common age group involved in RTAs was 26-35 years (Table 1) where 97% of patients were males. Most drivers (47.8%) were having less than 10-year experience and 33.1% of drivers had between 11 to 20 years of driving experience. Motorcycle accidents were more common (79.44%) than three-wheeler (11%), or other vehicle RTAs (8.61%) (Table 1). 33.5% of drivers had met with RTA while traveling at a speed between 31-45 km/h while the high-speed range of 46-60 km/h showed a 27.8% of RTA rate. Of all the drivers, 6.9% were under the influence of alcohol when the RTA occurred and 14.4% were professional drivers (Table 1).

High numbers of RTAs (61.4 %) took place during the dry season. Wednesdays (16 %) and Fridays (23%) witnessed the maximum number of accidents than any other day of the week. The majority of RTAs had occurred after 6 pm (31.11%) and 29.17% of cases had been reported from 10 a.m-2 p.m (Table 1). 76.9% of RTAs in our study had occurred on carpet roads than on any other types of roads. This study also proves that the majority of RTAs had occurred on straight roads (43%) and at bends (28%).

Furthermore, 86% of victims had used their safety measures properly. Most of the victims had leg injuries (39.7%) and limb injuries (73%). Out of the 360 participants, only 29 (8.055%) vehicles had technical problems (brake system, tire conditions, engine troubles, and light system) at the time of the accident. According to our study from the interviewed drivers, 46.4% had at least 8 hours of sleep on the night before the accident and only 23.6% had less than 6 hours of sleep (Table 1).

There is a significant association ($p<0.001$) between the age of drivers and the driving experience of the drivers, for RTA occurrence. Over 78% of the individuals are aged less than 35 years and have driving experience of less than 10 years.

Table 1: Frequency of RTA incidents in different categories.

Type of the category	N (%)
Age (years)	
<25	91 (25.3)
25-34	104 (28.9)
35-50	93 (25.8)
>51	72 (20.0)
Occupation	
Professional driver	52 (14.4)
Businessmen, policemen, soldier, conductor, marketing agent	76 (21.1)
Other professions	208 (57.78)
Unemployed	24 (6.67)
Driving experiences (years)	
1-10	172 (47.8)
11-20	119 (33.1)
>21	69 (19.2)
Type of vehicle	
Motorcycles	287 (79.44)
Three wheel	43 (11.94)
Other vehicles	30 (8.61)
Day	
Monday	42 (11.67)
Tuesday	46 (12.78)
Wednesday	60 (16.67)
Thursday	44 (12.22)
Friday	83 (23.06)
Saturday	50 (13.89)
Sunday	35 (9.72)
Alcohol consumption	
Yes	25 (6.9)
No	335 (93.1)
Time of the accident	
6 am to 10 am	74 (20.56)
10 am to 2 pm	105 (29.17)
2 pm to 6 pm	69 (19.17)
6 pm to 10 pm	112 (31.11)
Speed (Km/ph)	
<30	102 (28.3)
31-45	117 (32.5)
46-60	100 (27.8)
>60	41 (11.4)
Distance from start to accident point (safe distance)	
<1	76 (21.1)
1-3	107 (29.7)
4-10	89 (24.7)
>10	88 (24.4)
Distance to destination from the accident point (remain distance)	
<1	97 (26.9)
1-4	110 (30.6)
5-7	59 (16.4)
>7	94 (26.1)
Condition of the day of the RTA	
Dry	221 (61.39)
Rain, foggy, wet	139 (38.61)

Continued.

Type of the category	N (%)
Site of injury	
Only head and face	62 (17.22)
Only hands	
Only legs	143 (39.72)
Head/hand/leg	77 (21.39)
Multiple	26 (7.22)

There is a significant association (p<0.001) between the speed of the vehicle and the driving experience of the drivers too. Of the drivers who had driven their vehicle more than 60 km/h, 78% had only less than 10 years of driving experience. A significant association (p<0.05) was also seen between the type of vehicle and the age of the participants as most RTAs had occurred among motorcycle riders under 35 years (57.69%) (Table 2).

Table 2: Association between factors.

Variables	P value
Age of the drivers and driving experience	0.000
Speed of the vehicle and driving experience	0.000
Type of the vehicle and age of the participants	0.012
Type of the vehicle and site of injury	0.038
The speed of the vehicle and usage of alcohol	0.002

There is a significant association (p<0.05) between the type of vehicle and the site of injury of the drivers. Nearly 70% of the participants who faced motorcycle accidents presented with injuries in either legs or head or the head/hand/leg category. There is a significant association (p<0.01) between safe distance and type of road. Out of the speed category 46-60 km/h, 86% used carpet roads at the time of the accident. There is a significant association (p<0.01) between the speed of the vehicle and the usage of alcohol. 32% of drivers who had been under the influence of alcohol during the time of the RTA were driving at speeds over 60 km/h.

DISCUSSION

This study aimed to determine risk factors for RTA admissions among drivers. According to the findings of this survey, the majority of the drivers are in the age group of 25 to 34. 97.8% of the men were at higher risk for RTA in this research. In Sri Lanka, the male/female ratio is 45:1, resulting in more RTA fatalities for males.

Most participants in this study had less than 10 years of driving experience. However, a study conducted in India, a neighboring country, revealed that the majority of drivers who met with RTAs had less than 5 years of experience[8]. This study also supports this fact. When taking the age of the drivers into account and their experience at <25 years, the results show RTAs are at 25%. When taking into account that license is issued after 18 years in Sri Lanka, and most adults work after 21 years, we can conclude that in both India and Sri Lanka, individuals with around 5 years of experience are most vulnerable to RTAs. Considering the significant association (p=0.000) between age and driving experience of the drivers, over 78% of the individuals were less than 35 years of age and had less than 10 years of driving experience which also supports statistics obtained in India.

In this study, motorcyclists were responsible for the majority of RTAs accounting for 79.7% of accidents. As a developing country, a motorcycle is the cheapest vehicle in Sri Lanka, thus purchasing a motorcycle fits the budget of most individuals. After receiving the license at the age of 18 years, most young drivers purchase motorcycles as their first vehicle due to the low cost associated.[7] Like most developing Asian countries, motorcycles are the most common mode of transport in Sri Lanka. Nearly, 55% of registered vehicles comprise motorcycles. Motorcycle-related RTAs contribute to nearly 79.7% % of total accidents in this study. Inadequacies in the public transport system and the growth of the lower-middle-income sectors in the general population have contributed to the influx of motorcycles in the country. It is a popular transport mode in lower-middle-income families and the youth due to low transport costs.[9] The rising motorcycle-related RTAs can be a direct result of an absence of a national structure to enforce and promote road safety laws and regulations. Another vital issue that needs to be highlighted is the sale of low-cost two-wheeled vehicles in the country. There is also a dire need for the quality of motorcycles to be assessed before importation.[10]

The majority of vehicles had a speed range of 31-45 km/h (32.5%) but the speed range from 46-60 km/h also showed a significant number of RTAs (27.8%). A study conducted by Pathak et al proved that vehicles which had a speed range of 40-60 km/h (37.9%) were responsible for higher percentages of accidents.[8] As 31-45 km/h is the average speed stipulated by traffic regulations in Sri Lanka, RTAs due to high speed are not a major concern. The reason for RTAs at average speeds might be due to cumulative reasons. There is a general lack of discipline on roads and during traffic congestions. Two-wheelers and three-wheelers have a tendency to move between other vehicles and topple over easily.[9] The lack of a

pronounced bicycle lane throughout the country and high traffic congestion due to the influx of vehicles also pose significant problems.

The present study also revealed that RTAs were more likely to occur on Wednesdays (16%) and Fridays (23%) respectively than any other days of the week. As per the Sri Lankan government, Wednesday is a public day where the public can meet with government officials for their needs increasing traffic in streets. Also, most people return to their homes from the city on Friday evenings. Therefore, there are many reported traffic congestions as additional vehicles are observed on the roads in most cities in the country as there is an intercity vehicular movement.[11] Around 31.1% of RTAs had occurred after 6 p.m and 29.2% of cases had been reported during 10 am - 2 pm. This may be due to the fact that the majority of people return to their homes after work during these hours (after 6 p.m.). This was supported by studies performed by Pathak et al and Samaraweera, which revealed that most accidents occurred between 6 p.m. to 10 p.m.[8,12] Another reason for this might be low visibility at this time on roads. The 10 am to 2 pm time period in Sri Lanka is where the primary and secondary schools conclude for the day and children need to be taken home. Thus, many public and private transport systems take to the road. This will result in congestion due to time constraints to get to places on time leading to RTAs.[13]

The highest percentage, which was 76.9% of RTAs, had occurred on carpet roads and only a few had occurred on tarry and other roads. This is mainly due to the lack of road markings and speed bumps on carpet roads.[14,15] Many drivers use bypass routes that are carpeted but are narrow. Kandy, a hilly terrain, has low-width roads with curvatures which can cause RTAs easily.[16] This study showed a significant association ($p<0.01$) between speed and the type of road. Out of the 46-60 km/h speed category, 86% had used carpet roads at the time of the accident. Evidence of driving speed ranges between 46-60 km/h are higher in carpet roads than on tarry and other roads, where drivers had a tendency to drive at increased speeds leading to RTAs. There was a significant association ($p<0.01$) between the speed of the vehicle and the usage of alcohol. 32% of the drivers who had consumed alcohol before the accident were driving at speeds over 60 km/h. Alcohol consumption was a contributory factor for the speed of driving.[17]

This study also depicted that RTAs were related to environmental factors. Most RTAs occurred during the dry season, which was at 61.4%. In a study conducted by Singh, it was found that RTAs were influenced by months too.[18] As this cross-sectional study was conducted during a two months period of time, this factor was not considered. Months can influence RTAs due to seasonal changes. Singh recognizes in his study that extreme temperatures have both physiological and psychological effects on drivers. With motorcyclists, these effects can be exacerbated as they are directly exposed to the natural elements. As temperatures rise, drivers can get easily agitated and irritated resulting in loss of concentration and fatigue. Thus, the reaction time tends to increase too, leading to RTAs. Colder or wetter temperatures can result in poor visibility which again results in RTAs.[18]

Among the injury sites, the legs were the most commonly affected part of the body (39.7%). As motorcyclists are prevalent in Sri Lanka, head and limb injuries are high. There is also an association ($p<0.05$) between the type of vehicle and the site of the injury. In this study, motorcycle crashes were also the leading cause of leg, head, and multiple injuries. Nearly 70% of the participants who had faced motorcycle accidents had injuries in either their leg or hand and head/hand/ leg categories.

Most drivers also affirmed that they did not have any prior damages to their vehicles before the RTA and the vehicles were in good condition. A few cases had been reported with some issues in their vehicles. Out of 360 vehicles, only 29 (8.055%) vehicles had technical problems at the time of the accident. Only a few injured drivers, less than 15%, had not considered safety measures prior to the accidents. Alcohol had been a contributory cause in 6.9% of accidents in this study. Another Sri Lankan study observed that 32% of RTAs occurred due to alcohol consumption.[2] A Nepal study had found 46.37% RTAs occurred under the influence of alcohol consumption.[19] These results were quite contrasting to the ones of this study.

According to this study, there was a significant association ($p<0.001$) between the speed of the vehicle and the driving experience of drivers. 78% of drivers who had driven their vehicle at the speed of 60 km/h had less than 10 years of experience in driving. In addition, 56% of drivers who had driven their vehicle at speeds less than 60 km/h had more than 10 years of driving experience. Therefore, drivers who had less driving experience are involved in accidents during high-speed driving, while drivers who had more driving experience are involved in accidents during low-speed driving. Consequently, even with average speeds and more driving experience, RTAs remain significantly high. Therefore, it can be deduced that RTAs may occur due to other reasons which include traffic congestion, lack of discipline on the roads, environmental causative factors, and poor legislation rather than speed.[20]

Moreover, a significant association ($p<0.05$) between the type of vehicle and the age of drivers was found in this study. Motorcycles were the most popular vehicle among young drivers who are less than 25 years old which expresses a trend among the youth. The results of a study in Sweden had revealed that young motorcyclists with poor financial status have a higher risk of RTAs when compared to wealthy individuals.[21] Therefore, motorcyclists are most likely to be involved in RTAs, as these types of vehicles are purchased at cheaper prices.

Therefore, the motorcycles may have faulty mechanical and automotive parts which need to be checked and reviewed before importing.

There is a significant association ($p<0.001$) between the speed and site of injury. In our study, over 46% of individuals who presented with leg injuries were driving at speeds less than 45 km/h. This was further confirmed by Pathak et al who revealed in their research that drivers traveling at speeds more than 40 km/h had 71.9% chances of sustaining a severe injury.[8]

Out of the drivers who had more than 8 hours of sleep the night before the accident, 85% of drivers had not faced any conditions leading to stress. When drivers get enough sleep, they are more calm when driving.[22] With or without having conditions leading to stress, 76% of people had slept for 8 hours. The majority of people who got enough sleep had RTA's. However, some research says sleeplessness and sleep apnea are significant factors of RTAs.[23]

Limitations

One limitation of this study was that only drivers were considered which included only road traffic crashes and injuries recorded by the hospital. Police reports and passenger/pedestrian injuries were not considered. Only two provinces were considered for the study; there is a need to conduct studies at a national level in other provinces to identify variations and the nature of the accidents. There is a need to conduct further studies on RTAs during the seasonal changes in Sri Lanka to study environmental effects, accidents related to collisions with animals, the prevalence of accidents in an urban area vs non-urban areas, the severity of the injury of the accidents with follow up studies and how the attire of the drivers affect the severity of RTA injuries. It was clearly seen that there were several parameters that contributed to RTAs. However, driver negligence and poor driving skills are parameters that cannot be quantified. Therefore, there need to be proper policies and stricter criteria that need to be met when issuing driving licenses.

CONCLUSION

Age, speed (also linked to alcohol intake), vehicle type (motorcycle), carpet roads, road layout (straight or curved), and stress-inducing circumstances have all been identified as risk factors for RTAs. Experienced drivers have been shown to be more careful and exhibit less dangerous behaviours when driving, yet they are still vulnerable to RTAs. There is a widespread lack of road discipline and an upsurge in RTAs across the country on particular days and hours due to increased traffic volume. There are also a number of additional factors that might influence the current findings. Having a hectic schedule, returning home right after work, only riding motorbikes for short distances, and living a restless existence may have an impact on the study's outcomes. Furthermore, in the current investigation, only the driver's injuries were taken into account. The research gave detailed suggestions based on the data collected and open talks with drivers about their experiences, as well as their alternatives and thoughts for what needs to change and evolve. The true burden of RTAs isn't fully highlighted with drivers alone, as people traveling with the driver, and even pedestrians on the road, sustain injuries and death and disabilities due to RTAs.

Recommendations

A wide range of effective prevention and safety interventions have to be implemented. A scientific approach to tackle the road safety issues in Sri Lanka is crucial to handle these types of accidents. The prevention strategy should address the road traffic system as a whole in Sri Lanka, and look into several interactions between the motor vehicles, road infrastructure, pedestrians, drivers to identify key solutions. This following section draws recommendation from the data obtained and the open discussions with the drivers. Motor vehicles; during the importation of motor vehicles, especially cheap motor vehicles like motorcycles, there needs to be a rigorous checking system of the mechanical and automotive parts. Motor vehicles should have seat belts and other safety mechanisms like airbags etc. Motorcycles should have strict protocols for riding and RTA injury prevention. This may include specific helmets, limb guards, and so on. Assessment of vehicle, driving experiences, and RTAs met in the last five years should be analyzed by research institutes or other authoritative bodies. Motorcycles can be equipped with an Anti-lock Brake System. Road conditions; Roads need to be well maintained with frequent surveying of the road surfaces, width and road safety signs and markings. Proper footpaths and crossings should be provided at intersections. Separate lanes should be provided for fast and slow-moving vehicles. Separate lanes for two-wheelers around the country will be recommended. It should be legalized and strictly implemented. Roads and junctions must be wide. The lighting in the area should be excellent to provide good visibility as most accidents happen between 6 pm to 10 pm. Encourage them to check the condition of the vehicle (license-vehicle inspection) at least once a month. Enforce speed controls and restrictions on straight roads and around locations like schools, hospitals, children's parks, government offices and buildings, etc. Road defects like potholes, road bumps, steep slopes etc should be well maintained.

Human factors; developed countries like the USA, UK, New Zealand and Canada have a graduated licensing system, especially for motorcyclists, where learner drivers have to complete compulsory basic training (CBT) and drive with L plates for two years. In Sri Lanka, full licenses are issued at the age of 18, which needs to be reformed. Licenses should be issued based on proficiency acquired only in designated driving schools. Although all participants stated that they have valid

licenses, one cannot be sure of how and on what basis they obtained them. Education of drivers regarding traffic rules is essential. Carrying out periodic medical check-ups for hearing and vision of drivers.

Legislation; legislation should be placed which mandates it compulsory for helmets to be worn by two-wheelers and seat belts for four-wheelers. Legislation for traffic rules must be strictly followed by authorities. Removal of obstructions to footpaths and road margins to allow smooth traffic flow. Haphazard parking of motor vehicles on busy intersections and roads should be prevented. Strict penalties on drivers who have invalid licenses. A better and faster public transport system is required to reduce the number of moving vehicles on roads. Driving licenses must be renewed at least every 5 years and drivers require updates on the relevant knowledge about safe driving practices. The government public day should not be reduced to only one day of the week (Wednesdays) which increases RTAs.

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