

MEDICO LEGAL ASPECTS OF INJURIES SUSTAINED BY OCCUPANTS OF THREE WHEELERS IN ROAD TRAFFIC CRASHES:

A study conducted in a tertiary care hospital in the central province of Sri Lanka

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Abstract

Introduction: Injuries and death due to road traffic accidents (RTA) are a major public health problem in third world countries like Sri Lanka. Sixteen percent of all vehicles used in Sri Lanka are three-wheelers. Statistics reveal a high incidence of impacts involving three-wheelers in Sri Lanka.

Objectives: To determine the nature of the incident, nature of injuries and mechanism of causation of injury due to road traffic crashes among patients admitted to a tertiary care unit in Kandy, Sri Lanka.

Methodology: Data on socio-demographic profile, type of occupant, nature of the incident, mechanism of causation of injury, type of injury, region of the body affected and severity of injury were retrieved from Medico-Legal Examination Forms (MLEF) of patients admitted after three-wheeler crashes to the Teaching Hospital Peradeniya from 2016 to 2018. Data were analyzed using SPSS VERSION22.

Results: The commonest incident was the toppling of the vehicle (55%). Most injuries were sustained by the impact on an object inside the three-wheeler (44%). The commonest injury seen was abrasion (63%) and the majority of injuries were non-grievous (68%). Lower limb was the most affected (45%). More rear passengers were injured than drivers (62%). There was no significant difference in injury pattern between driver and rear passenger group.

Conclusion: Toppling was the commonest type of incident with most injuries being abrasions and sustained by rear-seat passengers by the impact on objects within the three-wheeler.

Keywords: Three-wheeler accidents, pattern of injuries, Safety measures



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Introduction

History of road traffic accidents dates back to the 18th century. Statistics indicate that road traffic accidents are rising steadily resulting in approximately 1.24 million deaths annually worldwide.¹

World Health Organization (WHO) statistics indicate that deaths due to road traffic accidents ranked 9th among the leading causes of death in 2012 with a prediction of being 8th in 2030.² RTAs affect countries with lower per capita income more than higher-income countries with expenditure amounting to approximately 1% -1.5 % of gross national income.² This is in contrast to developed countries where death from road traffic accidents rank lower among the leading causes of death.³

A study done in India concluded that, approximately 3247 people die daily worldwide due to RTA and that it is a major cause of death in the 5–29 year age group. It estimates that approximately 20 million die and 50 million are injured from RTA annually. This study indicates that 90% of RTA deaths occur in developing countries, it is 11th among leading causes of death and amounts to 2.1% of all deaths worldwide. Most victims were young adults between 15- 44 years with 73% of deaths occurring in males. The most affected groups were pedestrians, cyclists, two-wheeler riders, and passengers on public transport. Furthermore, they predict that RTA injuries would be in the third position in the list of diseases worldwide by 2020. Interestingly RTA deaths are expected to rise by 83% in low-income countries and reduce by 27% in higher-income countries. Therefore, RTA injuries would be a major burden on health care budgets.⁴

Southeast Asian countries have a higher number of deaths from RTA from the year 2000 to 2011.⁵ Among them, around 33% of deaths were seen in the occupants of the motorized two or three-wheelers.⁶ A study

done among the occupants of vehicles in RTAs revealed that 37% were on motorcycles, 28% in three-wheelers, 13% in dual-purpose vehicles and 11% in buses.⁷

In Sri Lanka, 22,000 persons had been injured as a result of RTA in 2015 with 2801 deaths.² The World Bank predicts that there would be a 150% increase of RTAs from 2000 to 2020 in Sri Lanka.⁸

Sri Lanka is a country where all injured persons of vehicle accidents are mandatorily reported to the police if they seek medical treatment. This differs from countries like New Zealand and the UK, where they can refrain from reporting.^{9, 10}

Statistics indicate that registered three-wheelers in Sri Lanka are 766,784 in the year 2012 and was 15.7% of total vehicles registered in the country.⁶ From 2004 to 2012, the number of registered three-wheelers in Sri Lanka has risen by 260%.

A study done in the western province of Sri Lanka indicates that 54 % of three-wheeler accidents took place during the daytime (between 07.00h to 19.00h) and that passengers were the commonest victims (40%).⁵ Soft tissue injury was the commonest injury observed (75%) with 21% sustaining long bone fractures. Toppling of the three-wheelers due to a sudden turn of the vehicle has accounted for 30% of accidents. Out of 28 drivers in the study group, 25 had admitted tampering with handle lock to increase the vehicle's turning angle. Toppling due to a sudden turn was identified as the cause of the accident in all those who had tampered with the handle-lock. At the time of the accident, 89% of the drivers and 28% of pedestrians who were injured have been under the influence of alcohol. Being under the influence of Alcohol was identified in 67% of three-wheeler accidents in the night.⁷

A study done in the central province, Sri Lanka revealed that 28% of the victims of

road traffic accidents were occupants of three-wheelers while a study conducted in the western province of Sri Lanka, revealed that the occupants of the three-wheelers were the commonest victims (40%).⁵

Road traffic accidents occur due to careless and high-speed driving, not abiding by traffic rules, attitudes of the drivers (“right of the mighty”), overcrowding of vehicles, and lack of attention to the condition of vehicles, driving under the influence of alcohol and drug, driver fatigue, congested roads, illegal constructions.¹¹

Despite the high frequency of three-wheeler accidents, studies regarding the topic are sparse. Studies on the injury patterns of occupants of three-wheeler crashes, in the central province of Sri Lanka, is important due to its unique geographic and climatic feature.

Objectives

To determine the nature of the incident, nature of injuries and mechanism of causation of injury due to three-wheeler crashes among patients admitted to a tertiary care unit in Kandy, Sri Lanka from 2016-2018.

Materials and methods

A descriptive study was conducted on patients admitted to the teaching hospital Peradeniya, with a history of three-wheeler crashes, from 2016 to 2018.

Data on socio-demographic profile, type of occupant, nature of the incident, mechanism of causation of injury, type of injury, region of the body affected and severity of injury were retrieved from clinical forensic examination and Medico-Legal Examination Forms (MLEF).

Patients less than 3 years of age, the elderly or debilitated and road fatalities were excluded.

Data were analyzed using SPSS VERSION22.

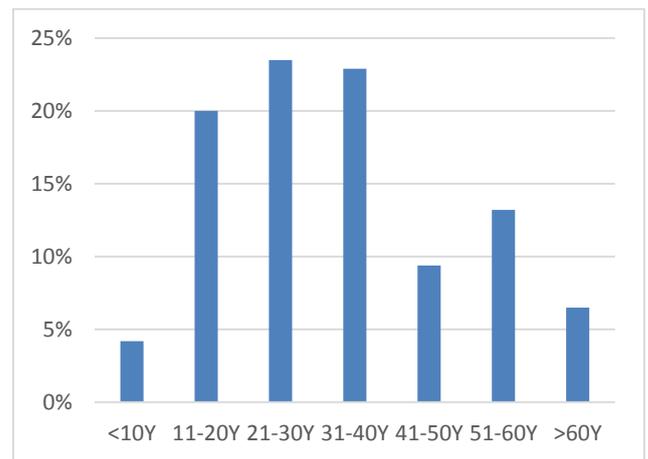
Ethical approval was obtained from the Ethical Review Committee of the University of Peradeniya.

Results

Socio-demographic profile

There were 310 patients with 91% (281) males.

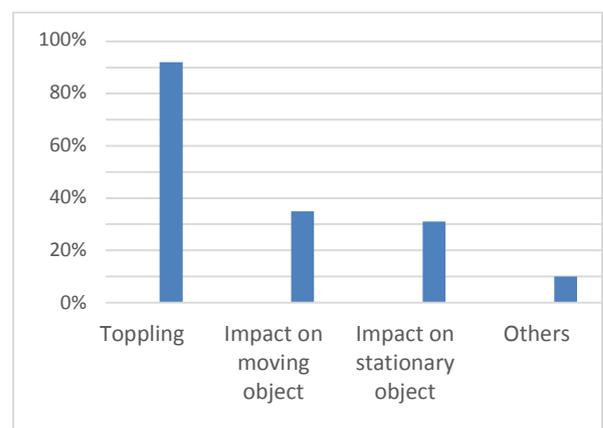
Figure 1: Age distribution of victims



The majority of 24% (73) were between 21 to 30 years of age.

Nature of the incident

Figure 2: Type of incident

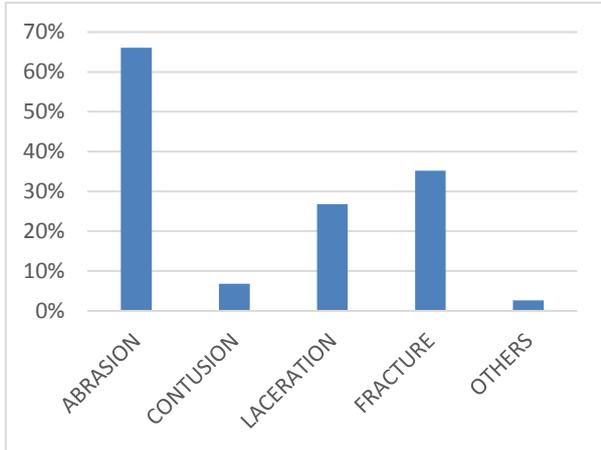


Toppling was the commonest type of incident seen in 56% (172)

Comparison of injury pattern between drivers and rear passengers

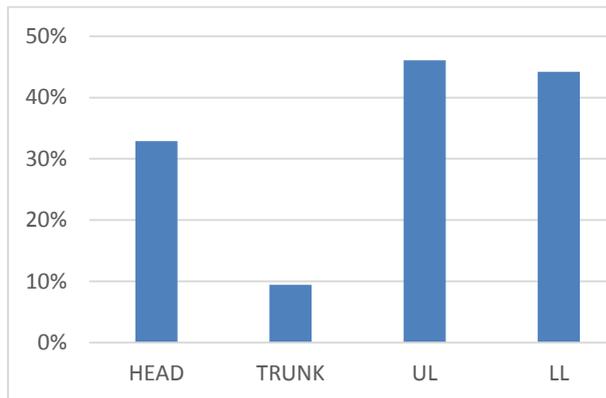
Nature of the injuries

Figure 4: Type of injury



The majority had more than one type of injury. Abrasions were the commonest seen in 66% (220) victims.

Figure 5: Region of body injured

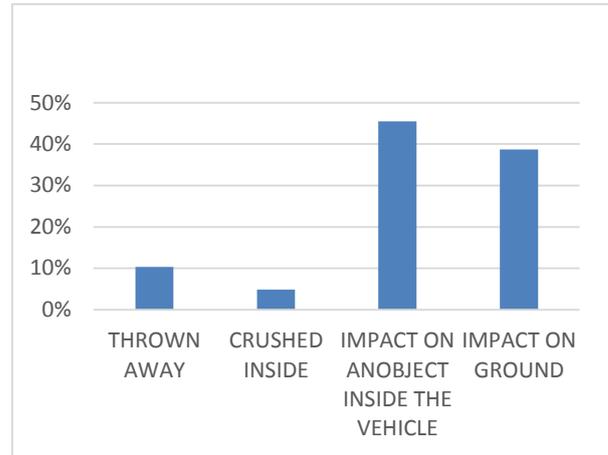


46% (143) victims had injuries in the upper limbs.

Sixty-nine percent (214) victims had non-grievous injuries with 31% (95) having grievous injuries.

Mechanism of causation of injuries

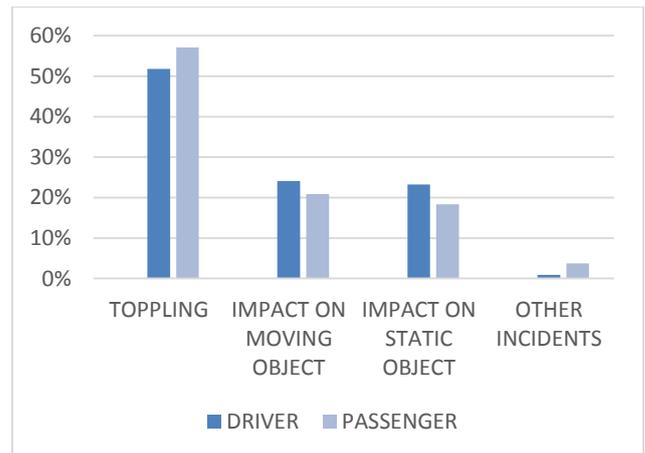
Figure 3: Mechanism of causation of injuries



Majority 48% (141) of victims were injured due to the impact on an object inside the three-wheeler.

Nature of incident

Figure 6: Type of incident

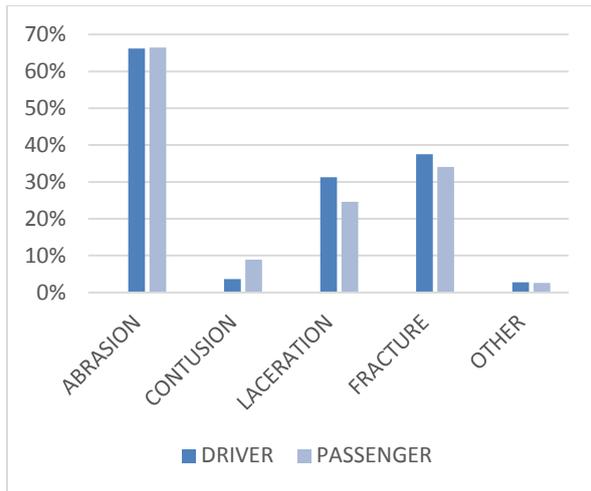


More passengers (57%) were affected than drivers (52%) where there was toppling of the vehicle but more drivers than passengers sustained injuries due to impact on objects

There was no significant difference between the type of incident of the driver and passenger group.

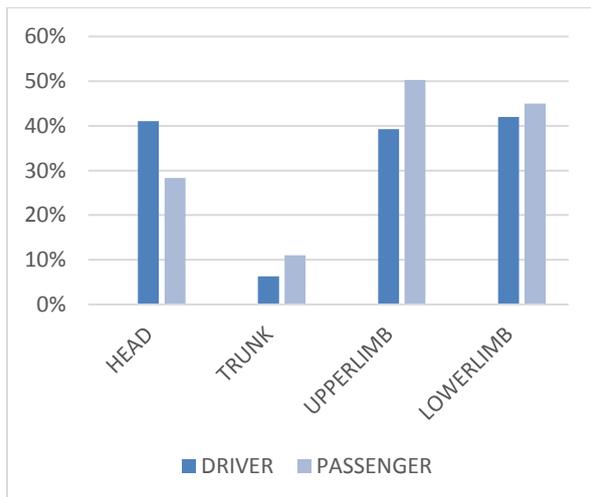
Nature of injuries

Figure 8: Type of injury



Abrasions were seen almost equally among drivers and rear passengers while contusions were seen more among passengers. However, lacerations and fractures were more commonly seen in drivers than in passengers. There was no significant difference between the type of injury of the driver and rear passengers. (Fisher’s exact test values = 0.5)

Figure 9: Region of body injured

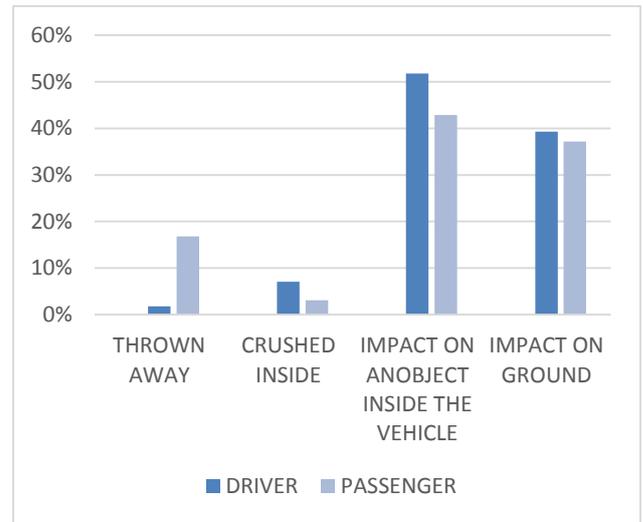


More drivers sustained head injury than passengers while injuries to trunk, upper limb and lower limb were seen more among passengers than in drivers.

However, there is no significant difference in the region of the body injured between drivers and passengers.

Mechanism of causation of injuries

Figure 7: Mechanism of causation of injuries



The majority of rear passengers (17%) were injured by being thrown out from the vehicle than drivers (2%). However, all other injuries were seen more frequently in the driver than in passengers.

Discussion

Three-wheelers are light weighted motorized vehicles with a relatively open structure. The recommended carrying capacity of this vehicle is three rear passengers and a driver.¹² This paper focuses on the nature of the incident, nature of injuries and mechanism of causation of injury due to road traffic crashes among patients admitted to a tertiary care unit in Kandy, Sri Lanka.

This study recognized males as the most vulnerable. Even though the trend appears to be changing overall due to an increase in female drivers it is not reflected in this study.¹ This is highlighted by the male predominance in our sample as well among occupants of other types of vehicle accidents, in other studies conducted in the Kandy and Anuradhapura districts of Sri Lanka and in countries like India.^{13,14,15} In our study population the 21 -30 year age group was the most vulnerable which is compatible with previous Sri Lankan

studies in the central province where the most vulnerable group was identified as 20- 29 years among victims of all road traffic accidents and 21 -30 years in a study conducted on three-wheeler crashes.^{5, 13,14,15}

The commonest type of incident seen was toppling of the vehicle.⁵ However, a study done in the western province revealed that a majority of three-wheeler crashes were due to impact with another vehicle.⁶ Studies revealed that interfering with the handle lock of the vehicle to increase the turning cycle was an important contributory factor especially of three-wheelers operating in the city. However, poor road surface and foggy climatic conditions may contribute to the toppling of three-wheelers in the central province. Conversely, studies reveal that crashes are more common in dry road surfaces probably because of the greater number of vehicles traveling under such conditions.⁶

The impact on objects inside the vehicle was the commonest mechanism of causation of injuries in this study. Surprisingly, the injury pattern was similar in drivers as well as rear-seat passengers. However, the drivers sustained injuries from impacts on the handlebar and structures such as windscreen and other modifications introduced to the vehicle, while rear-seat passengers impacted the front metal bar which was not padded. Some impacts were due to goods inside the vehicle while some were due to modifications made to the vehicle. Injuries in rear passengers in three-wheelers differ from injuries sustained by passengers of other vehicles as they impact on the front metal bars instead of the front seat. The next frequently mechanism of causation of injuries was impact on the ground due to being thrown away or crushed between vehicle and ground.

The study revealed that passengers are more at risk of being thrown away than drivers. This may be due to drivers bracing

themselves for the impact or due to holding on to the handlebar.

Ninety percent of victims sustained surface injuries without internal damage.¹ A study conducted in Sri Lanka revealed soft tissue injury as the commonest type of injury among victims of three-wheeler crashes.¹¹ Abrasions were identified as commonest type of injury in occupants of three-wheelers, motorcyclists and motor car passengers in another study.¹³

Surface injuries caused by shattered glass seen in other vehicular accidents are rarely seen among victims of three-wheeler crashes. Injuries to the limbs which were the commonest in our study were similar to the injuries sustained by passengers of motorcycles.¹³ However, this contrasted with the findings of Vadysinghe et al where the most affected region of the body was the head where they have described a similar mechanism of causation of injuries.
21

Three-wheelers are included in the term "traffic" defined in section 240 of the motor traffic act of Sri Lanka. (Motor traffic act of SL, section 240) Hence they are under the common law relating to the motor vehicle in Sri Lanka.

Seat belts were mandatory for the passengers of the vehicles on the highways as the law introduced by the Amendments made at the road traffic act in 2009 and described in the section 157(1) which stated "No person shall travel in a prescribed seat in a vehicle of a prescribed class or description unless he uses a seat belt of a type prescribed by the minister". Three-wheelers as type of motor vehicle, Is also under this law.

This study revealed that most injuries were non-grievous. This is because the fatalities were excluded. The pattern of injury among the fatal three-wheeler crashes needs further investigation.

Ejection of the passenger from the vehicle is known to occur in high-speed collisions and if the vehicle is toppled.¹ In three-wheeler accidents, the relatively open structure of the vehicle has contributed to throwing away from the vehicle. Furthermore, Unrestrained by seat belts of the occupants of three-wheelers is also influenced by this mechanism significantly.

The type and severity of the injuries sustained by the occupants of vehicles in road traffic accidents, depends on factors like force of impact, duration of impact, position of the passenger in the vehicle, use of seat belts, intrusion of the external objects, ejection from the vehicle at the incident, and the vehicular behavior after the impact.¹

The force of impact depends on the speed of the vehicle. The maximum speed limit for the three-wheeler is 60 km /h, which is much less than for other vehicles. However, the positive effect of this speed limit is negated by a lack of seat belts and airbags in these vehicles.

The direction of impact is important in severity assessment. The lack of protective structures, bumpers and a bonnet makes three-wheel occupants more vulnerable to injuries with impact from any direction. There was no significant difference seen between the driver and rear passenger category in our study population.

Conclusions

The most vulnerable group were males between 21- 40 years of age. The commonest type of incident was the toppling of the vehicle. The majority were injured due to impact on objects inside the three-wheeler. Abrasions were the commonest type of injury while the limbs were the most affected body region. The majority of injuries were non-grievous with no significant difference in the injury pattern between the driver and passengers.

Recommendations

Ensure that:

- (1) seat belts are in place for both the passenger and the driver compartments
- (2) there is Padding of the passenger compartment with the removal of unnecessary modifications
- (3) protective doors are installed
- (4) drivers and the general public are educated regarding the effects of overcrowding, speed limit, transportation of goods and modifications to the vehicle
- (5) those roads are maintained in good condition and traffic laws are abided

References

1. Mason, J.K. Pathology of trauma. London: Arnold; 2000. Pp.1-17.
2. World health organization. The top 10 causes of death [Internet]. 2018 [Updated 2018; cited 2018 Mar 5]. Available from: <http://www.who.int/medicentre/factsheets/fs310/en/>
3. Ameratunga S, Hajar M, Norton R. Road-traffic injuries: confronting disparities to address a global-health problem. *The Lancet*. 2006; 367(9521): 1533-40. DOI: 10.1016/S0140-6736(06)68654-6
4. Gopalakrishnan S. A public health perspective of road traffic accidents. *Journal of family medicine and primary care*. 2012; 1(2): 144. DOI: 10.4103/2249-4863.104987

5. de Silva M, Nellihala LP, Fernando D. Pattern of accidents and injuries involving three-wheelers. *Ceylon medical journal*. 2014; 46(1). DOI: <http://doi.org/10.4038/cmj.v46i1.6517>
6. Amarasingha N. Characteristics of three wheeler crashes”. International research symposium on engineering advancement, SAITM; 2015; Malabe, Sri Lanka.
7. Edirisinghe PA, Kitulwatte ID, Senarathne UD. Injuries in the vulnerable road user fatalities; a study from Sri Lanka. *Journal of forensic and legal medicine*. 2014; 27: 9-12. DOI: 10.1016/j.jflm.2014.07.002
8. Kopits E, Cropper M. Traffic fatalities and economic growth (Policy Research Working Paper No 3035). Washington, DC: The World Bank; 2003.
9. Alsop J, Langley J. Under-reporting of motor vehicle traffic crash victims in New Zealand. *Accident Analysis & Prevention*. 2001; 33(3): 353-9.
10. Cryer PC, Westrup S, Cook AC, Ashwell V, Bridger P, Clarke C. Investigation of bias after data linkage of hospital admissions data to police road traffic crash reports. *Injury Prevention*. 2001; 7(3): 234-41. DOI: 10.1136/ip.7.3.234
11. Teaching Hospital Peradeniya. Cost Accounting Report [Internet]. Peradeniya: Sri Lanka; 2013 [cited 2018 Mar 5]. Available from: 10 http://www.peradeniya_hospital.health.gov.lk.759
12. Mohan D, Kajzer J, Bawa-Bhalla KS, Chawla A. Impact modelling studies for a threewheeled scooter taxi. *Accident Analysis & Prevention*. 1997;29(2):161-70.
13. Fernando DM, Tennakoon SU, Samaranayake AN, Wickramasinghe M. Characteristics of road traffic accident casualties admitted to a tertiary care hospital in Sri Lanka. *Forensic science, medicine, and pathology*. 2017; 13(1): 44-51. DOI: 10.1007/s12024-016-9828-3
14. Weerawardena WA, Illanagasingha TD, Piyadasa IJ, Rathnayaka SM, Subaweera WT, Niroshana GA. Analysis of patients admitted with history of road traffic accidents to surgical unit B Teaching Hospital Anuradhapura, Sri Lanka. *Anuradhapura Medical Journal*. 2013; 7(1): 2-5.
15. Patil SS, Kakade RV, Durgawale PM, Kakade SV. Pattern of road traffic injuries: A study from western Maharashtra. *Indian journal of community medicine*. 2008; 33(1): 56. DOI: 10.4103/0970-0218.39248
16. Litman T. Distance-based vehicle insurance feasibility, costs and benefits. Victoria. 2007; 11.

17. Edlin A. Per-Mile Premiums for Auto Insurance. Department of Economics. The University of California Berkeley. 1998.
18. Perera UCP. Principles of medical law for the medical undergraduates and practitioners. Sri Lanka, Southern Province: Chief Ministry, Health, Law and Order; 2016. Pp.34-35.
19. Motor Traffic (Seat belts) Regulations Number 03 of 2011.
20. Penal code of Sri Lanka, Chapter XVI: Of offences affecting the human body, of offences affecting life; 311
21. Vadysinghe A.N, Katugaha B.H.M.K.D, Piyarathna Colambage S.M., Injury pattern and causes of death among occupants of three wheelers succumbed to their injuries from road traffic accidents in Sri lanka, International journal of Medical Toxicology and Forensic medicine, 2018;8(2)55-62: <http://dx.doi.org/10.22037/ijmtfm.voio.20803>.