



Original communication

Injuries in the vulnerable road user fatalities; a study from Sri Lanka



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ABSTRACT

Vulnerable Road Users defined as people at risk in traffic due to absence of an outside protective shield to absorb energy during a collision are mainly pedestrians, bicycle riders and motor cyclists. In low income countries, deaths of VRUs outnumber vehicular drivers and occupants. A forensic pathologist not only reports the cause of death but also forms opinions on type of road user. We attempted to find whether pedestrians could be differentiated from other types of VRUs. A retrospective descriptive study, based on case records of VRUs fatalities from 2005 to 2012 referred to a tertiary care unit for post-mortem examination, was conducted. A pro-forma was developed to extract data from the post-mortem reports and toxicology reports. Data was analysed using SPSS version 16. Out of the 328 cases 48% ($n = 157$) were pedestrians while 45% ($n = 147$) were riders/pillion riders of two wheeled vehicles and 5% ($n = 16$) were drivers/occupants of three-wheelers. The majority (87%) was males and 43% of pedestrians were elderly. 59% had 10–25 injuries and 87% had external injuries in the head, face and neck. The majority of skeletal injuries were in the skull followed by ribs. Analysis of different variables of pedestrians to other types of VRUs showed that the variables of, elderly male, road crosser, skull injuries, brain injuries, cause of death being head injuries and multiple injuries were significantly greater among pedestrian group ($p < 0.001$). The traffic hours (peak and off peak), number of injuries, rib injuries, limb injuries, crushed/run over injuries or lung and liver injuries had no significant association. Although some features helped in determining a pedestrian, many other factors were not associated to differentiate a pedestrian from other VRUs. Therefore, a forensic pathologist has to be cautious in expressing opinions when other corroborative evidence is lacking.

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1. Introduction

“Vulnerable Road User” is a term applied to those at more risk in traffic, i.e. those who are unprotected by an outside shield.^{1,2} Therefore, pedestrians, pedal cyclists and motor cyclists have been considered as vulnerable since they benefit from little or no external protective device that would absorb energy during a collision. Although the category of vulnerable road user (VRU) may depend on the type of the vehicle used, categorization has to be considered depending on each country's situation. For an example, drivers and occupants of three-wheelers (tuk-tuks) have been considered as VRUs in 2009 WHO report since it is a popular mode of transport in low and middle income countries in Asia. On the other hand, a traveller who is on the foot-board or the roof top of an overcrowded public transport in Sri Lanka/India, a bullock cart rider, a rickshaw man and its occupant have to be categorized

under vulnerable road users since they also don't receive any protection from a shield that would absorb energy during a collision.

World statistics on VRUs' deaths clearly show that, in low-income countries and some regions in Africa, Asia, the Caribbean and Latin America, the majority of road deaths are among pedestrians, passengers, cyclists, users of motorized two-wheelers and unsafe travellers of buses and minibuses.^{3,4} The leading casualties in most high-income countries, on the other hand, are among the occupants of cars.² According to the statistics of the Sri Lankan Police, the number of road fatalities from 2004 to 2009 has been fluctuating around 2300–2500 deaths per year with the latest figure being 2721 deaths in 2011, showing an upward trend.^{5,6} Although police statistics do not categorize VRUs separately, the percentage of pedestrian fatalities has been around 33% while drivers and riders amount to 44% and rest being passengers.

Road traffic fatalities are inquired by an Inquirer into Sudden Death or a Magistrate and undergo a post-mortem examination in Sri Lanka. A forensic pathologist who conducts such autopsy is not only expected to record injuries but also to give necessary medical opinion as to the cause and the circumstances of death. Thus,

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recognizing different patterns or locations of injuries in a VRU is very important to corroborate other evidence especially when the accident is due to rash and negligent act of an individual.

2. Objective

To study the injury patterns in different types of VRUs encountered in medico-legal autopsies and to find if pedestrians could be differentiated from other types of VRUs.

3. Study design

After obtaining ethical approval a retrospective descriptive study was carried out based on the case records of VRUs referred for post-mortem examination at a teaching unit of the North Colombo Teaching Hospital, Ragama, Sri Lanka (a tertiary care hospital in the Western Province) from 2005 January to 2012 December. A deceased vulnerable road user was defined as a pedestrian/motor cyclist (rider/pillion rider)/moped or scooter rider/pillion rider/cyclist/driver of a three-wheeler/occupant of a three wheeler/rider of a bullock cart or a traveller on the foot board of an overcrowded bus.

A pro-forma was developed to extract data from the case records. Post-mortem reports and toxicological reports were perused. Post-mortem reports where quality data cannot be extracted were excluded from the study. The pro-forma contained data on age, sex, type of vulnerable road user number of injuries, location of injuries, damage to the internal organs, as well as data on the cause of death and relevant opinions. Ethical clearance for the study was obtained from Ethics Review Committee of the Faculty of Medicine, University of Kelaniya, Sri Lanka.

4. Results

Analysis of the type of the VRU was based on the police information, eye witness records as well as final interpretation of the post-mortem report. During the study period of 2005 January to 2012 December a total of 7266 post-mortem examinations were conducted at the North Colombo Teaching Hospital where the study was conducted. Although 840 deaths of road traffic fatalities underwent post-mortem examination, only 504 deaths belonged to vulnerable road users group. However, 328 cases became eligible for the study considering the quality of the data. Among the study group 48% ($n = 157$) were pedestrians while 45% ($n = 147$) and 5% ($n = 16$) were riders/pillion riders of two wheeled vehicles (motor cycles and bicycles) and drivers/occupants of three-wheelers respectively. Unsafe travelling on the foot board or other modes of unsafe transport such as bullock carts accounted for 2% ($n = 8$) of the cases.

5. Age and sex distribution

87% of the study population were males where as male to female ratio was 6.3:1. The majority were over 40 years of age with 32% and 28% belonging to the age categories of 40–60 years and above 60 years respectively. In 12 (4%), person's age was not known. Young persons of 20–39 years comprised only 29% of the study population. The analysis of age group according to the type of VRU, revealed that the pedestrians consisted of more elderly men (>60 years) as opposed to others groups (Table 1).

6. Type of the alleged vehicle involved and the type of the activity, the VRU was engaged at the time of impact according to the history

A heavy vehicle was involved in the alleged incident in 43% (lorry/container: 25% and bus: 18%) of the cases, while in 27% of the

cases a light vehicle (car/van) was involved. In 4% and 12% of cases the offending vehicle was a three wheeler and a two wheel vehicle (Motor cycle/bicycle) respectively. Other types of transportation (eg: Bullock cart) accounted for 7%, while in 4 cases multiple vehicles were involved. In 6% of cases information of the offending vehicle was not available. All "hit and run" incidents were categorized under this group.

The analysis of the type of activity VRU was engaged in according to the historical information resulted, 31% ($n:103$) as crossing and 35% ($n:115$) as riding/driving, 16% ($n:53$) of the VRUs were walking while 7% of the VRUs were turning or over taking. In 11% ($n:37$), the activity was not recorded.

7. External and internal injuries

We analysed the external injuries according to the body areas (Table 2) while bone injuries were categorized into main skeletal areas (Table 3) and visceral injuries according to their respective organs (Table 4). The injury distribution showed that although the percentage of external injuries were greater than the skeletal and visceral injuries in all VRUs there was no difference in the injury distribution pattern between the pedestrian and the other types of VRUs except skull and brain injuries. Out of 157 pedestrians, 109 (70%) had skull injuries but 119 (78%) sustained brain injuries. On the other hand out of 171 non-pedestrian VRUs, 11 (7%) and 25 (16%) had skull and brain injuries respectively (Tables 3 and 4).

8. Crushed/run-over injuries

28% ($n = 92$) of the victims had crushed/run over injuries and majority of them were seen in pedestrians (52 cases) as expected. However there was no statistical difference between the pedestrians and other VRUs (Table 5).

9. Cause of death

49% ($n = 159$) died from head injuries while multiple injuries were the cause of death in 35% ($n = 114$) of study population. Chest injuries abdominal injuries and spinal injuries accounted for 5% ($n = 15$), 3% ($n = 9$) and 3% ($n = 9$) respectively. 6% ($n = 20$) died of other causes such as Ischemic heart disease aggravated by minor trauma or other natural diseases like bronchopneumonia due to chronic debilitation following head or spinal cord injury.

10. Pedestrians VS other VRUs

The statistical analysis of different variables showed that being an elderly (>60 years) male pedestrian was statistically significant compared to other type of VRUs (Table 5). When considering the impact/collision, time of occurrence, the type of vehicle alleged to

Table 1
Distribution of VRUs according to age groups.

Type of VRUs	Age category						Total	
	<10 years	11–19 years	20–39 years	40–60 years	>60 years	Not known	n	%
Pedestrian	2	5	21	50	68	11	157	48
Two wheel	3	13	63	48	20	0	147	45
Three wheel	0	1	6	9	0	0	16	5
Unsafe travelling	0	0	3	0	2	0	5	2
Other	0	0	1	0	1	1	3	
Total	5	19	94	107	91	12	328	100
Percentage %	1	6	29	32	28	4		

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