

ORIGINAL ARTICLE

PATTERNS OF INJURIES IN PEDESTRIAN ROAD TRAFFIC ACCIDENTS: A COMPARATIVE ANALYSIS OF DECEASED AND SURVIVING VICTIMS ADMITTED TO THE TEACHING HOSPITAL, KARAPITIYA, SRI LANKA

Perera HAVK^{1*}, Ruwanpura PR², Kitulwatte IDG¹

¹Department of Forensic Medicine, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka

²Office of the Judicial Medical Officer, National Hospital, Galle, Sri Lanka

ABSTRACT

Introduction: Pedestrian road traffic injuries represent a significant public health and medico-legal concern in Sri Lanka. Understanding injury patterns and mechanisms among pedestrian victims is essential for prevention strategies, trauma management, and forensic evaluation.

Methods: A retrospective observational study was conducted using medico-legal examination forms (MLEFs) and post-mortem reports (PMRs) of pedestrians admitted to Teaching Hospital Karapitiya, Sri Lanka, from 2023 to 2024. Victims were categorized into deceased and survivors. Demographic characteristics, vehicle types involved, injury patterns, mechanisms of injury (ground impact, primary impact), and type of death were analyzed descriptively.

Results: A total of 234 pedestrian victims were included, comprising 154 survivors (65.8%) and 80 deceased (34.2%). Males constituted the majority of both survivors and fatalities. Among deceased pedestrians, the 41-60 years age group was the most affected, while the 21- 40 years age group predominated among survivors. Ground impact injuries were significantly more common among deceased victims and were particularly frequent in on- the-spot deaths. Survivors more commonly sustained extremity injuries, whereas fatalities predominantly involved severe head injuries, including skull fractures and intracranial hemorrhages. Motorcycles were the most frequently involved vehicles in both groups. Delayed deaths were commonly observed following hospital admission, particularly among patients who had undergone surgical intervention for head injuries.

Conclusion: Distinct injury patterns were observed between surviving and deceased pedestrian victims. Ground impact injuries (tertiary impact) and severe head trauma were strongly associated with fatal outcomes, while survivors more frequently sustained non- fatal extremity injuries. These findings emphasize the importance of mechanism-based injury assessment in medico-legal investigations and highlight the need for targeted preventive strategies to reduce pedestrian mortality in Sri Lanka.

Corresponding author: Perera HAVK
pvishadha@gmail.com
<https://orcid.org/0009-0008-1798-8015>

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Keywords: Ground impact injuries; pedestrians; road traffic accidents

INTRODUCTION

Road traffic accidents (RTAs) are a major cause of morbidity and mortality among pedestrians, representing one of the most vulnerable road user groups. Due to direct exposure to vehicle collisions, pedestrians are at high risk of sustaining severe or fatal injuries. According to World Health Organization data, vulnerable road users- including pedestrians, cyclists, and motorcyclists account for more than half of global road traffic deaths, with pedestrians alone contributing 23% of fatalities¹.

In Sri Lanka, pedestrian fatalities continue to constitute a substantial proportion of road traffic deaths. In 2022, pedestrians accounted for nearly one-third of all road traffic fatalities, reflecting a significant public health and medico-legal burden. Pedestrian injuries commonly result from a combination of primary impact and secondary injuries (ground impact/tertiary impact injuries), producing complex injury patterns involving the head, thorax, abdomen, and extremities^{2,3}.

Analysis of the injury patterns is essential not only for improving trauma care and prevention strategies but also for medico-legal reconstruction of accident mechanisms. Differentiating primary impact injuries from ground impact injuries assists in understanding vehicle speed, point of contact, and pedestrian position at the time of collision. Such analysis is important in determining liability, assessing negligence, and corroborating eyewitness accounts⁴⁻⁶.

OBJECTIVES

This study aimed to comparatively analyze injury patterns among deceased and surviving pedestrian victims admitted to Teaching Hospital, Karapitiya, Sri Lanka, with emphasis on injury mechanisms and medico-legal relevance.

METHODS

This retrospective observational study was conducted at the office of the Judicial Medical Officer, Teaching Hospital Karapitiya. Pedestrian

victims of road traffic accidents examined between 1 December 2023 and 30 August 2024 were included in the study, and a total of 234 pedestrians were analyzed. Data were obtained from Medico -Legal Examination Forms (MLEFs) of surviving victims and Post-Mortem Reports (PMRs) of deceased victims. Inquest records, Police reports, and accompanying medical documents were reviewed where available, to supplement accident- related details.

The inclusion criteria for the study were surviving pedestrians admitted for treatment with completed medico-legal examination records, deceased pedestrians declared dead on arrival or succumbed to injuries post-admission, and underwent a post-mortem examination, especially those with clear eyewitness accounts or CCTV evidence confirming the circumstances of the accident. Cases were excluded when the degree of decomposition prevented meaningful injury assessments. Additionally, cases with incomplete, inadequate, or unclear injury documentation were not included in the analysis.

Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, University of Ruhuna (Ref: 2024/P/020 [17.05.2024]), and permission was granted by the relevant judicial medical officers.

Demographic details, vehicle type, mechanism of injury (primary impact and ground impact), injury distribution, and outcome were recorded. Injuries were categorized by anatomical region and type. Data were analyzed descriptively using frequencies and percentages. Statistical analysis was performed using IBM SPSS Statistics version 16, with Chi-square testing applied where appropriate.

RESULTS

A total of 234 pedestrian road traffic injury cases were analysed, of which 154 (65.8%) survived, and 80 (34.2%) succumbed to their injuries (Table 1). Among the deceased, 32 (40.0%) died at the scene, while 48 (60.0%) experienced delayed deaths following hospital

admission. Almost all delayed deaths occurred in patients who had undergone surgical intervention for head injuries. Males constituted the majority of both survivors and deceased victims. Among survivors, males accounted for 102 (66.2%) cases and females 52 (33.8%), while among deceased pedestrians, males comprised 54 (68%) and females 26 (32%). Age distribution differed between outcome groups. The highest proportion of deceased pedestrians belonged to the 41–60-year age group (35.0%), whereas among survivors, the 21–40-year age group predominated (37.7%) (Table 1).

Table 1: Demographic and outcome characteristics of pedestrian road traffic injury victims (n=234)

Characteristic	Survived (n=154)	Deceased (n=80)	Total (n=234)
Outcome status	154 (65.8%)	80 (34.2%)	234 (100%)
Type of death (among deceased)			
On-the-spot deaths		32 (40.0%)	
Delayed deaths after admission		48 (60.0%)	
Sex			
Male	102 (66.2%)	54 (68.0%)	156 (66.7%)
Female	52 (33.8%)	26 (32.0%)	78 (33.3%)
Age group (years)			
<20	22 (14.3%)	8 (10.0%)	30 (12.8%)
21–40	58 (37.7%)	26 (32.5%)	84 (35.9%)
41–60	46 (29.9%)	28 (35.0%)	74 (31.6%)
>60	28 (18.1%)	18 (22.5%)	46 (19.7%)

Primary impact injuries were observed in 60 (75%) of deceased pedestrians compared to 70 (45.5%) of survivors. Ground impact injuries were present in 55 (68.8%) of deceased victims, while only 30 (19.5%) of survivors sustained such injuries. Both injury types were more prevalent among deceased pedestrians; however, ground impact injuries demonstrated

a particularly strong association with fatal outcomes. Since injury patterns were not mutually exclusive, some victims sustained both primary and ground impact injuries. This association between ground impact injuries and mortality was statistically significant (χ^2 test, $p<0.001$) (Table 2).

Table 2: Distribution of injury patterns among deceased and surviving pedestrians

Injury pattern	Survived (n=154)	Deceased (n=80)	Total (n=234)
Primary impact injury	70 (45.5%)	60 (75.0%)	130 (55.6%)
Ground impact injury	30 (19.5%)	55 (68.8%)	85 (36.3%)

Motorcycles were the most frequently involved vehicles in pedestrian collisions in both survivors (55.8%) and deceased victims (57.5%) (Table 3). Ground impact injuries were more frequent among on-the-spot deaths compared to delayed deaths (81.3% vs 60.4%), whereas primary impact injuries were commonly observed in delayed deaths following hospital admission (Table 4).

Table 4: Distribution of injury patterns according to type of death among deceased pedestrians (n=80)

Injury pattern	On-the-spot death (n=32)	Delayed death (n=48)
Ground impact injury	26 (81.3%)	29 (60.4%)
Primary impact injury	18 (56.3%)	42 (87.5%)

The injury spectrum ranged from superficial to severe trauma. Common injuries included skull, rib, pelvic, and long bone fractures; internal abdominal injuries; and soft-tissue injuries such as lacerations and abrasions. Head injuries predominated among deceased pedestrians, observed in approximately **62 (77.5%)**, while injuries involving both upper and lower limbs were more frequent among survivors. Skull fractures and intracranial haemorrhages were strongly associated with fatal outcomes.

Multiple injuries involving more than one body region were frequently observed among fatal cases.

DISCUSSION

This study demonstrates clear differences in injury patterns between surviving and deceased pedestrian road traffic accident victims. Fatal outcomes were predominantly associated with ground impact injuries and severe head trauma, while survivors more commonly sustained extremity and soft-tissue injuries. Similar observations have been reported in the previous forensic and trauma-based studies, where secondary injuries with the ground were identified as a major contributor to fatal injuries^{4,7}. The strong association between ground impact injuries and mortality, particularly among on-the-spot deaths, highlights the critical role of secondary injuries in determining injury severity and survival.

The predominance of head injuries, including skull fractures and intracranial haemorrhages, among deceased pedestrians underscores traumatic brain injury as a key mechanism of death. This finding is consistent with earlier studies reporting a high burden of severe head injuries among fatal pedestrian road traffic accidents^{3,4}. In contrast, delayed deaths following hospital admission were more frequently associated with primary impact injuries, suggesting progression of injury severity or post-operative complications, especially in cases requiring surgical intervention for head injuries³.

Male predominance among both survivors and fatalities is consistent with patterns reported in pedestrian trauma literature and global road safety data^{1,7,8}. This trend may reflect increased exposure to road environments and behavioural risk factors. Age-related differences were also observed, with fatalities more common in older age groups, which has been attributed in previous studies to reduced physiological reserve and higher vulnerability to severe trauma^{1,9}.

From a medico-legal perspective, distinguishing primary impact injuries from ground impact

injuries is crucial for accurate reconstruction of accident mechanisms and assessment of liability. The findings emphasize the importance of careful injury documentation and mechanism-based interpretation in forensic evaluations.

CONCLUSION

Pedestrian road traffic injuries result in substantial mortality, with fatal outcomes strongly associated with ground impact injuries and severe head trauma. On-the-spot deaths were more commonly linked to ground impact, while delayed deaths were frequently associated with primary impact injuries and surgical management of head injuries. Survivors predominantly sustained non-fatal extremity and soft-tissue injuries. These findings highlight the importance of mechanism-based injury analysis in medico-legal investigations and underscore the need for targeted preventive measures to reduce pedestrian fatalities in Sri Lanka.

LIMITATIONS

This study has several limitations. Its retrospective design relied on existing medico-legal and clinical records, which may have resulted in incomplete documentation of certain variables. Injury severity scoring and systematic toxicological analysis, including alcohol estimation, were not uniformly available and could not be analysed quantitatively. Some injury pattern distributions were analysed descriptively, limiting causal inference.

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CONFLICTS OF INTEREST

The authors declared no conflicts of interest.

ETHICAL ISSUES

Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, University of Ruhuna (Ref: 2024/P/020 [17.05.2024]).

SOURCES OF SUPPORT

None

AUTHOR CONTRIBUTIONS

HAVKP: Conception of the work; the acquisition, analysis, and interpretation of data for the work; drafting the work; final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **PRR:** Conception of the work; revising the work critically for important intellectual content; final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **IDGK:** Design of the work; drafting the work; final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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