

# Characteristics of Injuries in Road Traffic Accident Victims: An Autopsy Study at Srinagarind Hospital, Khon Kaen University, Thailand

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## Characteristics of Injuries in Road Traffic Accident Victims

**98** cases of road traffic accident victims were reviewed



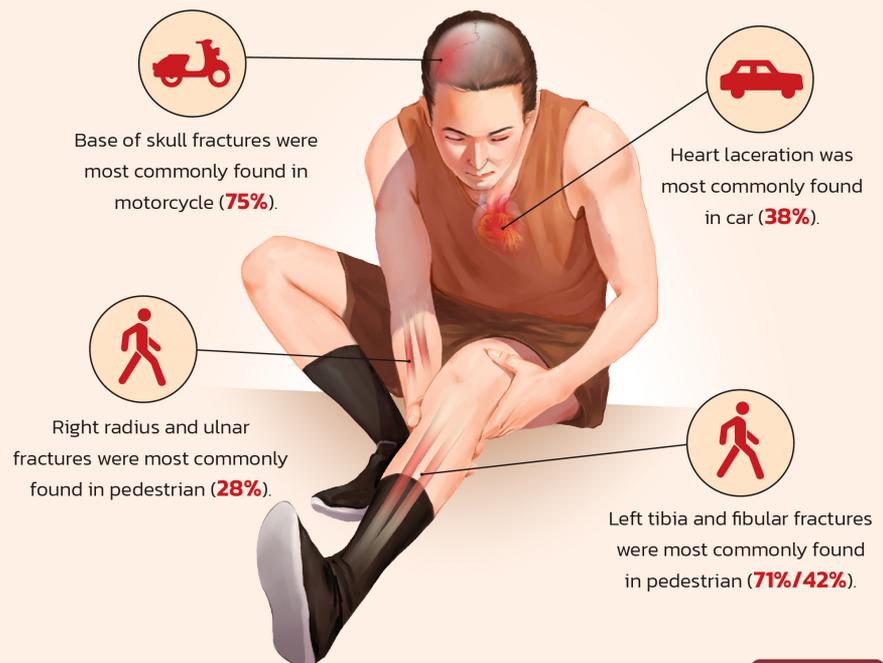
**41** cases were excluded



**57** cases were analyzed



**119** characters of injuries were analyzed



### Conclusions:

Characteristics of injuries differed between each type of road traffic accidents. The findings assist in determining the cause of death and reconstructing the crime scene.

SCAN FOR FULL TEXT



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## ABSTRACT

**Objective:** This ambidirectional cohort study aimed to investigate injury characteristics in road traffic accident (RTA) victims based on autopsy cases at the Department of Forensic Medicine, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand.

**Material and Methods:** Autopsy cases from September 2022 to August 2024 were reviewed, with data collected from autopsy reports and crime scene photographs. Injury characteristics, types of RTAs, time of accidents, and victim demographics were analyzed in 57 RTA cases.

**Results:** The results revealed noteworthy differences in injury patterns between types of RTAs. Fractures at the skull base (Car 38%, Motorcycle 75%, Pedestrian 28%;  $p < 0.01$ ), heart lacerations (Car 46%, Motorcycle 10%, Pedestrian 28%;  $p < 0.05$ ), and fractures of the right radius (Car 7.7%, Motorcycle 2.7%, Pedestrian 28%;  $p < 0.05$ ), right ulna (Car 7.7%, Motorcycle 2.7%, Pedestrian 28%;  $p < 0.05$ ), left tibia (Car 23%, Motorcycle 8%, Pedestrian 71%;  $p = 0.001$ ), and left fibula (Car 23%, Motorcycle 8%, Pedestrian 71%;  $p < 0.05$ ) were associated with specific accident types.

**Conclusion:** This study highlights the observed differences in injury characteristics across various types of RTAs at Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand. Key injuries, including fractures at the base of the skull, heart lacerations, and fractures of the right radius, right ulna, left tibia, and left fibula, were significantly associated with particular types of accidents. These results can serve as a guide for determining the causes of death, especially in RTA cases, particularly in areas lacking forensic pathologists.

**Keywords:** Road traffic accident; characteristic of injury; autopsy; forensic medicine; trauma (Siriraj Med J 2025; 77: 355-360)

## INTRODUCTION

Road traffic accidents (RTAs) are a major public health problem due to their being a major cause of morbidity and death.<sup>1</sup> They account for about 2.37% of all deaths worldwide. Approximately 1.19 million people die annually from traffic accidents, with nearly 50 million individuals sustaining injuries.<sup>2</sup> In Thailand, injuries from RTAs have been identified as a significant public health issue, contributing to high rates of mortality, morbidity, and disability, which impact individuals, families, and society. RTAs not only affect public health but also have significant financial implications. In 2002, the economic losses from traffic crashes, injuries, disabilities, and fatalities were estimated to exceed 168 billion Baht.<sup>3</sup>

Since deaths resulting from RTAs are classified as unnatural, RTAs present significant challenges for forensic pathologists tasked with determining the manner and cause of death. RTAs caused by different mechanisms typically exhibit specific injury patterns and characteristics.<sup>4</sup> For example, head injuries and fractures are frequently observed in motorcycle accidents, while thoracic trauma may be more common in car accidents due to the forceful impact of steering wheels or dashboards.<sup>5,6</sup> However, most studies on the patterns and characteristics of injuries resulting from RTAs have been conducted outside of Thailand; currently, there are no reports specific to the northeastern region of Thailand. Therefore, studying the characteristics of injuries specific to RTAs in the

northeastern region of Thailand is essential to establish baseline data for assessing the cause and manner of death, particularly in areas lacking specialized forensic pathologists.

The examination of injury patterns and characteristics across different types of accidents, vehicles, and participants provides valuable insights that can contribute to ongoing efforts to reduce RTA-related mortality and enhance forensic investigations in Thailand. Therefore, the present study aimed to investigate the patterns and characteristics of injuries in RTA victims through a detailed analysis of autopsy cases referred to the Department of Forensic Medicine, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand.

## MATERIALS AND METHODS

### *Study population and study design*

This ambidirectional cohort study included all RTA autopsy cases who were declared dead at the scene and referred to the Department of Forensic Medicine, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand, for autopsy from September 2022 to August 2024. Cases were excluded based on the following exclusion criteria: if they tested positive for COVID-19 using the Antigen Test Kit, presented with minimal external injuries, were completely decomposed (characterized by full skin discoloration, bloating, and the presence of purge fluid), or were suspected to be homicides.

**Study data**

The data for RTA cases, including age, gender, body weight, height, time and date of the accident, type of vehicles (e.g., car, motorcycle, bicycle, bus, truck, motorcycle trailer, agricultural vehicle, etc.), type of participant (driver, passenger, pedestrian), type of accident (e.g., vehicle hitting a pedestrian crossing the road, vehicle hitting a pedestrian on the footpath, vehicle hitting a fixed object, vehicle rollover, vehicle collision), type of litigant vehicles (e.g., car, motorcycle, bicycle, bus, truck, motorcycle trailer, agricultural vehicle, etc.), crime scene location, underlying diseases, and occupation, were included for statistical analysis.

The characteristics of injuries in RTA cases from autopsy reports were classified by anatomical region as follows:

*Head:* Abrasion wounds, contusion wounds, laceration wounds, skull fractures, maxillofacial fractures, base of skull fractures, epidural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, intraparenchymal brain hemorrhage, intraventricular hemorrhage, brain contusion, brain laceration, brainstem contusion, and brainstem laceration.

*Neck:* Abrasion wounds, contusion wounds, laceration wounds, neck muscle injuries, blood aspiration, upper airway injuries, esophageal injury, and cervical spine fractures or dislocation.

*Chest and back:* Abrasion wounds, contusion wounds, laceration wounds, chest or back muscle injuries, clavicle fractures, scapular fractures, rib fractures, thoracic spine fractures or dislocation, pneumothorax, hemothorax, hemopericardium, lung contusions, lung lacerations, heart contusions, heart lacerations, intrathoracic great vessel injuries, diaphragm injury, esophageal injury, and sternum fractures.

*Abdomen:* Abrasion wounds, contusion wounds, laceration wounds, abdominal muscle injuries, lumbar spine fractures or dislocation, liver injury, spleen injury, kidney injury, large intestine injury, small intestine injury, stomach injury, intraperitoneal hemorrhage, retroperitoneal hemorrhage, intra-abdominal great vessel injury, and mesentery injury.

*Pelvis:* Abrasion wounds, contusion wounds, laceration wounds, muscles of the hip injury, pelvis fracture, urinary bladder injury, colorectum injury, intrapelvic hemorrhage, and genital organ injury.

*Right upper limb:* Abrasion wounds, contusion wounds, laceration wounds, upper limb muscle injuries, humerus fracture, radius fracture, ulnar fracture, carpal bone fractures, metacarpal or phalanx fractures, vascular injury, shoulder dislocation, elbow dislocation, and wrist dislocation.

*Left upper limb:* Abrasion wounds, contusion wounds, laceration wounds, upper limb muscle injuries, humerus fracture, radius fracture, ulnar fracture, carpal bone fractures, metacarpal or phalanx fractures, vascular injury, shoulder dislocation, elbow dislocation, and wrist dislocation.

*Right lower limb:* Abrasion wounds, contusion wounds, laceration wounds, lower limb muscle injuries, femur fracture, patellar fracture, tibia fracture, fibula fracture, tarsal bone fractures, metatarsal or phalanx fractures, vascular injury, hip dislocation, knee dislocation, and ankle dislocation.

*Left lower limb:* Abrasion wounds, contusion wounds, laceration wounds, lower limb muscle injuries, femur fracture, patellar fracture, tibia fracture, fibula fracture, tarsal bone fractures, metatarsal or phalanx fractures, vascular injury, hip dislocation, knee dislocation, and ankle dislocation.

**Ethical clearance**

The experimental design and protocol were approved by The Khon Kaen University Ethics Committee for Human Research (HE661607).

**Statistical analysis**

The data were statistically analyzed using IBM SPSS Statistics for Windows, version 28.0.0 (SPSS, Chicago, IL, USA). The proportions of injuries and ordinal demographic data across different types of road traffic accidents were compared using the Chi-squared test. The distributions of age and body weight for each type of road traffic accident were tested using the Kolmogorov-Smirnov (K-S) test. The comparison of mean age across different types of road traffic accidents was conducted using the Kruskal-Wallis H test, as age data did not follow a normal distribution. For body weight, the comparison of means across groups was performed using one-way ANOVA.

**RESULTS****Sociodemographic characteristics**

A total of 98 registries from road traffic accident (RTA) victims were reviewed, with 57 cases meeting the inclusion criteria. Among these cases, 73.68% were male, and 26.32% were female. The average age of the cases was 39.11 years, and the average body weight was 67.36 kilograms.

The timing of accidents was reported for 44 out of 57 cases. A statistically significant distribution was observed ( $p < 0.001$ ), with 45.45% of accidents occurring during Q1 (00:00–06:00), 20.45% during Q2 (06:00–12:00), 6.82% during Q3 (12:00–18:00), and 29.55% during Q4 (18:00–00:00).

Of the 57 cases, 13 involved cars, 37 involved motorcycles, and 7 involved pedestrians. Regarding participant roles, 45 were drivers, 5 were passengers, and 7 were pedestrians. Accident types included vehicle-pedestrian collisions (8 cases), vehicles striking fixed objects (11 cases), vehicle rollovers (6 cases), and vehicle collisions (30 cases). Vehicle types included 23 cars, 2 motorcycles, 11 trucks, and 1 bus.

### Characteristics of injuries in RTAs

As shown in Table 1, among the 119 types of injuries recorded, six patterns were statistically significant in their association with specific types of RTAs. These included fractures at the base of the skull, heart lacerations, and fractures of the right radius, right ulna, left tibia, and left fibula. Base of skull fractures were the most common injury (75%) in motorcycle accidents. Heart lacerations were observed in 46% of cases in car accidents. Common injuries in pedestrian accidents included fractures of the right radius (28%), right ulna (28%), left tibia (71%), and left fibula (42%).

## DISCUSSION

There are few publications that have demonstrated the characteristics of injuries in RTAs. This study was the first to report on the specific characteristics of injuries in RTAs in the northeastern region of Thailand. The majority of RTA cases were found in males. This distribution was similar to the previous report, which shows a higher incidence of traffic-related injuries and fatalities among men.<sup>7</sup> In Australia, young men have a higher incidence of crashes, with rates 1.25 to 2.07 times greater than

women for various crash types.<sup>7</sup> This was likely due to greater exposure to risky driving behaviors and more frequent vehicle operations.<sup>7,8</sup> The average age of 39.11 years reflects a population segment commonly involved in RTAs due to increased mobility and exposure to road traffic.

The increased incidence of RTA cases at night aligns with the literature. For example, Akerstedt and colleagues observed a significant increase in the risk of injury in traffic accidents during the night, especially around 04:00, with an odds ratio of 5.7 for total accidents and 11.4 for fatal accidents.<sup>9</sup> This observation can be attributed to factors such as reduced visibility<sup>10</sup> driver fatigue<sup>11</sup> and impaired driving due to alcohol consumption.<sup>12</sup> Moreover, environmental factors such as poor road conditions and adverse weather also contribute significantly to the occurrence and severity of RTAs.<sup>13</sup>

Of the 57 cases, 13 involved cars, 37 involved motorcycles, and 7 involved pedestrians. These findings were similar to those of previous studies, which found that motorcycles represented the majority of vehicles involved in RTAs in Thailand.<sup>14</sup> This trend may be attributed to the high prevalence of motorcycle use as a primary mode of transportation in Thailand. In addition, significant factors influencing motorcycle crash severity in Thailand include exceeding the speed limit, non-helmet use, road surface conditions, mobile phone use, and road lighting conditions.<sup>15,16</sup>

Base of skull fractures were most prevalent in motorcycle accidents caused by direct head impact. This observation confirmed a report from Vietnam<sup>17</sup>, where basilar skull fractures were found in 60.6% of

**TABLE 1.** Observed associations between injury types and road traffic accident categories.

Types of Injuries	Car (n = 13)	Motorcycle (n = 37)	Pedestrian (n = 7)	p-value
Base of skull fracture	5 (38.46%)	28 (75.68%)	2 (28.57%)	0.008
Heart laceration	6 (46.15%)	4 (10.81%)	2 (28.57%)	0.017
Right radius fracture	1 (7.69%)	1 (2.70%)	2 (28.57%)	0.041
Right ulnar fracture	1 (7.69%)	1 (2.70%)	2 (28.57%)	0.041
Left tibia fracture	3 (23.08%)	3 (8.11%)	5 (71.43%)	0.001
Left fibular fracture	2 (15.38%)	2 (5.41%)	3 (42.86%)	0.018

fatal motorcycle accident cases. This injury has been associated with high morbidity and mortality rates.<sup>18</sup> Therefore, base of skull fractures are a significant concern in motorcycle accidents.

Injury patterns in car crashes vary significantly depending on the type of collision, the position of the occupant, and the use of safety devices. In the present study, heart lacerations were common injuries found in car accidents. In frontal impact collisions, heart ruptures often occur due to collisions against the steering wheel or dashboard.<sup>19</sup> This finding was consistent with a study in Milan, Italy.<sup>4</sup> Autopsy studies reveal that cardiac ruptures can occur even without significant external injuries, highlighting the importance of thorough internal examinations in forensic investigations. In this study, heart injuries were classified into two categories, including heart contusion and heart laceration. However, a previous study reported traumatic ventricular septal defects without heart lacerations or heart contusions.<sup>20</sup> This finding highlights the necessity for further research to explore additional types and mechanisms of cardiac injuries to improve understanding and forensic practices.

Injuries of pedestrians in RTAs exhibit distinct patterns influenced by various factors. Our results indicated that pedestrians showed higher incidences of fractures in the right radius, ulna, left tibia, and fibula, which may suggest defensive postures during collisions. However, these fractures could also result from other mechanisms, such as energy transmission during impact or subsequent falls after the collision. A report in the U.S. demonstrated an increase in thorax and pelvis and hip injuries among pedestrians, while head injuries remained the most common.<sup>21</sup> The differences among each type of RTAs found in this study are consistent with findings from hospitals participating in TraumaRegister DGU, which found significant differences between pedestrians and motor vehicle occupants.<sup>22</sup>

There are several limitations in the present study, particularly the small sample size, which may have impacted the reliability of the results. In addition, the unavailability of injury severity score (ISS) and abbreviated injury scale (AIS) data, as all RTA cases were declared dead at the scene, restricted the ability to systematically assess injury severity and its correlation with accident outcomes. Research with larger datasets or multi-center studies could provide more robust insights into RTA trends. Moreover, further investigation into the role of environmental factors (e.g., weather conditions, road design) and driver behavior (e.g., alcohol consumption) would provide a more comprehensive understanding of the causes of accidents.

## CONCLUSION

This study provides critical insights into the specific injury patterns associated with different types of RTAs in the northeastern region of Thailand. These injury patterns include skull base fractures in motorcycle accidents, heart lacerations in car crashes, and a high incidence of lower limb fractures in pedestrians, reflecting the unique impact dynamics of each accident type. These findings can guide strategies for improving road safety and reducing traffic-related fatalities. In addition, the study supports forensic investigations by identifying injury patterns specific to each vehicle type, aiding in determining the mechanism of injury and clarifying accident circumstances. These insights strengthen forensic reports and contribute to targeted road safety strategies.

## Data Availability Statement

The data of this study is available upon request.

## ACKNOWLEDGMENTS

None

## DECLARATION

### Grants and Funding Information

This project is not funded by any external sources.

### Conflict of Interest

The authors declare that they have no conflicts of interest.

### Registration Number of Clinical trial

Not applicable

### Author Contributions

Conceptualization and methodology, NC, WK, TW, and WS; Investigation, NC and WS; Formal analysis, NC; Visualization and writing—original draft, NC; Writing—review and editing, WS; Supervision, WK, TW, and WS. All authors have read and agreed to the final version of the manuscript.

### Use of Artificial Intelligence

This manuscript used artificial intelligence tools, including ChatGPT (OpenAI, version GPT-4) and QuillBot for language enhancement and grammar correction. These tools were applied exclusively to improve the quality of the English writing and did not influence the scientific content, analysis, or interpretation of the findings. All final decisions regarding the text were made by the authors.

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