Injury Distribution and Related Factors in Trauma Patient's Requiring Immediate Intervention Referred to the First Level Trauma Hospital in Southwestern Iran

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Research Article

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Abstract

Background: The extent and severity of injury distribution can determine the patient's mortality and morbidity. The purpose of this study was to determine the pattern and role of different variables in an injury distribution and outcome of trauma patients.

Method: This retrospective cohort study was performed in the largest trauma center in south of Iran, Shiraz in 2020. All the patient's demographic, laboratory, clinical and paraclinical records were studied. The extent of injury distribution in the body, Glasgow coma scale and the injury severity score in these patients were carefully recorded.

Results: In patients with multiple trauma, chest injury had the highest percentage of association with other body injuries; head and neck injuries were more associated with chest injuries. Facial and limb injuries were associated with head and abdominal injuries, respectively. In patients with car accidents, the injuries distribution analysis also showed that chest was the most common site of injury in car drivers. Injuries to the head and neck area is the most common site in motorcycle drivers and limb and chest injuries were more common in pedestrian-related accidents.

Conclusion: The body injury pattern can be vary depending on the injury cause. Among the injury sites, it is more important to pay attention to the chest and head injuries. It is necessary to take the patient's history during a thorough examination and perform paraclinical tests such as ultrasound and CT scan to prevent the diagnosis of missing body injuries.

Background

Trauma has become a major problem with the technology advancement and the industrialization of societies. In Iran, young and middle-aged people are exposed to the most traumatic and traffic accidents due to the increasing population growth. 17,000 peoples in Iran and 6 million in the world will die annually due to the traffic accidents (1). According to world health organization statistics, trauma is the second leading cause of death in the country and the leading cause of disability and wasted years of life (2).

In patients before and during hospitalization, potential risk factors have been considered by many specialists for treatment and prevention in trauma patients (3). Regardless of the number of patients who die in severe trauma, mortality and the trauma effects can be greatly prevented by improving treatment and preventing risk factors (4). Risk factors includes age, injury severity, injury location, time and manner of patients' arrival at the hospital, and underlying diseases have been considered in previous studies (5–6). In the study of rollover accident, the most common sites of injury were head, upper limbs, and chest (7). Another study on traffic accidents in Kerman/ Iran showed that the injuries distribution among pedestrians and cyclists was different from motorcyclists (8). Determine the multiple trauma distribution will help to identify the increasing of concomitant injuries in each part of the body. In a study of multiple trauma patients which has been done in Germany, chest and upper limb injuries have been observed

along with clavicle fractures (9). The injury's distribution in patients with multiple trauma can also be affected by demographic variables such as gender and age (9). The distribution of injury in deceased patients is different from of the living patients. However, this distribution is also related to the mechanism of injury and the cause of the accident (10). Various studies showed a significant prevalence of not paying enough attention to the initial evaluation of patients (11–12). This is more common in patients with higher severity of injury (11).

Therefore, it is more important to know the locations of associated and prevalent injuries in order to assess the whole body in the absence of facilities, high load of patients, or the risk of patient exposure to radiation. Understanding the types of injury distribution in the body can help physicians to prevent the mortality risk factors and to perform better screening and treatment management by considering severity of the injury and patients' condition in different mechanisms of trauma and its comparison in deceased and surviving patients. This study was designed to determine the injury's distribution in trauma patients of immediate lifesaving intervention need.

Method

This retrospective cohort study was performed on injured patients in rapid intervention need by census method in the largest first level trauma center in southern Iran (Emtiaz Hospital) in Shiraz during an entire year, 2019. Inclusion criteria were included injury codes from S.00 to Y09 and age over 15 years based on ICD10 codes, and exclusion criteria were patients who did not want to continue the treatment in the relevant hospital and did not need prompt intervention or resuscitation.

In this study, the information recorded by the hospital information system includes demographic information, cause of injury, length of hospital stay, type of surgery, and discharge outcome (mortality or recovery) were collected. These data were combined with the data collected by the hospital infection control system in regards of the incidence and kinds of nosocomial infections. Then, the severity of injury and the injured area of the patients were recorded by observing the patients' graphs by a radiologist, study the records and reports the patients' surgery in resuscitation wards according to Injury Severity Score (ISS) criteria. Information includes blood pressure, heart rate, respiration rate, Glasgow Coma Scale (GCS), and clinical status were also extracted from patients' records.

Mean and frequency methods were used to determine quantitative and qualitative information such as length of hospital stay, severity of injury, surgery, and treatment outcome. Logistic regression modeling was used to determine the variables affecting patients' deaths. All the data preparation steps include clearing, coding, and placement as well as modeling were performed in Stata14 software. In addition, R statistical software version 3.4.3 was used to plot the relationship between injuries.

Results

During one year, 1309 patients were admitted to the resuscitation unit. Patient's information is comprehensively summarized in Table 1. The men to women sex ratio was five to one. Patients with penetrating injuries (29.50 ± 11.37) were the youngest, and patients with fall injury mechanism (47.73 ± 23.51) were the oldest.

Table 1
Characteristics of the study population based on injury mechanism

variables	Accident	Falling down	Assault	penetrating	Attempt to suicide	Total N (%)
Age mean (SD)	37.68 ± 17.79	47.73 ± 23.51	31.74 ± 18.93	29.50 ± 11.37	35.56 ± 16.20	38.06(18.72)
Gender N (%)						
Male	697(81.24)	153(76.88)	59 (6.35)	109 (98.20)	24 (88.89)	1084(82.81)
Female	161 (18.76)	46 (23.12)	4 (93.65)	2 (1.80)	3 (11.11)	225 (17.19)
Length of hospitalization mean (SD)	14.08 (10.00)	11.50 (6.00)	4.03 (3.00)	6.33 (4.00)	7.18 (6.00)	12.26(13.73)
Injury severity score mean)SD(	18.31 (17.00)	16.06 (16.00)	8.12 (6.00)	11.22 (10.00)	6.07 (5.00)	16.37(11.27)
Glasgow Coma Scale Mean (SD)	11.29 (4.07)	11.66 (4.07)	13.90 (2.53)	14.27 (2.45)	12.57 (3.71)	11.9(3.98)
Respiratory rate Mean (SD)	19.67 (6.94)	20.21 (11.76)	18.42 (3.24)	19.49 (4.24)	18.20 (3.04)	19.58(7.43)
Pulse rate Mean (SD)	101.54(23.79)	94.71 (26.82)	98.01 (18.73)	99.94 (20.58)	98.81 (25.30)	99.99(23.87)
Surgery N (%)						
Yes	672 (78.32)	134 (67.34)	50 (79.37)	93 (83.78)	23 (85.19)	1001(76.47)
Infection N (%)						
Yes	193 (22.49)	40 (20.10)	0	5 (4.50)	0	224 (18.64)
Outcome N (%)						
Death	130 (15.15)	35 (17.59)	2 (3.17)	6 (5.41)	0	176 (13.45)

The maximum duration of hospitalization was related to traffic accidents (14.08 days) and the minimum duration was 4 days in the beating mechanism. Patients referred by accident mechanism had the highest mean severity of injury (18.31%) and patients who attempted suicide had the lowest mean severity of injury (6.07%). Most surgery cases were related to penetrate injuries (83.78%), and the percentage of nosocomial infections was the highest in traffic accident victims. The mechanism of falls and traffic accidents accounted for 17.59% and 15.15%, respectively, with the highest percentage of deaths.

According to the results, skull fracture and brain contusion were the most common types of injuries in patients with head and neck injuries. Injuries to the eye, maxilla, and mandible also accounted for more than 50% of facial injuries. Lung and rib injuries were the most common, and heart injuries were the least common in chest injuries. The liver and spleen were the most common sites of injury in the abdomen. The prevalence of lower limb injuries was higher than the upper limbs (Table 2).

Table 2
Distribution of injuries based on injury mechanism

variables	Accident	Falling down	Assault	penetrating	Attempt to suicide	Total N (%)
Skull fracture	284 (24.7)	44 (19.3)	3 (15.79)	6 (25)	1 (33.33)	338 (23.74)
Contusion brain	173 (15.04)	44 (19.3)	2 (10.53)	1 (4.17)	0	220 (15.45)
Scalp injury	146 (12.7)	24 (10.53)	6 (31.58)	8 (33.33)	0	184 (12.92)
subdural hematoma	121 (10.52)	41 (17.98)	2 (10.53)	1 (4.17)	1 (33.33)	166 (11.66)
Pneumocephalus	119 (10.35)	19 (8.33)	2 (10.53)	2 (8.33)	0	142 (9.97)
Intracerebral hemorrhage	84 (7.3)	21 (9.21)	1 (5.26)	3 (12.5)	1 (3.33)	110 (7.72)
Subarachnoid hemorrhage	88 (7.65)	10 (4.39)	0	2 (8.33)	0	100 (7.02)
Epidural hematoma	75 (6.52)	16 (7.02)	2 (10.53)	0	0	93 (6.53)
Intraventricular hemorrhage	46 (4.00)	6 (2.63)	1 (5.26)	1 (4.17)	0	54 (3.78)
brain swelling	14 (1.22)	3 (1.32)	0	0	0	17 (1.19)
Diffuse axonal injury	2 (0.39)	1 (2.27)	0	0	0	3 (0.52)
Neck injuries N (%)						
Injuries to the neck minor[1]	9 (90.00)	0	4 (66.66)	1 (10.00)	4 (80.00)	18 (58.06)
Injuries to the neck major[2]	1 (10.00)	0	1 (16.17)	7 (70.00)	1 (20.00)	10 (32.26)
Blood loss > 20% by volume	0	0	1 (16.17)	2 (20.00)	0	3 (9.68)
Face injuries N (%)						
Eye injury	148 (28.74)	11 (25)	0	2 (20)	0	161 (28.1)

1. Minor; superficial- abrasion-contusion; hematoma- laceration NFS

2. With tissue loss > 25cm2 or major;>10cm long and into subcutaneous tissue or avulsion; major; >25cm2

variables	Accident	Falling down	Assault	penetrating	Attempt to suicide	Total N (%)
Maxilla fracture	115 (22.33)	9 (20.45)	1	2 (20)	1 (33.33)	128 (22.34)
Zygomatic fracture	95 (18.45)	10 (22.73)	0	1 (10)	0	106 (18.5)
Nose fracture	82 (15.92)	5 (11.36)	0	0	2 (66.67)	89 (15.53)
Mandible fracture	65 (12.62)	7 (15.91)	0	4 (40)	0	76 (13.26)
Month fracture	7 (1.36)	1 (2.27)	0	1 (10)	0	9 (1.57)
Ear fracture	1 (0.19)	0	0	0	0	1 (0.17)
Thorax injuries N (%)						
Lung contusion	422 (42.62)	83 (48.26)	17 (25.76)	31 (27.93)	5 (33.33)	558 (43.29)
Rib fracture	206 (22.27)	39 (22.67)	5 (7.58)	4 (3.60)	0	254 (19.71)
Pneumothorax	131 (14.16)	20 (11.63)	19 (28.79)	24 (21.62)	2 (13.33)	196 (15.21)
Hemothorax	122 (13.19)	26 (15.12)	11 (16.67)	21 (18.92)	3 (20)	183 (14.2)
Mediastinal injury	23 (2.49)	2 (1.16)	5 (7.58)	2 (1.80)	0	32 (2.48)
Heart injury	5 (0.54)	1 (0.58)	0	2 (1.80)	2 (13.33)	10 (0.78)
Other thoracic injury	16 (1.73)	1 (0.58)	9 (13.64)	27 (24.32)	3 (20)	56 (4.34)
Abdomen injury N (%)						
Liver	48 (44.86)	11 (52.38)	2 (66.67)	0	0	61 (43.57)
Spleen	30 (28.04)	3 (14.29)	1 (33.33)	1 (11.11)	0	35 (25.00)
Kidney	21 (19.63)	3 (14.29)	0	1 (11.11)	0	25 (17.86)

1. Minor; superficial- abrasion-contusion; hematoma- laceration NFS

2. With tissue loss > 25cm2 or major;>10cm long and into subcutaneous tissue or avulsion; major; >25cm2

variables	Accident	Falling down	Assault	penetrating	Attempt to suicide	Total N (%)
Small & large Bowel	2 (1.87)	1 (4.76)	0	6 (66.67)	0	9 (6.43)
Bladder	5 (4.67)	0	0	1 (11.11)	0	6 (4.29)
Pancreas	1 (0.93)	3 (14.29)	0	0	0	4 (2.86)
extremity injury						
Lower extremity	235 (56.22)	31 (50.82)	1 (100.00)	3(33.33)	3 (66.67)	273 (55.38)
Upper extremity	183 (43.78)	30 (49.18)	0	6 (66.67)	1 (25.00)	220 (44.62)
Pelvic fracture N (%)	154	28	0	2	2	186 (100)
Spine injury						
Thoracic	79 (38.16)	21 (39.62)	3 (75.00)	2 (50.00)	0	105 (39.03)
Cervical	64 (30.92)	11 (20.75)	0	1 (25.00)	0	76 (28.25)
Lumbar	64 (30.92)	21 (39.62)	1 (25.00)	1 (25.00)	1 (100)	88 (32.71)
1. Minor; superficial- abrasion-contusion; hematoma- laceration NFS						
2. With tissue loss > 25cm2 or major;>10cm long and into subcutaneous tissue or avulsion; major; >25cm2						

Table 3 shows the predictors of death in trauma patients who admitted to the resuscitation unit. According to the results of logistic regression by backward method, age, gender, head, abdomen and limb injuries, severity of injury, and nosocomial infection were among the factors affecting the death of trauma patients in the resuscitation unit.

Table 3
logistic regression for predictors of mortality among patients

Variables	*Odds ratio*	p-value	95% CI[a] for *RR*	
			Lower	upper
Age				
45–64 to under 45	3.80	< 0.001	1.69	8.56
65 and more to under 45	5.56	< 0.001	2.47	12.51
Gender				
Male to female	2.7	0.02	1.15	6.34
Head & neck injury	2.64	0.01	1.28	3.42
Face injury	0.56	0.28	0.19	1.61
Thorax injury	0.76	0.45	0.37	1.55
Abdomen injury	1.55	0.03	1.03	2.98
Extremities injury	1.49	0.04	1.31	1.98
External injury	1.32	0.75	0.64	2.72
Injury severity score (1–3)				
4–8	4.40	0.03	1.11	17.40
9–15	7.60	0.002	2.03	27.72
16–24	18.73	< 0.001	4.52	37.57
25 and more	21.60	< 0.001	4.85	44.88
Infection	1.80	0.04	1.06	3.12

According to the findings with increasing age, death in traumatic events were increased. The mortality rate in patients aged 64 – 45 years and also 65 years and older was 3.80 and 5.56 times higher than the patients under 45 years. The mortality rate was 2.7% higher in men than in women, and having head, abdomen, and limb injuries significantly increased mortality. Head injury increased the chance of death by 2.64 times, and abdominal injury increased the chance of death by 1.55 times; limb injury led to a 1.49% increase in death. In addition, the ISS was directly related to the death of trauma patients. The mortality rate in patients with a score of 4–8, 9–15, 16–24, and above 25 was 4.40, 7.60, 18.73, and 21.60 times higher than that the patients with an injury severity index of less than three. Infection increased the chance of death in patients by 1.81%.

Figure 1 shows the distribution of multiple injuries in trauma patients. According to the findings, head and neck injuries were associated with chest injuries. It can also be said that facial injuries were associated

with head injuries, and limb injuries were associated with abdominal injuries. According to the results and in general, chest injury occurred simultaneously with other injuries in patients.

Figure 2 shows the distribution of damage by injury mechanism. According to the findings, the most common places of injuries in accidents and falls were the head and neck. In injuries related to beatings, penetrating injuries and suicide attempts were the most affected area which was related to the chest.

According to the findings of Fig. 3, the injuries pattern has been significantly different in traffic accident patients, therefore, the most injuries among the injured drivers and passengers were in the chest area. Among the injured with motor vehicles, the most injuries were related to the head and neck area, and among pedestrians were in the limbs and chest area.

Discussion

In this study, the exact location of the injury was recorded based on a detailed study of the physician's reports of repeated examinations and surgery reports, radiological photographs, and computed tomography (CT) scans of patients after the end of the treatment period in the hospital.

In this study, the most common sites of injuries were related to the chest and then the head and neck, which is different from other studies in which the limbs, head, and neck were among the most common sites of injury (13–14–15). In 2017, a similar study was performed at the same center on all patients with randomized selection. In this study, similar to previous studies in other countries, limbs, head, and neck were among the most common sites of injury in trauma patients (16). Therefore, the reason for the difference may be due to the conditions of patients entering the study, therefore, only patients with immediate lifesaving intervention were included in this study. Similar to the previous studies (17–20), traffic accidents were the most common cause of injuries in our study.

In the present study, the mean length of patients' hospital stay was longer than the length of hospital stays in other studies (21). The length of hospital stay can be considered as a measure of the severity and morbidity of the disease and as a result, the burden of the society's disease and the reason for the increase in the hospital stay length may be due to the severity of injury in patients and the surgery need, although this time was shorter than the time mentioned in the study conducted in Turkey (19).

Mortality in this study was 13.45%, which is much higher than the rate mentioned in some studies (21). Of course, there are also studies with a higher mortality rate (19). The highest distribution of injuries in hospitalized patients was related to abdominal, head, and neck injuries. However, head and neck involvement in this study was less than other studies (19–22). In this study, the highest chance of death was age over 65 years based on multivariate logistic regression analysis, men gender, head and neck injury, abdomen, limbs, nosocomial infection, and high injury severity. Other studies have found more or less similar results (19–23). These results are consistent with a previous study conducted in the same hospital with census sampling method on all patients (whether hospitalized with or without immediate lifesaving intervention) (18).

Most patients with multiple trauma also had chest injuries at the same time. Thoracic injury is one of the most common body regions of missed injuries (12), therefore, it is necessary to pay attention to paraclinical testing, contrast-enhanced CT scans in patients with the evidence of chest injury. This result is completely consistent with a study conducted in Taiwan with the highest late diagnosis in trauma patients with chest injuries (14, 24). In this study, abdominal injury was one of the least common injuries in multiple trauma patients (18%), which is similar to a previous study (25).

Similar to other studies, among abdominal injuries, liver injury followed by spleen and kidney injuries were the most common abdominal injuries (25–27). The most common chest injuries were lung contusion followed by pneumothorax rib fracture and hemothorax. The lung contusion percentage in this study was higher than the British report (20) but was similar to Turkey (19). Similar to other studies, the most common sites of facial injury were eye followed by maxilla and zygmatic (28–30). However, in the previous study, the most common sites of facial injury was somewhat different (31). The prevalence of skull fractures was one of the most traumatic sites of head injury, which is similar to another study (32). A high frequency of skull fractures was expected because traffic accidents are the most common type of injury in these patients and most of them have been injured in motorcycle accidents, therefore, it is because of using the low helmet prevalence among motorcyclists in Iran (16, 33).

The most common cause of chest injury was car accidents. This result is similar to the previous studies conducted in the same trauma center (34) and Turkey (19); however, in the British study, the majority of patients were pedestrians (20). The most common cause of limb damage was due to the pedestrian accidents, which is consistent with the previous study on pedestrian accidents (35).

Head and neck injuries were significantly more common in patients due to falls from heights. In a previous study (36) and in addition to the head and neck, injuries were highly prevalent in the limbs. In that study, most patients did not need resuscitation and showed low severity of injury. Considering the high prevalence of chest injuries in patients with injuries related to beatings, penetrating injuries and suicide attempts, the need for attention, accuracy in examination, and paraclinical examinations in these patients increases. Similarly, these considerations are equally important in traffic accidents and falls from heights.

Accuracy in data collection, investigation of injury distribution by re-reading radiographs and patient records, high number of patients and review of the study in an entire one-year period are some of the significant points of this study; however, there were some limitations. For example, in this study, patients who died at the accident scene and autopsies were not examined. A study with forensic and autopsy reports is recommended due to the lack of accurate assessment of patients who died of arriving to the hospital and lack of sufficient information about the exact injury location in these patients. In other research, it is necessary to investigate the extent of missing injuries and their causes.

Conclusion

This study showed a higher prevalence of multiple injuries than single injuries. This study showed that careful examination and patients' follow-up referred to the trauma center while entering the resuscitation unit is very necessary. Accurate paraclinical tests are required to prevent missing and subsequent injuries as well as patient's mortality and morbidity. Among the injury sites, it is more important to pay attention to the chest and head injuries. Therefore, preparing a checklist may reduce the number of missing injuries in the diagnosis stage. The pattern of injuries in the body can vary depending on their causes. Therefore, as soon as the patient enters the hospital, taking the patient's history during a thorough examination and paraclinical tests such as ultrasound and CT scan reduces the mortality and morbidity of patients.

Abbreviations

ISS**:** Injury severity score; GCS: Glasgow coma scale; CT: computed tomography

Declarations

Ethics approval and consent to participate

This project has been approved by the research ethic committee of Shiraz University of Medical Sciences with number IR.SUMS.REC.1397.846

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

None

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Authors' contributions

MY gathered data, analyzed, wrote draft and approved final manuscript.

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Figures

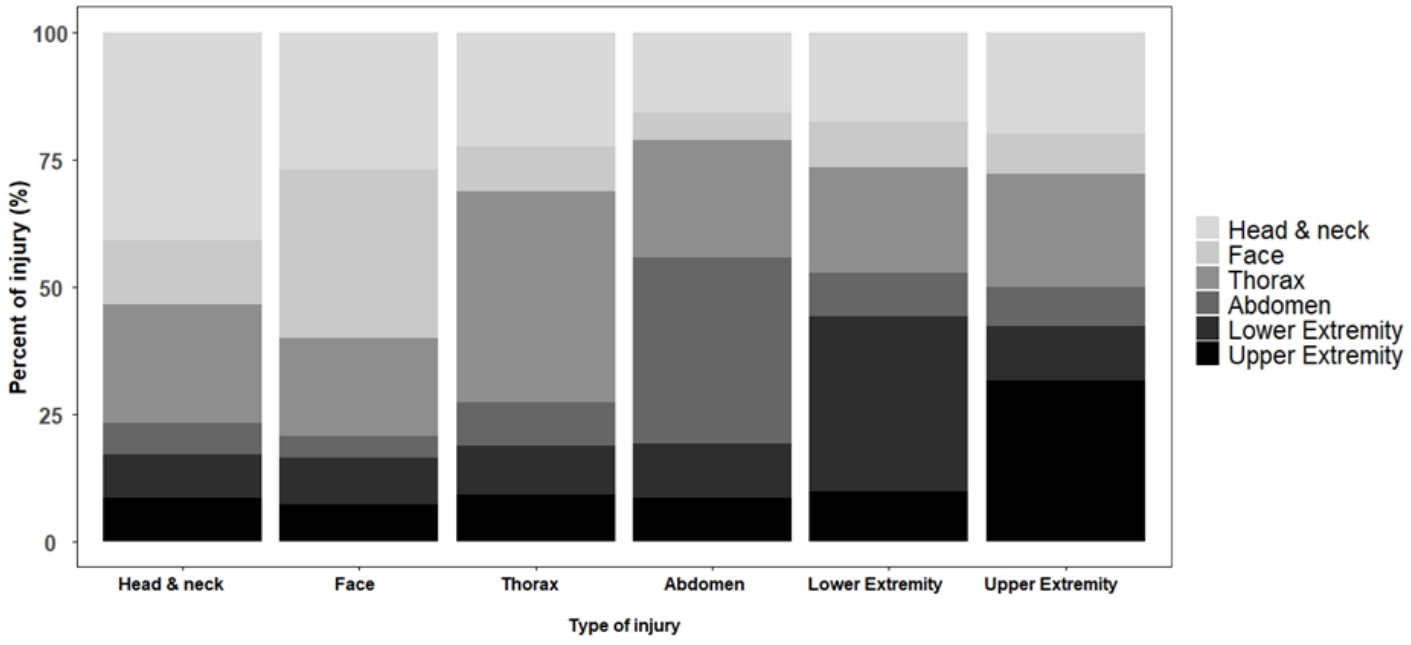

Figure 1

Distribution of multiple injuries in trauma patients

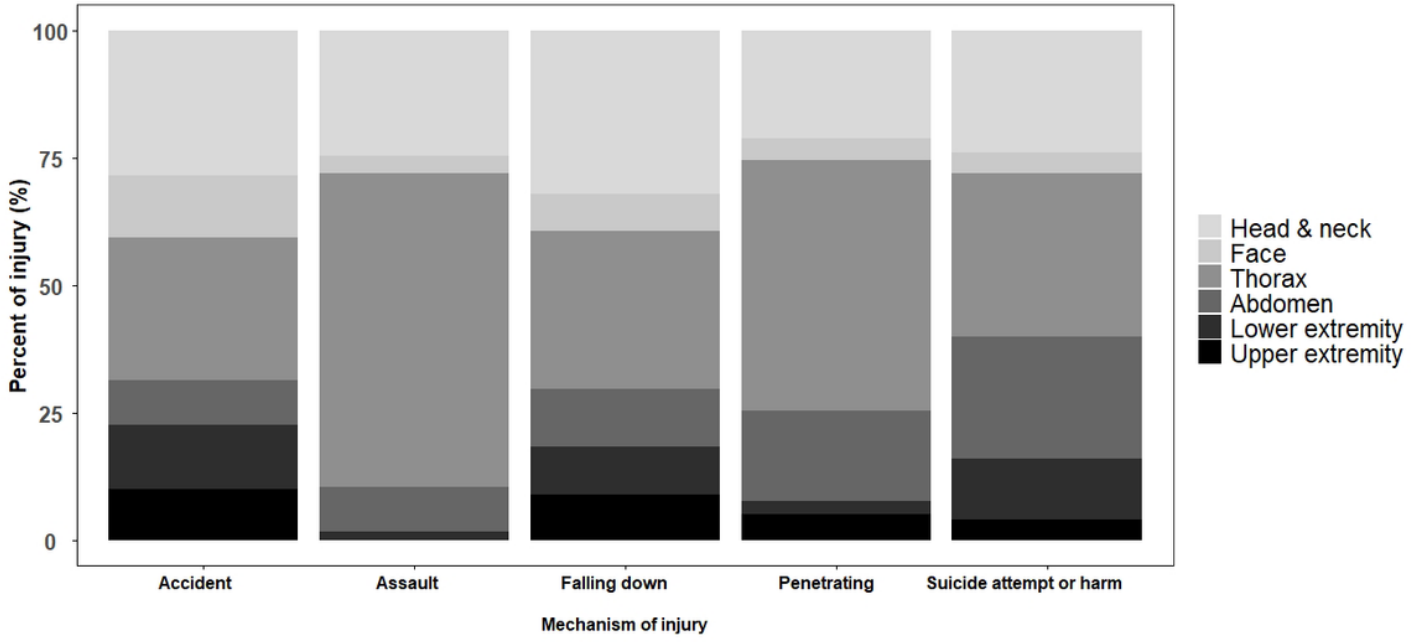

Figure 2

Type of injuries frequency stratified by mechanism of injuries

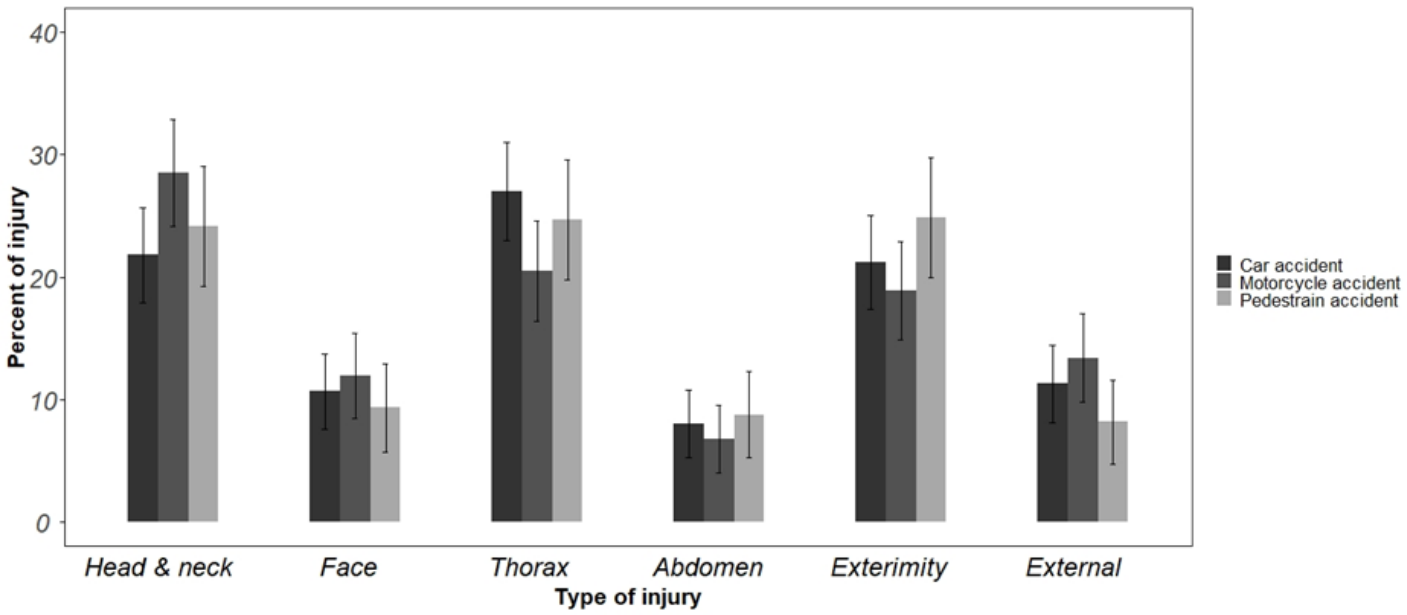

Figure 3

Type of injuries frequency stratified by mechanism of accident