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Characteristics of Injury Patients in the Emergency Department in Shanghai, China: A Retrospective Observational Study

Authors' Contribution:
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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Background: This study analyzed the epidemiological characteristics and trends of trauma injuries in Ruijin Hospital North, Shanghai, China, and the feasibility of methods to prevent trauma.

Material/Methods: In this retrospective cross-sectional study, the electronic databases of Ruijin Hospital North were searched for patients who experienced severe trauma from 2013 to 2016. Characteristics of severe trauma were analyzed, including trauma mechanism, gender, reasons for injury, and injury-associated causes of death.

Results: Of the 17,093 patients who experienced trauma during the study period, 11,165 (65.3%) were male and 5,928 (34.7%) were female. Analysis by age showed that the highest incidence of traumatic injuries was in subjects aged 25–34 years, whereas analysis by occupation showed the highest incidence of injury in migrant workers without higher education. Classification by Injury Severity Score (ISS) showed that 12,563 (73.5%) subjects had minor injuries, 4,273 (25.0%) had serious injuries, and 256 (1.5%) had severe injuries. In addition, 256 (1.5%) subjects died, with traffic accidents and falling injuries being the main causes of death. The incidence of injury peaked at 9–11 am and 2–4 pm and was significantly higher in autumn and winter than in spring and summer.

Conclusions: Most trauma patients were young adults. Injuries due to traffic accidents and falling were the main causes of death, with disregard of driving regulations and other health and safety regulations being the main cause of trauma. Trauma injuries may be prevented by strengthening education and by obeying traffic laws and construction site safety regulations.

MeSH Keywords: **Emergency Service, Hospital • Epidemiology • Multiple Trauma**

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Background

Traumatic injuries are the third leading cause of death among all age groups, with rates of mortality and disability being exceptionally high, especially among children and young adults [1]. Estimates indicate that 5,800,000 people die from traumatic injuries annually, accounting for more than 10% of deaths worldwide [2]. The economic cost of global traumatic injuries is high, with 90% of the cost borne by lower-middle-income countries (LMICs) [3]. Moreover, the incidence of traumatic injuries in LMICs has markedly increased in recent years [4,5]. Traumatic injuries have a serious negative impact on the lives of patients and their families, as well as on health-care systems [6,7].

Efforts are being made in developed countries to reduce trauma injuries, including their associated morbidity and mortality. Despite their effectiveness in developed countries, these methods are rarely applied in developing countries due to the lack of financial support, infrastructure and human resources [8,9]. The rapid urbanization and motorization in China have significantly increased the rates of injury and injury related deaths. Little is known, however, about the epidemiology of local traumatic injuries in China.

Ruijin Hospital North is a new suburban hospital located in the northwest part of Shanghai, China, at the intersection between urban and rural areas, and adjacent to Jiangsu province. The incidence of accidental injuries at local construction sites has increased in recent years and may be higher in the future. Relevant departments have not introduced interventions to prevent these injuries. Of the 10,000 people treated each year in the Emergency Department of Ruijin Hospital North, about one-third were patients who experienced trauma.

Epidemiological information about traumatic injuries can be obtained by tracking patients using the laboratory information management system (LIS). This study analyzed the epidemiological characteristics and trends of trauma injuries of patients treated at Ruijin Hospital North, and investigated the feasibility of methods to prevent trauma.

Material and Methods

Patients

Ruijin Hospital North is a new suburban hospital in Shanghai, China, with an Emergency Department that operates 24 hours a day. Information on patients who experienced traumatic injuries from January 2013 to January 2016 was retrieved from the LIS of the hospital. Keywords used for searching included injury, acute pain, falls, and traffic accidents.

Injury patients were classified based on their history of injury, clinical symptoms and results of imaging examinations. Details on all patients were recorded by experienced Emergency Department physicians and surgeons. The accuracy and completeness of all included patient records were checked. Patients lacking complete medical records or with unknown outcomes were excluded.

Data collection

Collected information included patient age, gender, cost of treatment, and times of admission to and discharge from the Emergency Department. All enrolled patients were divided into seven age groups, aged 14–24, 25–34, 35–44, 45–54, 55–64, 64–75, and >75 years. The injury severity score (ISS) and Abbreviated Injury Scale (AIS) were determined for each patient [10,11]. The AIS includes nine regions of the body, whereas the ISS classifies the severity of injury into three categories, with ≤ 15 points indicating minor injury, 16–25 points indicating serious injury, and ≥ 26 points indicating severe injury [11,12].

Statistical analysis

The chi-squared test was used for comparisons between two groups, whereas ANOVA was used for comparisons among three or more groups. All results include 95% confidence intervals (CIs). All statistical analyses were performed using SPSS software (version 16.0), with $P < 0.05$ considered statistically significant.

Results

Characteristics of included patients

During the study period, from January 2013 to January 2016, the total number of visits to the Emergency Department visits was 46,084. During this period, 17,093 patients were treated for traumatic injury in the Emergency Room at Ruijin Hospital North. These 17,093 patients included 11,165 males (65.3%) and 5,928 females (34.7%), with a male-to-female ratio of 1.7 ($P < 0.05$). Of these 17,093 patients, 12,633 (73.9%) were migrant workers and 4,460 (26.09%) were residents. Moreover, 13,674 (80.1%) had a high-school degree or less, whereas 3,419 (19.9%) had at least a university education (Table 1).

Degree of injury and causes of death

Of the 17,093 patients, 12,563 (73.5%) had minor injuries, 4,273 (25.0%) had serious injuries and 256 (1.5%) had severe injuries. Of the 4,529 patients with serious and severe injury, 1,179 (32.7%) died. Causes of death included traffic accident

Table 1. Characteristics of Ruijin Hospital North Emergency Department visits.

Variable	Sample size (%)	Emergency surgery visits (%)	Rate per 10,000 (%)	P
Gender				0.040
Male	11165 (65.3)	24.23	1.11	
Female	5928 (34.7)	12.86	0.59	
Source				<0.001
Local residents	4460 (26.09)	9.68		
Foreign personnel	12633 (73.90)	27.41		
Degree of education				<0.001
High school and below	13674 (80.52)	29.67		
University or above	3419 (20.00)	7.42		

Table 2. Degree of injury and the cause of death.

Variables	Injured patients (n, %)	Emergency surgery visits (%)	P
Degree			0.04
Minor injury	12563 (73.50)	27.26	
Serious injury	4273 (25.0)	9.27	
Severe injury	256 (1.50)	0.56	<0.001
Death	1179 (6.90)	2.56	
Causes			<0.001
Traffic accident	681 (3.98)	1.48	
Fall injury	404 (2.36)	0.88	
Others	94 (0.55)	0.20	

in 681 (3.98%), falling in 404 (2.36%) and other reasons in 94 (0.55%) (Table 2).

Figure 1 shows the age distribution of trauma injury presentation by gender. The rate of injury was highest in those aged 25–34 years, remaining high in those aged 35–54 years, and decreased in subjects aged 55–64 and >65 years. The ratio of males to females was about 2 in patients aged 14–54 years, declining in those aged >55 years.

Injured anatomical region and injury type

Table 3 details the anatomical regions of traumatic injury. The rate of lower extremity injury was the highest in these patients (n=4,454, 26.1%), accounting for 9.7% of all Emergency Room visits. Table 4 shows that the incidence of contusion/abrasion was highest among trauma injured patients (n=11,672, 68.3%), with 4,319 (25.3%) having fractures, but only six (0.04%) having pneumothorax.

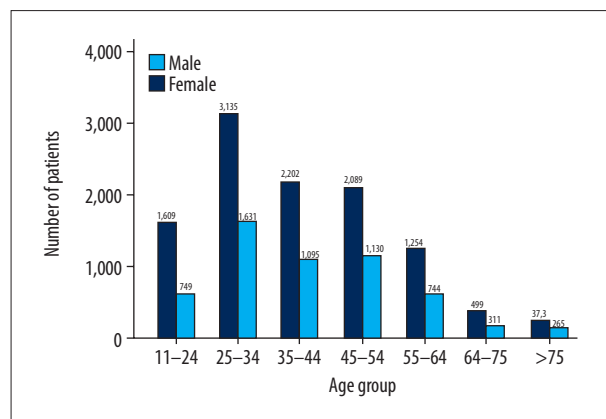


Figure 1. Distribution of trauma injury at different ages.

Table 3. Comparison of injured anatomical regions of trauma patients.

Region	Number of patients (%)	Emergency surgery visits (%)	Rate per 10,000 (%)	P
				0.030
Head/face/neck	4650 (27.2%)	10.09	0.045	
Chest/back	863 (5.0%)	1.87	0.09	
Abdomen/loin	597 (3.5%)	1.26	0.06	
Upper extremity	3680 (21.5%)	7.99	0.37	
Lower extremity	4454 (26.06%)	9.66	0.55	
Spine	230 (1.3%)	0.50	0.02	
Two anatomical regions	1323 (7.7%)	2.87	0.00	
Three anatomical regions	296 (1.7%)	0.64	0.03	

Table 4. Comparison of injury type of trauma patients.

Region	Number of patients (%)	Emergency surgery visits (%)	Rate per 10,000 (%)	P
				<0.001
Contusion/abrasion	11672 (68.3%)	25.38	116.72	
Foreign body	75 (0.4%)	0.16	0.75	
Hemorrhage	160 (0.9%)	0.35	1.6	
Laceration	64 (0.4)	0.14	0.64	
Hematoma	445 (2.6%)	0.97	4.45	
Fracture	4319 (25.3%)	9.37	43.19	
Strain	197 (1.2%)	0.43	1.97	
Dislocation	155 (0.9%)	0.34	1.55	
Pneumothorax	6 (0%)	0	0	

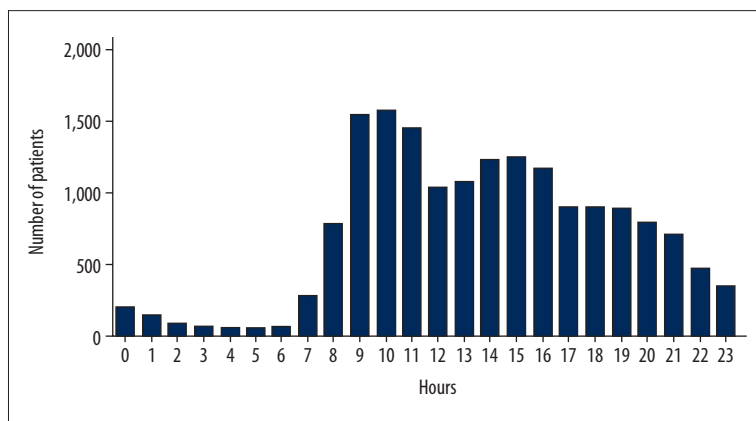


Figure 2. Hourly distribution of trauma injury during the day.

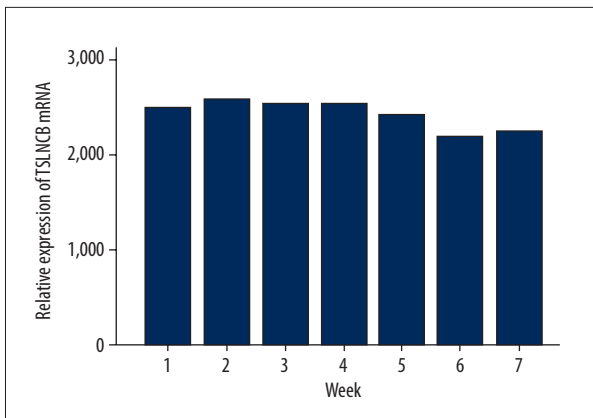


Figure 3. Daily distribution of trauma injury during the week.

Diurnal distribution of trauma injury

Figure 2 shows the distribution of trauma injury over 24 hours. Two peaks were observed, the first and highest peak at 9–11 am and the second at 2–4 pm, with a slight decrease at noon. After 5 pm, the incidence of injury began to decrease, with minimum incidence at 12–6 am. There were no obvious intra-week differences in the incidence of injury, although the rate was slightly lower on Saturday than on other days (Figure 3). The month-by-month incidence of injury is shown in Figure 4. The number and rate of injury increased from year to year, although the number of injuries was lower in February of all three years. The incidence of injury was significantly higher during the autumn and winter than during the spring and summer.

Discussion

To our knowledge, the present study is the first to analyze the epidemiological characteristics of traumatic injury on a local level. This study included 17,093 patients, 11,165 males and 5,928 females, who presented to the Emergency Room at Ruijin

Hospital North in Shanghai, China, over a three-year period. In agreement with previous findings, this study found that injury rates were higher in males than in females, and that the most frequent types of injuries were contusions and abrasions [13]. The higher incidence of trauma injuries in males may be due to the predominance of males in physically demanding and hazardous jobs [14], including those in construction and manufacturing industries, and as drivers [15]. Because men are more vulnerable to trauma, they require a supportive environment during working activities to avoid injury. These include enhancing safety measures at construction sites and providing protective equipment [16,17].

Age has been found to affect the distribution of injury [18], as individuals aged 25–54 years were at higher risk of injury than older and younger persons. Interestingly, the incidence of fall-related injuries was reported highest among middle-aged adults aged 45–64 years and older women aged ≥ 65 years [19], whereas the general incidence of injury was highest among subjects aged 25–34 years [20].

We also observed two daily time peaks of trauma injury, from 9–11 am and from 2–4 pm. The latter was somewhat surprising, as the mid-day break from 12–1:30 pm should reduce the incidence of tiredness as a cause of injury. Fatigue due to continuous high-intensity work may reduce an individual's ability to respond to dangerous situations, increasing traumatic events. A study from the United Arab Emirates reported that the occurrence of occupational injuries was low from 12:30–4:00 pm, possibly due to high outdoor temperatures during the afternoon [21]. Although we observed no significant statistical differences in the daily incidence of trauma, a study in Iraq reported that the highest incidence during the week was on Wednesday, likely because Wednesday is the last working day during the week [21].

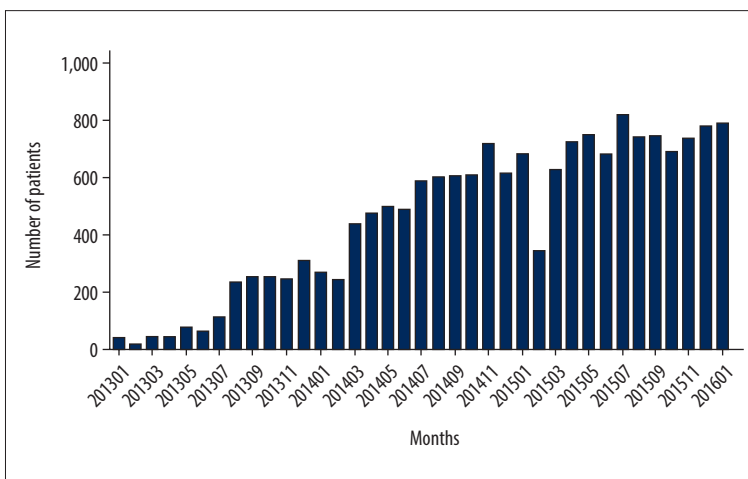


Figure 4. Monthly distribution of trauma injury during the year.

The incidence of injury during each of the three years of this study was significantly higher during the autumn and winter than during the spring and summer. The higher incidence of falls and traffic injuries during the autumn and winter may be due to the wet and cold weather in Shanghai during those seasons, consistent with results in Canada [22]. We also found that the incidence of injury was lower in February than in other months, perhaps because the lunar New Year occurs in late January to early February; during that time, people are on vacation, reducing the likelihood of injury.

Most severe injuries and deaths due to trauma were caused by transportation injuries and falls at construction sites, with road traffic accidents being the primary cause of severe injuries and deaths. Risk factors associated with road traffic deaths include increased numbers of traffic accidents due to rapid urbanization and motorization throughout China; drivers' lack of awareness and knowledge of safety measures [23,24]; and poor awareness of safety regarding the risk of accidents to pedestrians, especially elderly pedestrians.

Fall was the most cause of injury at construction sites. The construction industry is regarded as quite hazardous [25]. Most construction workers treated at Ruijin Hospital North were not residents of Shanghai; moreover, they had a low degree of education, lacked consciousness of safety measures and had insufficient self-protection. Illegal activities and labor intensity during work also likely enhanced the incidence of fall injuries, as did poor working environments and a lack of effective security measures.

To our knowledge, the present study is the first to assess the epidemiological characteristics of injury in Shanghai, providing

theoretical data on trauma in other geographic areas. However, this study had several limitations, including its retrospective design, preventing classification of patients according to the mechanisms responsible for traumatic injuries, the duration of hospital stay, and costs. This study also did not assess long-term outcomes in patients with injuries. In addition, the low death rate among injured patients may be due in part to patients dying before arriving at the hospital. Also, family members may cease treatment after the cessation of spontaneous breathing and heartbeat, and the ISS scale used in this study could not reflect injuries to multiple organs in the chest and abdomen.

Conclusions

This study demonstrated that trauma was a particular cause of injury in young adults and migrant workers with a low degree of education. Traffic accidents and falling were the main causes of trauma-associated death, and were in turn due to disregard of driving regulations and health and safety regulations. Measures to strengthen education about obeying traffic laws and construction site safety regulations may reduce or prevent trauma.

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Conflicts of interest

None.

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