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Traumatic Brain Injuries Caused By Fatal Pedestrian-Vehicle Accidents in Southwest China: An Epidemiological Survey of Five Years

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Abstract. In-depth investigations of fatal pedestrian-vehicle accidents provide valuable data for implementing effective emergency services to reduce the pedestrian injury related mortality and strengthening legal measures in peak hours of fatal accidents. We aimed to study, patterns of injuries especially fatal traumatic brain injuries occurring in pedestrian-vehicle accidents. Postmortem reports or clinical records of victims and accident circumstance of road traffic accident were studied and analyzed retrospectively during the period of 2013-2017. Out of total 989 pedestrian-vehicle cases collected during the study period, 678 (68.55%) were of fatal vehicular accidents. The male/female ratio was 1.58:1. Commonest age group affected was between 51-80 years old involving 337 (63.23%) cases. Prehospital mortality was in 371 (56.64%) cases. Fatal traumatic brain injuries were seen in 348 (87.88%) cases. Skull fractures were found in 377 (55.60%) cases of head injury and commonest bone fractured was temporal bone (n=123, 32.63%). The commonest variety of intracranial hemorrhage was subarachnoid hemorrhage (n=87, 69.05%). October month took maximum toll of deaths (n=82, 12.09%) of total accident fatalities in five years duration. 45.19% of fatal accidents occurred at 6-8 AM and 7-9 PM. The results of study emphasize the need to improve the prehospital care with provision of trauma services at site and to enhance the propagation of traffic safety awareness for the elderly.

INTRODUCTION

Road traffic accidents (RTAs) have been identified by leading public health organizations as a major concern. In its report, WHO estimated that 1.2 million people are killed and another 50 million are injured in road crashes each year. As a developing country with rapid increase in car ownership, China is believed to account for about 18% of road accident fatalities worldwide [1]. Among the traffic accident participants, pedestrian is the groups that suffer the worst damage [2] and the majority of fatalities was caused by the head impacts [3, 4]. Thus, there is a compelling need for prevention, treatment and rehabilitation initiatives informed by population-based data.

To our best knowledge, statistics on head injury caused by traffic accidents are generally obtained from the hospital's database with epidemiological research methods, while the number of studies dealing with TBI as a consequence of RTA in China is limited. And with continuous growth in number of motor vehicles, increase in population and access to health care, whether the characteristics of RTAs has changed from decades ago is still unknown. The objective of the present article is to provide an overview of the characteristics and the severity of TBI caused by pedestrian-vehicle in southwest China and to discuss some of the public health consequences of this burden.

MATERIAL AND METHODS

All the data in this paper came from the Chongqing Bayi Traffic Accident Judicial Appraisal Center. Based on traffic accident cases submitted to the Center from January 2013 to December 2017, only accidents that have clear

process of vehicle-pedestrian collision were included in this database. The data about the accidental circumstance was obtained from traffic police department’s report of determining the process of the accident. Using our database, basic data such as Weather, Vehicle type, Time, Road type, Road state, Gender, Age and Velocity were recorded. Meanwhile, the data about injury of the pedestrian involved was collected from corresponding hospital medical records or forensic autopsy reports. All injury data such as Bony fractures and Parenchyma injury, intracranial haemorrhage of head were recorded. If the person was dead, the time from the happening of accident to the death of the person and the main cause of the death were recorded, including the rescued invalid died at the hospital. The data were eventually checked and determined by a dedicated person.

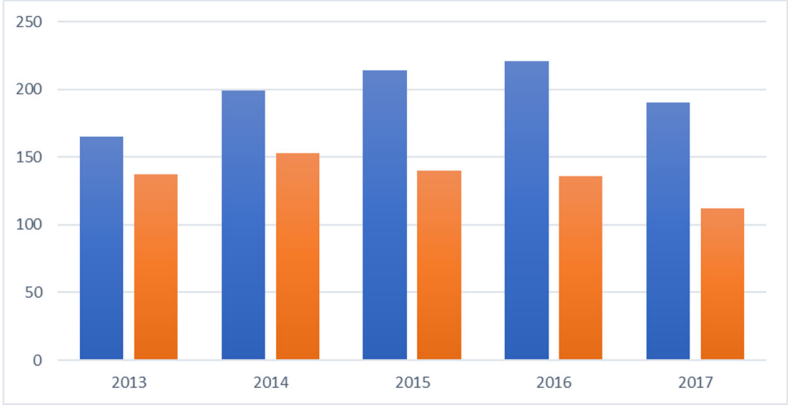


FIGURE 1. Yearly distribution of total pedestrian cases recorded (Blue bar) and fatal vehicular accidents (Orange bar).

OBSERVATIONS

Out of pedestrian accident cases collected during the study period, 678 (68.55%) were of vehicular accident fatalities (Fig. 1). Males comprised 61.22% of the total fatalities, while females accounted for 38.78% (Fig. 2). The age group between 61-70 years was the most vulnerable (n=136, 25.52%) of the total cases followed by the age group 71-80 years (n=105, 19.70%) and 51-60 years (n=96, 18.01%). Accordingly, the highest number of fatalities (63.23%) was in the 51-80 years age group. Children below 10 years comprised 3.75% of the total fatalities (Fig. 3). A large proportion of the victims (n=371, 56.64%) died on the spot while 21.07% (n=138) died within 2 hrs of the accident. On adding up these figures, 590 cases (90.08%) of the victims either died on the spot or within 24 hrs of the accident. Only a small portion of 36 cases (5.50%) survived for more than 3 days (Fig. 4).

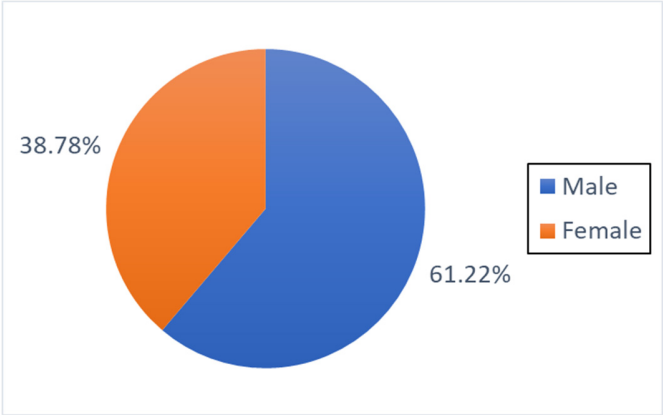


FIGURE 2. Sex distribution of cases of fatal vehicular accidents (2013-2017).

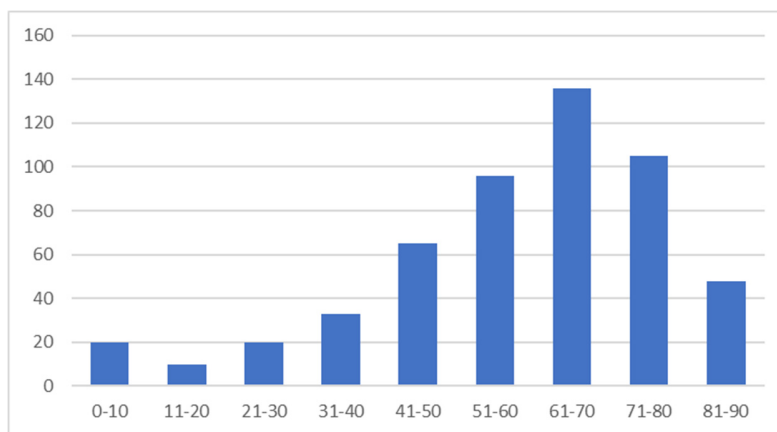


FIGURE 3. Age distribution of fatal vehicular accident victims (2013-2017)

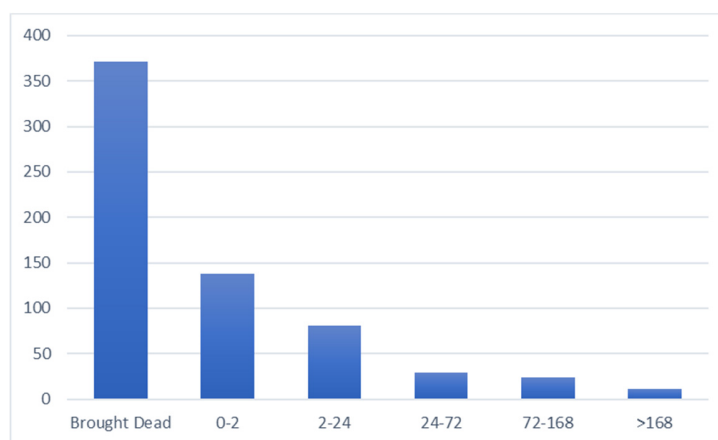


FIGURE 4. Survival time of fatal vehicular accidents (2013-2017)

Out of total number of 396 cases (58.41%) who sustained head injury, 220 cases (55.56%) sustained head injury without any significant injury to other parts of the body (Table 1). Skull fractures were found in 377 (55.60%) cases of head injury. The commonest bone involved was the temporal bone and parietal bone, both with 123 (32.63%), followed by base of skull (28.38%) and occipital bone (26.26%). The commonest variety of intracranial haemorrhage was subarachnoid (n=87, 69.05%) followed by subdural (n=75, 59.52%). Extradural haemorrhage was present in 14 cases (11.11%), as shown in Table 2.

TABLE 1. Death due to injury in fatal vehicular accidents (n=396)

Injury	No.	%
Head alone	220	55.56%
Head+other	128	32.32%
Other	48	12.12%

Ribs were the commonest bone to fracture (n=218, 57.37%) followed by long bones of lower limbs (n=114, 30.00%), upper limbs (n=99, 26.05%) and pelvic bone (n=67, 17.63%), as shown in Table 3. An effort was also made in the present study to find out any correlation between numbers of vehicular accident occurring on a particular month. Maximum number of deaths was observed in the month of October (n=82, 12.09%) followed by December (n=79, 11.65%). In the present study, peak time for fatal accidents (23.56 %) was 6 to 8 followed by 19 to 21 (21.63%) with 42.22% of fatal accidents occurring between 6 PM and 6 AM (Fig. 6).

TABLE 2. Types and categories of TBI in total fatal vehicular accident cases (n=377)

Injury category	No.	%
Brain stem injury	28	22.22%
Parenchyma injury		
Diffuse axonal injury	23	18.25%
Intracerebral hematoma	13	10.32%
Contusion and laceration	75	59.52%
Intracranial haemorrhage		
Subdural	75	59.52%
Subarachnoid	87	69.05%
Intracerebral	13	10.32%
Extradural	14	11.11%
Skull fracture		
Temporal	123	32.63%
Occipital	99	26.26%
Parietal	123	32.63%
Frontal	85	22.55%
Sphenoid	11	2.92%
Base of skull	107	28.38%

TABLE 3. Incidence of bony fractures (n=380) in fatal vehicular accident victims (2013-2017)

Bony injuries(fractures)	No.	%
Ribs	218	57.37%
Sternum	47	12.37%
Pelvis	67	17.63%
Facial bones	61	16.05%
Upper limbs	99	26.05%
Lower limbs	114	30.00%
Spine	45	11.84%

**FIGURE 5.** Monthly vehicular fatality in five years duration (2013-2017)

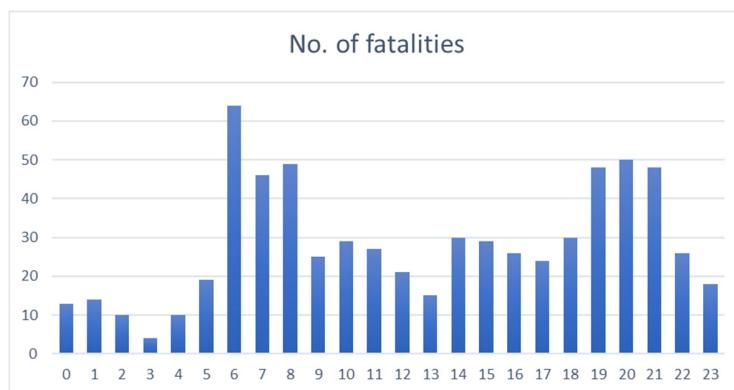


FIGURE 6. Daily vehicular fatality in five years duration (2013-2017)

DISCUSSION

In our present study total vehicular accident fatalities comprised 678 (68.55%) out of total 989 cases collected during five years (2013 to 2017). It is clear that the percentage of vehicular accident fatalities has been declining gradually during past five years. Not surprisingly our study shows the majority of the deceased (61.22%) were males. It is due to greater male exposure on urban streets and similar higher incidence of traffic accidents among males has been found by many other researchers [5, 6].

The commonest age group affected in the study was between 51-80 years (n=337, 63.23%), which is not consistent with the studies available about RTAs from India and other countries [7]. That is because when considering only pedestrians, older people respond more slowly than young people, have worse physical conditions, and have a weaker sense of traffic safety. They, therefore account for the maximum number of accidental deaths. These vehicular collision fatalities may have been a heavy burden to the whole society. Preventive measures targeting at these high-risk groups such as propaganda of traffic regulations are important to reduce the incidence of severe TBI.

Out of total 388 cases (57.23%) who sustained head injury, 297 cases (76.55%) had a fatal skull fracture. And most commonly found intracranial haemorrhage was subarachnoid haemorrhage (69.05%) which is consistent with the findings by other researchers [8]. Prehospital mortality was found to be in 371 cases (56.64%). The rest (43.36%) were taken to hospital where later they succumbed to their injuries. This is consistent with the study conducted in Iran [9].

Maximum number of fatal accident took place in October month (12.09%) with the peak time of 6-8 and 19-21 in present study. However in Nepal, maximum numbers of cases were reported in July followed by January [10]. National Crime Record Bureau has reported higher incidence of road accidents during May (10.3%) and March (9.3%) in India with the peak time between 3-6 PM. The two peak periods in this study are during the Chinese rush hours, and the surge of vehicles and pedestrian has made the favourable conditions for pedestrian-vehicle accidents, resulting in higher fatality.

The data for this article were obtained from an observational study which did not allow for random sampling. Thus, our results should be generalized with caution. The accident accidents took place mainly in Chongqing--a southwest city of China, which could not be considered sufficient to allow generalizing for the whole China region. Also as a consequence of the primary focus of the study (TBI), the sample used in this study only represents those RTA where the victims sustained a TBI. Therefore, any findings stated in this article only apply to this specific group of RTA. Despite its limitations, we believe that it presents useful and valuable information for the scientific and public health debate on this topic.

CONCLUSION

This study shows that most of the pedestrian deaths in road traffic accidents take place either on the spot or within 2 hours of injury which is very alarming and highlights the need for taking urgent steps for establishing good prehospital care and provision of trauma services at site in China. Our study also shows that head injuries remain the most common and serious type of trauma seen in emergency department and availability of good neurosurgical care is essential. A nationwide computerized trauma registry is urgent required to bring out the risk factors, circumstances,

chain of events leading to the accidents. And in order to reduce the mortality, the government still needs to put more effort in the propagation of traffic safety awareness for the elderly group.

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