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Profile of traumatic brain injury in Dr. R. Sosodoro Djatikoesoemo Hospital, Indonesia: A retrospective study

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ABSTRACT

Introduction: Traumatic brain injury (TBI) is defined as brain function alteration due to external force. It is often caused by motor vehicle injuries and falls. Though TBI severity assessment can be rapidly done through the Glasgow Coma Scale (GCS), head computed tomography (CT) scan provides more accuracy in showing ongoing brain pathology. The head CT scan is mandatory in moderate–severe TBI and selectively used in mild TBI. TBI poses a great risk to health, social, and economic burden. Understanding TBI epidemiology is needed to create effective prevention and reduction strategies. This study aimed to provide an overview of TBI cases in Dr. R. Sosodoro Djatikoesoemo Hospital at Bojonegoro, East Java, Indonesia.

Methods: A retrospective study with a total sampling method was conducted using TBI patient medical records at Dr. R. Sosodoro Djatikoesoemo Hospital from January 2020 to December 2022. Several variables were assessed in this study, including gender, age, mechanism of injury, and diagnosis based on head CT scan results. Descriptive analysis was used to process the data, then frequency tables and charts were presented.

Results: About 800 patients were admitted to Dr. R. Sosodoro Djatikoesoemo Hospital during the study period. Males (64.75%) and the age group of 11 – 20 years (24.75%) had the highest incidence of TBI. The most common mechanism was motorcycle-related injury, reaching up to 81.25% of all the cases. Normal head CT scan was found to be nearly half of the cases (48.88%).

Conclusion: Male, adolescence, motorcycle-related injury, and normal head CT scan findings were found in most TBI cases.

Keywords: Bojonegoro, epidemiology, Indonesia, traumatic brain injury.
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INTRODUCTION

Head injury is one of the most frequent types of trauma seen in the emergency department (ED).[1] Based on Indonesian Basic Health Research in 2018, head injury (including senses, face, and neck) constituted 11.9% of all types of injuries based on the affected body part.[2] Any kind of trauma forces such as rotational forces (e.g., angular acceleration or deceleration of the head), pressure waves, and blunt or penetrating injury on the head might cause alteration of the brain function. This condition is known as traumatic brain injury (TBI).[3] TBI contributed to around 2.53 million cases of ED admission. Approximately, 288,000 were hospitalized while 56,800 were dead. The common mechanism of TBI injury was found to be different depending on the age group. Motor vehicle collisions were the most common causes in productive age (15 – 44 years).[4] TBI poses a great burden on personal, family, and communities.[3]

Practically, head injuries can be divided based on injury severity and morphology. The severity of the injury is based on the Glasgow Coma Scale (GCS) which is classified as mild (13 – 15), moderate (9 – 12), and severe brain injury or coma (≤ 8). Based on its morphology, head injuries are classified into skull fractures and intracranial lesions. Furthermore, the intracranial lesion is constituted by diffuse brain injuries and focal brain injuries (epidural hematoma/ EDH, subdural hematoma/ SDH, contusion, and intracerebral hematoma/ ICH). By classifying based on severity, proper examination, and treatment could be done promptly. The use of a head CT scan in TBI is essential. However, must be done selectively according to the algorithm.[1]

Understanding the causes and risk factors of TBI requires a thorough understanding of the epidemiology of the condition. Only then effective injury prevention and reduction strategies could be created. However, TBI epidemiological studies are still limited and have not yet been conducted in East Java Province. Hence, this study determines to describe the characteristics of TBI in Dr. R. Sosodoro Djatikoesoemo Hospital from 2020 to 2022.

METHODS

This was a retrospective descriptive study based on medical records of TBI patients from January 2020 to December 2022 in Dr. R. Sosodoro Djatikoesoemo Hospital. The samples in this study were patients with TBI who were hospitalized from January 2020 to December 2022 and who underwent a head CT scan. The total sampling method was used in this study. The inclusion criteria were accessible and

complete medical records of TBI patients who undergo head CT scans. Head CT scan results were interpreted by certified radiologists. Data analysis was completed in the form of descriptive analysis consisting of gender, age, mode of injury, and diagnosis based on ICD-10 of TBI patients. Data processing was completed with Microsoft Excel 2019 and results were presented in tables and charts.

RESULTS

During the study period, 800 patients with TBI were admitted to the neurosurgery department. The demographic data can be seen in Table 1. More than half of the samples were male (n = 518; 64.75%). Subjects were then divided into age group categories, with a range of 10 years apart between each group. There were 68 subjects in 0 – 10 years (8.5%), 198 subjects in 11 – 20 years (24.75%), 117 subjects in 21 – 30 years (14.63%), 87 subjects in 31 – 40 years (10.88%), 104 subjects in 41 – 50 year (13%), 110 subjects in 51 – 60 year (13.75%), 73 subjects in 61 – 70 year (9.13%), and 43 subjects in 71 – 80 year (5.38%) (Figure 1). Based on the mode of injury, most were caused by motorcycle-related injury (n = 650; 81.25%) and followed by falls. Figure 2 presented the distribution based on the mode of injury in this study. Subject diagnoses were classified using ICD-10 codes S06, ranging from S06.0 – S06.A. However, not every ICD-10 code was found in this study. Nevertheless, normal head CT scan results were found in almost half of the cases (48.88%) as seen in Table 2 and Figure 3.

Table 1. Demographic data of head injury patients at Dr. R. Sosodoro Djatikoesoemo Hospital in 2020 – 2022

Variable	Characteristic	n	Percentage (%)
Gender	Male	518	64.75
	Female	282	35.25
Age (years)	0 – 10	68	8.50
	11 – 20	198	24.75
	21 – 30	117	14.63
	31 – 40	87	10.88
	41 – 50	104	13.00
	51 – 60	110	13.75
	61 – 70	73	9.13
	71 – 80	43	5.38
Mode of injury	Motorcycle-related	650	81.25
	Falls	124	15.50
	Other	26	3.25

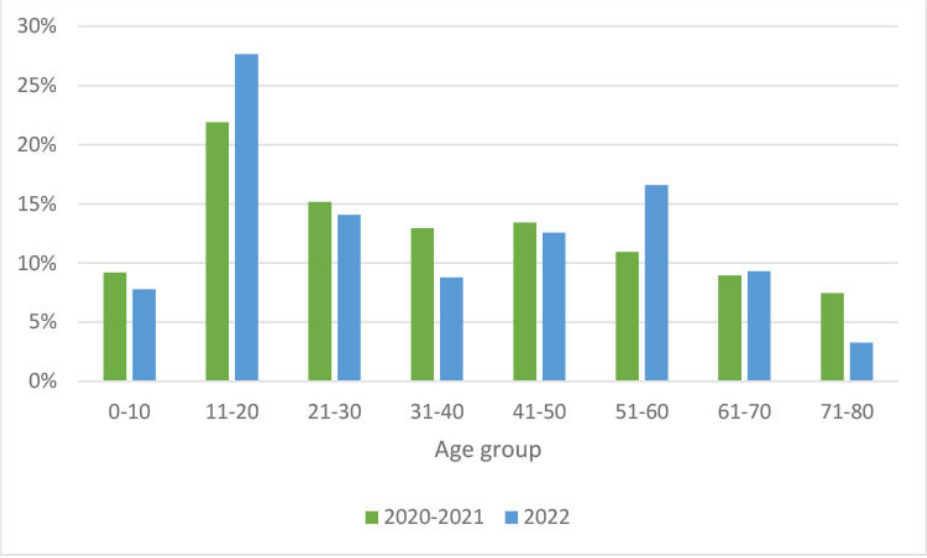

Figure 1. Distribution of traumatic brain injury age group based on years of the incident.

DISCUSSION

In 2019, the Centers for Disease Control (CDC) estimated the economic burden of injury had a $4.2 trillion economic cost, which included $327 billion in medical expenses, $69 billion in lost wages, and $3.8 trillion in losses to statistical life and quality of life in the United States.[5] Though CDC data did not specifically mention head trauma, the cost burden of TBI is proven high based on other studies. It is related to its short-term treatment, such as inpatient care, to long-term treatment, for example, rehabilitation. Other than the economic burden, TBI also imposed an immense burden on individuals, families, as well as communities.[3] Noticing the importance of better documentation of TBI incidence, this study presented the descriptive data of TBI in Dr. R. Sosodoro Djatikoesoemo Hospital. In this study, TBI cases mostly occurred in males, the age group of 11 – 20 years, with motorcycle-related injuries, and normal head CT scan findings. Male predominance in TBI cases had been shown in previous studies in other regions of Indonesia, including Bali, Lombok, and North Sumatra.[6-8] Higher risk in males is related to occupational risk.[8] Productive age males are more prone to head injury due to more exposure to vehicle operation and working from height.[7] In the pediatric population, boys are more likely to develop TBI than girls because they are less likely to wear safety equipment, more likely to fall from greater heights, more likely to be assaulted, and more likely to sustain additional injuries.[9]

In this study, the most common TBI cases were reported to be in the 11 – 20 year age group (24.75%), which is similar to findings at Makassar and Surabaya.[10,11] Around 8% of TBI-related hospitalizations and about 4.5% of TBI-related deaths in 2016 and 2017 were caused by children and teenagers under the age of 18 in the United States.[3] In adolescents, defined as 10 – 19 years old by the World Health Organization (WHO), TBI is often found in bicycle and motorcycle-related accidents as well as sport-related head injuries.[12,13] This included single accidents, motor vehicle collisions, bicycle falls,

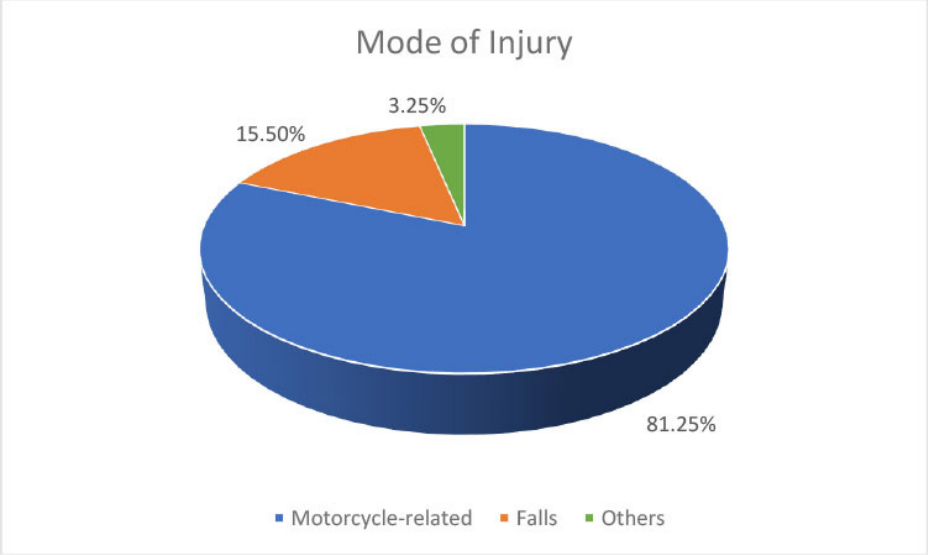

Figure 2. Distribution of mode of injury.

Table 2. Type of traumatic brain injury in Dr. R. Sosodoro Djatikoesoemo Hospital in 2020 – 2022

Diagnosis	n	Percentage (%)
Commotio cerebri	4	0.50
Traumatic cerebral edema	50	6.25
Diffuse brain injury	101	12.63
Intracerebral hemorrhage	9	1.13
Epidural hemorrhage	112	14.00
Subdural hemorrhage	71	8.88
Subarachnoid hemorrhage	62	7.75
Normal head CT scan	391	48.88

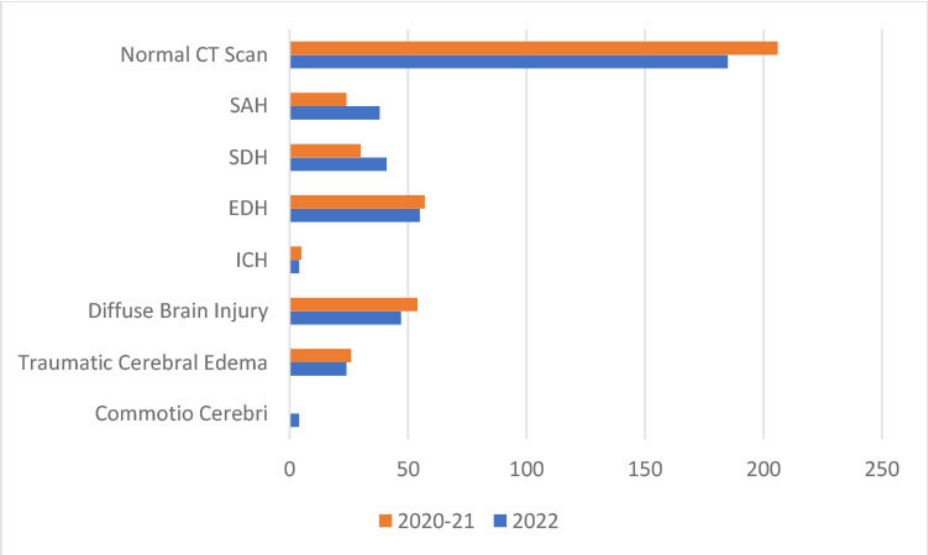

Figure 3. Distribution of traumatic brain injury diagnosis based on the year of the incident. SAH: Subarachnoid hemorrhage; SDH: Subdural hematoma; EDH: Epidural hematoma; ICH: Intracerebral hematoma

pedestrian collisions, and child passenger seat falls.[11] Children at this age tend to be more active and have a strong sense of exploration, therefore increasing the risk of injury, including head injury.

The result of this study showed the majority of mechanisms of injury were motorcycle-related injuries (81.25%). Prior studies in other regions in Indonesia support this research finding.[6-8] Ilie *et al.* found that motor vehicle collisions (MVC) constitute 5.4% of TBI causes in adolescence.[14] Motorcycle accidents are the major cause of traffic injuries since it is the main choice of transportation in Indonesia. It is relatively low cost and practical in use according to road conditions.[15] In Indonesia, traffic accidents occurred in 43.1% of urban areas and 28.2% of rural areas. Similarly, in Malaysia, the urban area has a higher prevalence of traffic accidents compared to rural areas.[15,16] The growing number of vehicles on the road, the growing population's mobility, and the unstandardized degree of security are the factors of traffic-related TBI incidence.[8] Sari *et al.* reported that structural factors such as road conditions, poor lighting, and poor road surface quality are related to higher casualties and fatalities in road collisions. Poor road lighting and road surface increased 4.2% and 3.4%, respectively, of road crash casualties.[17] Other factors such as speed and traffic volume have an indirect effect on accidents on inter-urban roads in Indonesia.[18] Seat passengers, drivers, careless driving, and drunk driving or driving under the influence of drugs had been linked to TBI patient outcomes.[19]

Although there was no correlation analysis completed in this study, male, adolescent, and motorcycle-related injuries might be associated with several factors which include personal and family background. Motor vehicle crashes is one of the most common mechanism of injury requiring hospitalization in children < 18 years old in the United States.[3] As the level of knowledge of safe driving affects traffic accidents, adolescent drivers (18 – 30 years old) are known to have a lack of experience and aggressive driving behavior.[20,21] During the COVID-19 pandemic, Zainafree *et al.* researched adolescent riding behavior. It was noted that 35.5% of adolescents, dominantly male, had traffic accidents, for example, side, head, and vehicle collisions.[22] Individual behavioral choices in driving are associated with TBI incidence.[19] Helmetless riders had a higher risk of head

injury (OR = 3.8) than those riders with helmets.[23] In 2018, Indonesian data showed that most of the age group of 5 – 14 years (58.2%) had never worn a helmet. Most 15 – 24 years (46.0%) reported wearing helmets only occasionally.[2] The lack of urgency in wearing helmets on short-distance trips, discomfort, disheveled hair, difficulties in hearing, preference for wearing a traditional head covering, the expensive price of the adequate helmet as well as lack of police control are reasons for not wearing a helmet while riding.[20,24] In comparison to females, male adolescents tended to have higher impulsiveness, decision-making styles, and higher participation in speeding, and drunk driving.[22,25] Family background was found to affect the likelihood of road traffic incidents (RTI) in adolescents and children. Uneducated and older guardians or families, raised by single mothers, and lower-income families are more likely to have RTI. The educational background of the guardian or family is related to TBI incidence, as less educated families become more prone to less knowledge of injury prevention. The older the age of the guardian (51 – 65 years) has odds of 1.6 times more likely to have RTI compared to a guardian aged less than 30 years. It might be related to aging, as aging decreases the guardian's ability to provide adequate supervision. In comparison to children with single mothers, those with divorced mothers were 99.9% less likely to have RTI in Ethiopia. This is related to the behavior of re-joining their grandfamilies, with the experiences of assisting children growing in a well-protected manner. Furthermore, lower RTI was found in children from higher-income families. This is related to the fact that poverty affects children's health status and the tendency to have a better environment and higher-income families.[26]

Almost half of the cases (48.88%) in this study showed normal head CT scans, in parallel to Zahabi *et al* research.[27] Normal head CT scan might indicate no ongoing pathological events. However, other conditions also show normal head CT scans, for instance, concussion, a type of mild diffuse brain injury of which often used interchangeably with mild TBI. These possibilities lead to the consideration of retaking the head CT scan examination. Serial head CT scan should be done after considering the radiation exposure to the patient. Physicians might start by predicting the percentage of positive head CT scan findings indicating trauma in head injuries based on severity. The lower the GCS, the higher the percentage of significant findings in head CT scans. Although a head CT scan in moderate to severe TBI is obligatory, its usage in mild TBI (GCS 13 – 15) should fulfill at least one of the moderate to high risk for neurosurgical intervention criteria. The criteria are GCS < 15 at two hours post-injury, suspected depressed or open skull fracture, evidence of basilar skull fracture sign, vomiting > 2 episodes, age > 65 years, anticoagulant use, loss of consciousness > 5 minutes, amnesia before impact > 30 minutes, and dangerous mechanism.[1] By following doing head CT scan based on these criteria, the physician may reduce unnecessary radiation to the patient and health care center's financial burden.[27]

This study has several limitations. First, the study design used was a descriptive study. There was no correlation analysis between variables conducted, which may provide a deeper understanding of how these variables interact with TBI incidence. Second, data were retrospectively collected from medical records. The discrepancy of each medical record rendered it difficult to obtain more variables to be included in this study. Therefore, further research with correlational analysis with more variables included, such as GCS score, patient follow-up data, and outcome, is needed. There are several poorly written medical records, hence limiting the diagnosis data. This is related to the unexplained normal head CT scan finding. More comprehensive written medical records might provide more information about whether the normal head CT scan finding means no injury or undetected by head CT scan. Third, data were specifically taken from the Dr. R. Sosodoro Djatikoesoemo Hospital. The result of this study might not be able to represent TBI in another region of Indonesia.

CONCLUSION

This study provided characteristics of TBI incidence in Bojonegoro, East Java, Indonesia. It was indicated that TBI in Bojonegoro is more likely to be found in men, 11 – 20 years old, and occurred due to motorcycle-related injury. More male dominance might be related to more head injury risk exposure in social or working environments and less compliance with safety behavior. Similarly, children aged 11 – 20 years were found to be more active and adventurous, which led to an increased risk of injury. Motorcycle, the most commonly used vehicle in Indonesia, was the main mechanism of injury in this study. It might be correlated to poor individuals' driving behaviors and road infrastructure. The result presented here also showed that most patients had normal head CT scans. The normal finding in the head CT scan indicates no brain alteration. Nevertheless, the possibility of unrecognized pathology by head CT scan still cannot be ignored completely. Encouraging safe driving behavior such as increasing the awareness of helmet usage is needed to prevent TBI incidence and to reduce the worse outcome. By providing the characteristics of TBI in Bojonegoro, this study might support the effort of increasing TBI prevention, for instance in public health policy decision-making.

CONFLICT OF INTEREST

There are no conflicts of interest in this study.

AUTHOR CONTRIBUTION

All authors contributed equally to the preparation of this manuscript.

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