

Traffic accidents and injury patterns in underage driving: a study from Klaten Soeradji Tirtonegoro Hospital data

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Abstract

Purpose: This study aims to determine the pattern of injury, distribution of age groups, roles, gender, and the most frequent helmet use compliance among victims of child traffic accidents. **Methods:** The study used a descriptive method with a cross-sectional research design. The research subjects were medical records of pediatric traffic accident patients in the Emergency Room (IGD) RSUP Dr. Soeradji Tirtonegoro from January 1, 2019, to December 31, 2019. **Results:** From 34 cases of child motorcycle accidents in the ER Soeradji Tirtonegoro, obtained data on the distribution of children's motorcycle accidents at RSUP Dr. Soeradji Tirtonegoro Klaten according to gender, age, the role of children, helmet use, type of injury, number of injuries, and location of the injury. **Conclusion:** Motorcycle traffic accidents in children are most often experienced by boys aged 16 years, the role of a driver. Most data on helmet use in children has yet to be discovered. The most common type of injury in cases of motorcycle traffic accidents in children is abrasions/vulnus excoriatum. Most cases (41%) had two injuries; the most common injury site was the lower extremity.

Keywords: children; distribution; injury; injury pattern; road traffic accident

Submitted:

December 29th, 2021

Accepted:

February 23th, 2022

Published:

February 28th, 2022

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INTRODUCTION

According to Law Number 22 of 2009 Chapter VIII Article 77 Paragraph (1), every person driving on the road must have a Driving License (SIM) according to the vehicle being driven. There are several requirements to obtain a driving license, such as having the competence to drive either from training or self-study and proven by passing the driving test, physical and mental health, administrative exams, and, of course, meeting the age as determined. The

minimum age requirement to make a Class C driving license is 17 years [1].

The number of motorized vehicles has increased rapidly every year. Data from the Central Statistics Agency (BPS) shows that in 2016 there were 105,150,082 motorbikes. However, in 2020, the number increased rapidly to 120,101,047 motorbikes. Motorbikes are one of the vehicles that dominate the road [2].

This rapid increase also seems to be followed by an increase in accident victims yearly. According to data from the Central Statistics Agency, there were 106,644 accident cases in Indonesia in 2016 and 109,215 in 2018 [2].

Nearly 30% of these cases result in death, while most others cause minor injuries. Of course, Traffic Accidents (KLL), especially those involving children, cannot be underestimated because the losses incurred are not only material but also endanger the lives of children. Zebra operations in the Special Region of Yogyakarta in 2019 reported that more than 9,000 motorized vehicle drivers were underage [3].

The Basic Health Research (RISKESDAS) of the Ministry of Health of the Republic of Indonesia in 2018 stated that the most frequent traffic accidents occurred at the age of 15-24, and the most significant cause was riding a motorbike. This data also showed that many people never/only occasionally use safety equipment such as helmets when riding a motorbike [4].

According to Potter & Perry (2005), injury is damage to standard anatomical structure and function due to pathological conditions. According to its anatomical location, the location of the wound can be classified into wounds on the head, neck, chest, abdomen, back, and upper and lower extremities. Most injuries in traffic accident victims are generally on the head, precisely in the frontal and orbital regions. Injuries to the extremities are also quite common, and the upper extremities are the second most common place of injury after head injuries [5].

Laceration/vulnus laceratum is defined as a wound that causes a tear in the skin. According to other sources, it is said that vulnus laceratum is an event of disruption of the continuity of tissue so that the initially normal tissue is now torn/broken [6]. Abrasions/vulnus excoriatum are generally caused by friction of the epidermis with hard objects and have rough/sharp surfaces (asphalt, etc.) [7]. According to research conducted by Nandini et al., this type of wound almost always occurs in two-wheeled motor vehicle accidents [5]. Bruises/vulnus contusum are caused by bleeding under the skin due to ruptured capillaries or veins. Hematoma occurs when there is a buildup of blood outside the vasa. The most common head hematoma in traffic accidents is subarachnoid hematoma, followed by subdural hematoma [8]. Fracture is the loss of continuity of the bone. Closed fractures occur in trauma with less energy than open fractures [9].

A traffic accident is an unexpected and unintentional event involving vehicles with or without other road users that results in human casualties and/or property losses. According to the losses suffered, traffic accidents are classified into minor, moderate, and severe [1]. When viewed from the ten most significant causes of death in the world, traffic accidents are currently in the ninth position, and it is estimated that in 2030, traffic accidents will increase and occupy the fifth position [10].

In terms of their role, motorcyclists, cyclists, and pedestrians are the most vulnerable groups to traffic accidents. In the western area, 70% of deaths occur in this vulnerable group. In addition, the lack of regulations and the adoption and enforcement of traffic rules also affect traffic accidents. Therefore, fatality data and non-fatal injuries that occur in traffic accidents are critical to assessing the magnitude of the problem, responding, and evaluating interventions that are still minimal. Most of the existing data is still under-reported. Only 22% have adequate information on this matter [11].

According to the Regional Traffic Management Center of the Traffic Directorate (RTMC Ditlantas) of the East Java Regional Police, the causes of traffic accidents can be broadly grouped into several types: humans, drivers, vehicles, and roads. However, according to another version from Warpani (2002), the environment is another factor [12].

According to the Head of the Klaten Police Accident Unit, Police Inspector One (Iptu) Panut Haryono, the number of traffic accidents in early 2020 in Klaten was dominated by teenagers aged 16-25 years. The number of teenage victims is said to be around 700 people. Accidents often occur on inter-district roads and are caused by human error, such as not obeying the rules, lack of concentration, the driver's physical condition, and reckless driving behavior [13].

Helmet use is essential in avoiding head injuries. Correct and standardized helmet use will reduce the risk of fatal injuries by 42% and the risk of head injuries by 69%. Indonesia still needs to meet the standards in procuring helmet-use legislation. Legislation in Indonesia has yet to enforce the strict rules for tightening helmets. The enforcement rate is 9/10. The percentage of compliance with helmet use is 71% [10].

METHODS

This study is a descriptive study conducted with a cross-sectional research design. The study used data from the medical records of Dr. Soeradji Tirtonegoro General Hospital, Klaten, in 2019. The study population included medical records of children with traffic accidents recorded in the Emergency Room of Dr. Soeradji Tirtonegoro General Hospital. Samples were taken by *consecutive sampling* with inclusion criteria, including all medical records of motorcycle traffic accident patients under the age of 17 years in the Emergency Room of Dr. Soeradji Tirtonegoro General Hospital from January 1, 2019, to December 31, 2019. Medical records that did not contain any variables to be studied, including gender, age, role of children in

driving, information on helmet use, and physical examination of injuries, were excluded from the sample. Medical records were also excluded if they contained invalid information.

Data was collected using a research checklist containing variables to guide researchers. The existing data will be checked for completeness of the variables; then, elimination will be carried out according to the inclusion and exclusion criteria. After that, the data will be classified and entered into tables. The data will be calculated in frequency according to each variable: gender, age, child role, number and type of injury, location of injury, and helmet use. Furthermore, the data will be processed descriptively and presented as narratives, tables, and graphs containing data on the variables studied. Data processing, table, and graph creation will use Microsoft Excel 2019 software.

RESULTS

The data in Table 1 were obtained from medical records of children's motorcycle accidents at the Emergency Room of Dr. Soeradji Tirtonegoro Hospital, Klaten, in 2019. There were 38 cases of motorcycle traffic accidents. After being eliminated based on the inclusion and exclusion criteria, 34 cases were found that met the criteria in this study.

The mean age data is 13.79. The median is 15, and the mode is 16. Fifty-six injuries were obtained. Data is classified as no information if no related information is obtained in the medical record.

DISCUSSION

Distribution by gender

The research showed that boys experienced more traffic accidents than girls 56% of all cases. These results are the same as several other studies, where the comparison of victims of traffic accidents was dominated by men, as much as 78.9%, compared to women, who were only 21.1% [14]. In addition, research by Hidayati & Hendrati (2016) also presents the results of seventh and eighth-grade students who have experienced traffic accidents while riding a motorbike dominated by men, 55% compared to women as much as 45% [15]. This study is closer to the author's results because the percentage between men and women is not too different. In research by Gizela (2020), the results of male motorcycle accidents were 702 cases, while women were 574 cases, which means that men experience more motorcycle accidents than women [16]. The same results were also obtained in a previous study from five traffic accident victims who were interviewed; three were male [17].

Table 1. Distribution of child motorcycle traffic accident injury patterns

Variables	n	%
Gender		
Man	19	56
Woman	15	44
Age		
0-4 years	1	3
5-9 years	3	9
10-14 years	9	26
15-16 years	21	62
Role of children		
Rider	12	35
Passenger	3	9
No Information	19	56
Use of helmet		
Use	0	0
Do not use	1	3
No information	33	97
Types of injuries		
Fracture	10	18
Vulnus excoriatum	37	66
Vulnus laceratum	8	14
Hematoma	1	2
Number of injuries		
No injuries	0	0
1 Injury	12	35
2 Injuries	14	41
3 Injuries	7	21
4 Injuries	1	3
Location of injury		
Upper extremities	16	28
Lower extremities	19	34
Head	17	30
Thorax	2	4
No information	2	4

Research by Indriani & Yulianti (2015) also found that motorcyclists were dominated by men (90.5%) and women only 9.5% of all cases of death due to traffic accidents [18]. Gender can affect driving behavior. Boys and girls have different driving behaviors. Boys experience more traffic accidents because they are not yet able to drive well (rider incompetence), so boys have the potential to violate existing traffic regulations and lead to traffic accidents. The behavior of male students to commit violations is 30.08% higher than that of female students. Traffic violation behavior committed by male students is also more likely to result in accidents by 50.1% more than female students [19].

The same results were obtained in Australia, another country with different constitutional rules. The exact reasons were listed as the cause of boys' higher chance of having an accident, driving behavior that is willing to take risks, being more aggressive, seeking sensations, not being too sensitive to thinking about the results if an accident occurs, and not being too anxious when they are taking risks. Children will tend to feel they can drive vehicles, including motorbikes, and ignore the existing risks [20].

Self-control and logical thinking to avoid risks are better in women than men. However, one factor that can trigger traffic accidents in girls is difficulty controlling vehicles and understanding the situation on the road [21].

Distribution by age

The research showed that the age group that experienced the most accidents was 15-16. More specifically, most traffic accidents were experienced by children aged 16 years. There are some differences between the studies. Research conducted by Hidayati and Hendrati (2016) found that 62% of children who actively ride motorbikes are 14 years old [15]. The age of 15 is only 15% and 16 years is only 2%. This difference may occur because the population of the study were students of Junior High School (SMP)/equivalent in grades VII and VIII. At the same time, according to Article 7, the maximum age allowed to register for class VII SMP is 15 years. So, the average child aged 15-16 has entered grade IX and is not included in the study [22].

Research by Anjarani (2019) grouped accident cases by age, and the highest cumulative number of child accidents was in the 9-12 year age group. However, the number was similar to the 13-18 year age group, which was 637 cases compared to 616 cases. When viewed from the data per year, in 2015 and 2016, cases in the 13-18 year age group were higher than in the 9-12 year age group [23]. Teenagers are also a major contributor to traffic accident cases compared to all age groups (children to the elderly). Late adolescence ranks second, and early adolescence ranks fourth regarding the highest traffic accident cases [14].

Several factors can cause the 15-16 year old age group to become the most victims of traffic accidents. First, this age is still classified as a transitional age from school-age children to adolescence and young adulthood, where a child begins to desire to be independent of their parents and seek validation from people around them, such as friends, other adults, and even teachers. Children under 10 are generally not mature enough to control themselves and their vehicles. The parents' trust in their children increases as their age increases. Parents often consider children aged 15-16 as adults because they can already judge what is right and wrong, their thoughts and those of others, and understand their environment, so many parents allow their children to drive motorized vehicles for daily activities. However, what is often forgotten by many parents is that even though it seems that the child has been able to understand right and wrong, the child is also looking for their identity and still has a different perspective on morals, which can

affect their attitudes and behavior when driving a motorized vehicle. The existence of an inappropriate environment can influence the actions, attitudes, and feelings of children aged 15-16 years to do disruptive things such as driving fast, not keeping a distance from other vehicles, and overtaking carelessly. Motor skills, perception, and visual acuity also develop with age, and they are generally fully mature when they reach the age of 17-20 years. This factor also influences the small number of victims in the age groups 0-4 years and 5-9 years [24].

This does not only happen in Indonesia but also in other countries, one of which is Thailand. Thai regulations do not allow children under 15 to drive, but 49% of motorcycle accidents involve children aged 8-14 years [24].

Distribution based on child role

The medical record data studied showed that 35% acted as drivers, 9% as passengers, and 56% of medical records did not contain information about the child's role. In a study conducted on junior high school students in Wonokromo District, Hidayati & Hendrati (2016), 42.86% (42 children) who actively rode motorbikes experienced accidents [15]. In a study by Kepel et al. (2019), it was found that the role of the victim before the traffic accident was the driver/rider as much as 78.95%. The study also stated that most road accidents were caused by motorbikes, which was 41% [14].

Children's role in transportation accidents involving children <15 years old varies. In India, 15.5% of children act as drivers and 25.1% as passengers. In Nepal and Sri Lanka, the percentage of children acting as drivers is higher, at 10.9% and 53%, compared to children acting as passengers at 7% and 18.3%. The proportion in Thailand shows that the two roles are almost the same, with 43.8% of children as drivers and 44.2 as passengers. The large amount of data on unknown roles also occurs in Nepal, at 55.8% unknown. Only four Southeast Asian countries can provide information related to motorcycle accidents involving children: India, Nepal, Sri Lanka, and Thailand [11].

Many factors can influence accidents involving child drivers. These factors can be grouped into emotional, knowledge, and skill factors. Reasons that fall into emotional factors include increasing speed when the child is feeling unwell, feeling late, and feeling upset. Knowledge factors include children's ignorance of applicable traffic signs. This ignorance includes turning on high beams when driving a vehicle at night, which can endanger drivers from the opposite direction because it interferes with visibility. In

addition, children often ignore the importance of turn signals. The same study also examined which signs were least known by junior high and high school (SMA) children in the Sijunjung area. Sixty-six percent answered the steep descent sign incorrectly, and 53% answered the vehicle no-turn sign incorrectly. Skill factors include children's ability to control vehicles, rules for overtaking vehicles, and the like [25].

Children who become passengers will generally drive with parents, who tend to be more mature in knowledge, skills, and emotional management. According to research by Octavariny et al. (2021), owning a C driving license is related to driving safety behavior [26]. Child passengers who get injured can be affected by the use of inadequate protection [24].

This can be avoided if children do not break the rules. Law Number 22 of 2009 has regulated provisions regarding the obligation to have a driving license. For someone to get a driving license, essential competencies such as age, knowledge, and driving ability need to reach the specified standards [1].

Distribution based on helmet use

Most of the research results (97% of medical records) did not include information about helmet use. Only 3% (1 case) had information that the accident victim did not use a helmet. Data on helmet use in Indonesia, especially for children, is challenging. Most studies do not include helmet use as a variable. Similar results were found in a study of helmet use rates in child traffic accidents in Bandung City. There was no information on helmet use for 56% of cases. Forty-three percent of victims wore helmets, and only 1% did not. This study also wrote that the older a person is, the better and more correct their helmet use is.

The correct use of helmets also differs between school hours and departure times. 60% of child passengers use helmets correctly during school hours, whereas only 31% use helmets at departure times [27]. Another study examined helmet use in two-wheeled motor vehicle accidents, and only 0.3% were known to use helmets [28]. Data from Southeast Asian countries such as India and Thailand shows that 96% of child motorcycle accidents in 2007 involved children who were not wearing helmets [11].

The rules for wearing helmets have been enforced in India, including helmet standardization. However, the enforcement score is only 4 out of 10. In Thailand, helmet regulations and standardization have also been enforced, and the enforcement score is better than in India, which is 6 out of 10. The enforcement score for helmet regulations in Indonesia from the same source and standard is 9 out of 10, equivalent to Singapore and 1 point higher than Malaysia. With the rules that have

been enforced and also a higher enforcement score than Thailand and India, the possibility of compliance with helmet use in Indonesia is higher.

A Cincinnati Children's Hospital Medical Center study from 1995 to 2001 showed that 53.9% of child riders aged <16 did not wear helmets [10]. Enforcement is a critical factor in ensuring helmet use when driving. This is evident in research in Bandung, where law enforcement is generally looser during school hours than after school hours. In addition, when the helmet-wearing rate data is compared between India, Thailand, and Indonesia, the data is directly proportional to the enforcement score listed [10].

Distribution by type of injury

The most common injury is vulnus excoriatum or abrasion (66%). After that, it is followed by fracture (18%), vulnus lacerated or laceration (14%), and the least common is hematoma (2%). Generally, the results of the types of injuries obtained regarding motorcycle accident cases vary between studies. Research by Sukarno et al. (2016), which has the exact research location, states that the most common type of injury is fracture.

Another study conducted by Indriani & Yulianti (2015) using data from victims who died in 2014 at Sanglah General Hospital, Denpasar, obtained results that were in line with this study, that abrasions were the most common wounds among bruises, lacerations, and fractures [18]. Research in the same place was also conducted by Oktavianti (2016) using data from 2014. The results of this study showed that the proportion of abrasions was the most common (97.3%), followed by blunt open wounds (67.6%), bruises (64.9%), fractures (50%), treated wounds (33.8%) and sharp open wounds (2.7%) [29]. Traffic accident cases at Prof. Dr. RD Kandou Manado General Hospital in 2017 also showed consistent results: 53% abrasions, followed by bruises (32%) and lacerations (15%) [14].

For cases of child accidents, there are not many recent reference sources found either from Indonesia or from other countries. Some of the existing references range from 1990-2010. Research on 39 cases of child accidents related to motorcycles in Queensland, Australia, in 2002-2003 stated that closed fractures were the most common, followed by abrasion/contusion, laceration, compound fracture, organ injury, and the least head injury [30].

A 10-year study in Victoria, Australia, found that fractures were the most common type of injury, followed by open wounds, sprains, strains, and dislocations [31]. All results generally return to the two most common injuries: vulnus excoriated/abrasions and fractures. Several factors can influence this. The

first factor is speed. If an accident occurs at high speed, the injuries will generally be of high force, making it more likely to cause injuries such as open and closed bone fractures. *Vulnus excoriatum* occurs due to friction between a rough surface (asphalt) and the victim's skin and generally occurs in accidents at speeds that are not too high.

The second factor is what the rider is doing. Off-road/trail motorcycle accidents generally involve activities such as jumping and rocky uphill roads, so the type of injury that occurs can be different from accidents that occur on flatter and straighter highways. If a rider has an accident after a jump, it is generally caused by loss of balance; the force that causes the injury will be more significant, and fractures are more likely to occur. However, if the mechanism is like falling on the road or being dragged on the asphalt, it is more likely to cause abrasion injuries [31].

Distribution by number of injuries

Data from 34 cases showed that no cases had 0 injuries. The most data from this data group was two injuries, 14 cases (41%). Cases with one injury were 12 (35%), three injuries were 7 cases (21%), and the number of 4 injuries was 1 case (3%). Few sources include the number of injuries. The closest research on the number of injuries comes from the *visum et prepartum* of traffic accident victims from the Forensic Department at Dr. Mohammad Hoesin Palembang General Hospital, which obtained almost the same results. As many as 20.1% (37 victims) had one type of injury, 45.1% (83 victims) had two types of injuries, and 34.8% (64 victims) had three types of injuries [32].

According to Santosa et al. (2017), motorcycle accidents are the most common in Indonesia due to the increasing number of motorcycles. In addition, this study found that the population that most often experiences motor vehicle accidents in Indonesia is aged 16-30. Their analysis showed that motorcyclist traffic accidents contributed to 73% of fatalities and serious injuries from other vehicle accidents (Figure 16). Motorcycle accidents, especially in children, have a high potential for injury and fatalities [33].

Distribution by injury location

In this study, the location of the most injuries was found in the extremities. In the extremities, there were 35 injuries (63%). The comparison between the upper and lower extremities was 16 cases (29%) compared to 19 cases (34%). Other injuries were head injuries of 17 injuries (30%) and thorax two injuries (4%). There were two injuries (4%) that did not have information about the location of the injury.

According to the World Health Organization (2008), the body parts most frequently affected by traffic accidents are the extremities and head [34]. Research by Sukarno et al. (2016) showed different results from this study, where the head was said to be the location of the most traffic accident injuries [28]. This difference may be caused by differences in research subjects, where the study did not only take samples of two-wheeled motor vehicle accidents but also four-wheeled motor vehicle accidents.

Research by Indriani & Yulianti (2015) showed that 100% of motorcyclist traffic accidents experienced head injuries, followed by upper extremity injuries in 90.5% of all cases, then lower extremities in 85.7% of cases [18]. Research by Kepel et al. (2019) found that the location of the most injuries in traffic accidents was the head, followed by the lower extremities and upper extremities [14]. Research at the exact hospital location in different years also showed consistent results that the most injuries occurred to the head and face (90.5% of all cases), the second most were the lower extremities (86.5%), and the third most were the upper extremities (67.6%) [29].

Results that are in line with this study were presented by Robertson & Garrett (2008), that injuries suffered by children under 15 years of age mostly involved the lower extremities (50% of all injuries), followed by the upper extremities (30% of all injuries) and body parts other than the extremities [30]. Research by Abass et al. (2020) stated that the location of the most injuries in cases of motor traffic accidents was the extremities, followed by head-neck injuries. The study also stated that injuries to the lower extremities were more common than the upper extremities [35].

Several possibilities cause differences in the results of various studies. First, there are differences in research areas, so the socio-culture in these areas is also different, which can affect driving behavior. Second, there are differences in public awareness of wearing protective equipment, helmets, and protection on the extremities when driving. Third, it can be caused by differences in how accidents are handled. In a study of child motorcycle accidents that took place in Malaysia, the accident mechanisms that often occurred were head-on, angular, and also accidents due to loss of control [36]. Angular accidents have a higher possibility of head injury [37]. Injuries to the extremities are generally caused by direct impact to the extremities, one of which is a frontal (head-on) accident or due to impact with a motorbike handle [35].

Another possibility is the difference in age distribution. Studies that state that head injuries occur more often than extremities also include adults in the

research subjects. Children have different anatomy than adults, which can affect the difference in injury location [34].

CONCLUSION

Boys most often experience motorcycle traffic accidents in children. The most common age is 16, and the most common role is rider. Most data on helmet use in children is unknown. The most common type of injury in cases of motorcycle traffic accidents in children is abrasions/vulnus excoriatum. Most cases (41%) experienced two injuries, and the most common location of injury was in the lower extremities.

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