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Article

Injury Pattern of Blunt Trauma Cases Based on HDSS Sleman 2021

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ABSTRACT

Blunt trauma is a major global health issue, often resulting in death or serious injury. In Indonesia, traffic accidents remain the primary cause of blunt trauma, with Yogyakarta reporting a high number of such incidents. This study focuses on identifying patterns of blunt trauma in Sleman Regency in 2021, using data from the Health and Demographic Surveillance System (HDSS), a longitudinal tool for tracking health-related social changes. The research employed both univariate and bivariate analysis methods, including observational cross-sectional design and chi-square testing. A total of 315 blunt trauma cases were recorded in 2021, with the majority (263 cases) resulting from motorcycle accidents and 52 from other land transport. Most victims were male (55.9%) and adults aged 19–59 years (285 cases). The lower extremities were the most affected body part, accounting for 64% of injuries, and often resulted in motor function loss (10.7%). Contusions were the most common type of injury, particularly to the lower limbs (42.3%). The findings indicate that adult males are more vulnerable to blunt trauma, particularly from road traffic accidents. Injuries predominantly affect the lower extremities and are mostly non-penetrating contusions. The study highlights the role of demographic factors such as age and education in injury patterns, emphasizing the need for targeted prevention and improved emergency response strategies. These insights can inform public health policies and traffic safety programs to reduce the incidence and severity of blunt trauma injuries..

INTRODUCTION

Based on data from the World Health Organization (WHO), every year there are about 4.4 million injury cases resulting in 3.16 million individuals suffering from disability due to unintentional injuries[1]. In the United States, injury accounts for over 150,000 deaths and over 3 million non-fatal injuries per year, emphasizing the substantial impact of trauma on public

health[1]. Most injuries from traffic accidents in Indonesia leading to death and illness are due to blunt trauma[2]. The data collected from Regional Public Hospital dr. Doris Sylvanus reveals that sharp trauma was the most common, accounting for 33 (48.53%) corpses, followed by blunt trauma with 29 (42.65%) corpses[2]. In Yogyakarta, there were 4,559,000 accidents in 2020, with 346,000 fatalities, 5,715,000 minor injuries, and 1,000 severe injuries[3].

The burden of blunt injuries is significant worldwide, with a disproportionate concentration in low- and middle-income countries (LMIC)[4]. According to the World Health Organization, over 91% of unintentional injury deaths and 94% of disability-adjusted life-years were lost in LMIC in 2004. The economic impact of both blunt and penetrating trauma is substantial. This means that the costs associated with treating and addressing the consequences of injuries caused by both blunt and penetrating trauma have a significant and noteworthy impact on the economy[4]. In a study conducted in Sierra Leone, it was estimated that injuries are responsible for 10% of the global burden of disease, resulting in around 5 million deaths annually[4].

Trauma is defined as a tissue injury that occurs more or less suddenly due to violence or accident and is accountable for initiating hypothalamic–pituitary–adrenal axis, immunologic and metabolic responses that are responsible for restoring homeostasis[5]. An injury refers to physical harm or damage to the body caused by an external force or event. Injuries can vary in severity and may include cuts, bruises, fractures, burns, sprains, and more[6]. Injury is a condition where the body can't move because different parts of the body are damaged due to physical force[7]. Injury damage can involve various elements such as bones, muscles, and soft tissues, caused by trauma, excessive load, environmental conditions, or technical errors during sports activities[8]. Traumatic injuries can result in various physical injuries, ranging from minor cuts and bruises to more severe injuries such as broken bones, organ damage, and traumatic brain injuries [8].

Blunt trauma, also known as non-penetrating trauma or blunt force trauma, refers to injury of the body by forceful impact, falls, or physical attack with a dull object. Blunt trauma death refers to physical trauma to the body through fall, impact, or attack that results in death[9]. The appearance of wounds depends on multiple factors, including the force, speed, length of time of impact, the surface area of contact, and elasticity of tissues impacted. A large, crushing force applied to a sizable area over several minutes will result in vast tissue damage; for example, failure of the integrity of a retaining wall at a construction site will likely cause significant blunt impact injury if the wall collapses on and traps the legs of an individual[9]. Alternatively, a smaller force applied to a smaller area will result in less tissue damage; for example, the impact of a thrown baseball to the shoulder of an individual will likely cause minor blunt trauma[6]. Recognizing these factors is crucial for assessing the severity of injuries and providing appropriate medical care in cases of blunt trauma.

Injury patterns can be used to identify risk factors for certain types of injuries and develop strategies to prevent them. Injury pattern analysis can also be used in the context of forensic investigation, where it may be used to identify the cause and manner of death, such as in cases of homicide or accidental death[10] One of the assessments of injury in a post-mortem et repertum is the assessment of the location of the injury. The location of the wound assessed is divided based on the wound region, wound side, or coordinates which include two or more wounds. In these cases, injury pattern analysis may involve examining patterns of bruising, lacerations, fractures, and other injuries to determine the type of force or weapon used. The pattern of injury also explains how, with what force, and on which portion of the patient's body the injury occurred[11].

Determining a suitable research area is a very vital decision in any thesis project, as this forms the basis for the objectives and results of the research. Ring roads and inter-city roads in Sleman have become a source of serious concern due to the increasing number of accidents. Obstacles such as traffic congestion, lack of adequate infrastructure, and drivers' lack of awareness in following traffic rules further worsen the situation. The reason for choosing 2021 is based on the latest report from Bappeda DIY for 2020. Health and Demographic Surveillance System (HDSS) data for 2021 is the most up-to-date data that can be compared with the previous year's Bappeda DIY report. This research aims to examine the patterns of blunt trauma cases in Sleman District based on the Health and Demographic Surveillance System (HDSS). The HDSS is a surveillance system that periodically collects data on social transitions within a specific timeframe, specifically in Sleman.

METHODS

The research utilized both univariate and bivariate analyses. The univariate analysis, based on a cross-sectional observational design, aimed to describe the characteristics and distribution of individual variables. This involved examining individual variables independently to understand their characteristics and distributions within the dataset. On the other hand, bivariate analysis employed the chi-square test to explore associations between categorical variables. This statistical method was utilized to assess the association or dependence between pairs of variables, providing insights into potential connections or patterns within the data. Out of 624 individuals identified based on HDSS criteria, 519 met the eligibility requirements. The final sample size of 221 was calculated using the Taro Yamane formula. Ethical clearance was granted by the Ethics Commission of FK-KMK, Universitas Gadjah Mada (Ref. No: KE/FK/0299/EC/2024).

RESULTS

Univariate Analysis

Table 1 presents the investigation of injury patterns in blunt trauma cases in Sleman, Yogyakarta, during the year 2021, using data from the Sleman HDSS. Analysis reveals that male constitute the largest group affected by blunt trauma injuries, with 290 respondents involved. The adult age group, especially those aged 19 – 59 years, emerges as the most affected demographic, comprising 285 respondents. Furthermore, the study highlights the educational background of the respondents, with those who completed secondary school accounting for the largest contribution to blunt trauma injuries, totaling 205 respondents.

Table 1. Study Characteristics

Study Characteristics		***Total***	
		n	***%***
Gender	Male	290	64
	Female	229	36
Age Categories	< 5 years	24	5
	5 – 9 years	15	3
	10 – 18 years	68	13
	19 – 59 years	285	55
	> 60 years	127	24
Education Level	Higher	73	14
	Secondary	205	40
	Basic	173	33
	No/Never	68	13

Table 2 shows that accidents were the main cause of blunt trauma injuries in 2021. Specifically, there were 263 cases of motorcycle-related road traffic accidents and 52 cases of other types of road traffic accidents. These were followed by 193 cases of falls and 11 cases of injuries caused by being hit or struck with a blunt object.

Table 2. Blunt Trauma Cases in Sleman

Blunt Trauma Cases	***Total***	
	n	***%***
Motorcycle Road Traffic Accident	263	51
Other Road Traffic Accident	52	10
Fall	193	37
Hit or Thrown by a Blunt Object	11	2

Based on the blunt trauma cases data from HDSS Sleman in 2021, there were several sites of injury based on anatomical topography that were injured, including the head, chest, back, stomach/internal organ, upper extremities and lower extremities. Table 3 shows that the most

common injury location was the lower extremities (64%), followed by upper extremities (42%), head (16%), back (7%), chest (2%), and stomach/internal organs (1%). It can be concluded that the lower extremities are the most vulnerable to injuries, followed by the upper extremities and head, respectively.

Table 3. Anatomical Topography

Anatomical Topography	***Total***	
	n	***%***
Head	85	16
Chest	14	2
Back	37	7
Stomach/Internal Organ	6	1
Upper Extremity	218	42
Lower Extremity	332	64

Bivariate Analysis

Based on the blunt trauma cases data of HDSS Sleman 2021, the dataset was tested for the correlation between anatomical topography and severity. This analysis specifically prioritized variables with the largest frequency of occurrence.

Table 4. Frequency of Anatomical Topography and Severity

Severity	***Total***	
	n	***%***
Head injury and permanent wound	17	20
Chest injury and loss of motoric	5	35
Back injury and loss of motoric	10	27
Stomach injury and permanent wound	2	25
Upper extremity injury and loss of motoric	43	19
Loss of motoric and loss of motoric	56	17

Table 4 shows the distribution of injury severity by anatomical location. The most common severity was upper extremity injury with motoric loss (43 cases, 19%), followed by general motoric loss (56 cases, 17%). Head injuries with permanent wounds were reported in 17 cases (20%), chest injuries with motoric loss in 5 cases (35%), back injuries with motoric loss in 10 cases (27%), and stomach injuries with permanent wounds in 2 cases (25%) Overall, the majority of respondents had injuries to the lower extremities with a total of 332. It can be seen in the table that the majority of respondents who suffered lower extremity injuries experienced loss of motoric, with a total of 56 cases. However, statistical analysis precisely reveals a significant correlation between lower extremity injury and the occurrence of permanent wound, with a p-value of 0.029, which is smaller than the predetermined value of 0.05.

Based on the results on the table 5, several cases of blunt trauma were also found a significant correlation between the anatomical topography and the level of severity with a p-value below 0.05.

Table 5. p-value of Anatomical Topography and Severity

Severity	***p-value***
Head and loss of sensory	0,001
Head and permanent wound	0,008
Chest injury and losing limb	<0.001
Chest injury and permanent wound	0.044
Lower extremity and permanent wound	0,029

Based on the data there are 315 blunt trauma cases due to accident. From the data obtained, the majority of respondents experienced injuries to the lower extremities, with a total of 216 individuals. Following that, injuries to the upper extremities occurred in 155 individuals, followed by head injuries in 52 cases. Meanwhile, injuries to the back were recorded in 16 cases, followed by chest injuries in 10 cases, and abdominal injuries in 6 cases. The dataset was tested for the correlation between anatomical topography and type of injury in accident cases. This analysis specifically prioritized variables with the largest frequency of occurrence.

Table 6. Frequency of Anatomical Topography and Type of Injury due to Accident

Type of Injury	***Total***	
	n	***%***
Head injury and contusion or abrasion	46	88
Chest injury and contusion or abrasion	9	90
Back injury and contusion or abrasion	12	75
Stomach injury and contusion or abrasion	6	100
Upper extremity injury and contusion or abrasion	133	85
Lower extremity and contusion or abrasion	195	90

Based on the results of the data, several cases of blunt trauma due to accident were also found a significant correlation between the anatomical topography and severity with a p-value below 0.05.

Table 7. p-value of Anatomical Topography and Type of Injury due to Accident

Severity	***p-value***
Head and laceration	<0.001
Chest injury and fracture	0.046
Upper Extremity and Fracture	0.017
Lower extremity and contusion or abrasion	<0.001
Lower extremity and fracture	0.017

Based on the data obtained, the majority of blunt trauma due to accident victims suffered injuries to the lower extremities with total 216 cases. It can be seen in the table that the majority

of respondents who suffered lower extremity injuries experienced contusion and abrasion, with a total of 195 cases. Statistical analysis using the chi-square test indicates a significant correlation between lower extremity injuries with contusion or abrasion and fracture.

Based on the data there are 193 blunt trauma cases due to fall. From the data obtained, the majority of respondents suffered injuries to the lower extremities, with the number reaching 112 people. Then, injuries to the upper extremities occurred in 59 people, followed by injuries to the head in 29 cases. Meanwhile, 20 cases of injuries to the back were recorded, followed by injuries to the chest with 3 cases, and injuries to the stomach with 2 cases. The dataset was tested for the correlation between anatomical topography and type of injury in fall cases. This analysis specifically prioritized variables with the largest frequency of occurrence.

Table 8. Frequency of Anatomical Topography and Type of Injury due to Fall

Type of Injury	***Total***	
	n	***%***
Head injury and contusion or abrasion	14	48
Chest injury and contusion or abrasion	3	100
Back injury and contusion or abrasion	9	45
Stomach injury and contusion or abrasion	2	100
Upper extremity injury and contusion or abrasion	28	47
Lower extremity and contusion or abrasion	60	53

Based on the results of the data, several cases of blunt trauma due to fall were also found a significant correlation between the anatomical topography and severity with a p-value below 0.05.

Table 9. p-value of Anatomical Topography and Type of Injury due to Fall

Severity	***p-value***
Head and laceration	<0.001
Upper Extremity and Fracture	0.003
Lower extremity and contusion or abrasion	0.015

Based on the data obtained, the majority of blunt trauma due to fall victims suffered injuries to the lower extremities with total 112 cases. It can be seen in the table that the majority of respondents who suffered lower extremity injuries experienced contusion and abrasion, with a total of 60 cases. Statistical analysis using the chi-square test indicates a significant correlation between lower extremity injuries and contusion or abrasion.

Based on the data there are 11 blunt trauma cases due to hit or thrown by a blunt object. From the data obtained, the majority of respondents suffered injuries to the head and the lower extremities, with the number reaching 4 people each. Followed by injuries to the upper extremities which occurred in 3 people. Meanwhile, no one suffered injuries to the back, chest or stomach. The dataset was tested for the correlation between anatomical topography and type of injury in hit or

thrown by a blunt object case. This analysis specifically prioritized variables with the largest frequency of occurrence.

Table 10. Frequency of Anatomical Topography and Type of Injury due to Hit or Thrown by a Blunt Object

Type of Injury	***Total***	
	n	***%***
Head injury and laceration	2	50
Chest injury and contusion or abrasion	2	66
Back injury and contusion or abrasion	2	55

Based on the results of the data, several cases of blunt trauma due to hit or thrown by a blunt object were also found a significant correlation between the anatomical topography and severity with a p-value below 0.05.

Table 11. p-value of Anatomical Topography and Type of Injury due to Hit or Thrown by a Blunt Object

Severity	***p-value***
Head and laceration	<0.001

Based on the data obtained, the majority of blunt trauma due to hit or thrown by a blunt object victims suffered injuries to the head with total 2 cases. It can be seen in the table that the majority of respondents who suffered head injuries experienced contusion and abrasion, with a total of 2 cases. However, statistical analysis using the chi-square test indicates a significant correlation between head injuries and laceration.

DISCUSSION

Proportion of Blunt Trauma Cases in Sleman

In 2021, accidents were identified as the primary cause of blunt trauma injuries. Motorbike transportation accidents accounted for 263 respondents, while other transportation accidents involved 52 respondents. Factors contributing to these accidents include traffic violations, lack of awareness and safety measures, alcohol influence, and driver fatigue. Injuries and fatalities from traffic accidents represent major public health issues in developing countries [12]. Similarly, a study found that the leading causes of injury were falls (45,987 people, 59.6%), traffic accidents (20,829 people, 27%), and sharp/blunt object injuries (144,127 people, 18.3%) [13].

Blunt Trauma Cases Count by Gender

Data shows that men are the largest group experiencing blunt trauma injuries, with 290 respondents involved. Non-parametric binomial test did not show any significant relationship

between the two sexes. with a significance of 0.08, this value is greater than the predetermined value of 0.05. A similar study found that in blunt trauma cases, there were 12 male victims (92%) and one female victim (8%) [14]. Conversely, in domestic violence cases, women are more likely to experience blunt force trauma, while male victims tend to be injured by sharp or rough objects [15]. These findings highlight the gendered patterns of blunt trauma injuries, with males predominating in non-domestic settings and specific age groups, while domestic violence cases show distinct injury patterns between male and female victims.

Blunt Trauma Cases Count by Age Group

In addition, the adult age group (19-59 years) is the one that most frequently experiences blunt trauma injuries, with 285 cases recorded in Sleman in 2021. Similarly, a related study identified that the largest age group affected by such injuries was 24-35 years (15.07%), which falls within the adult category [16]. Meanwhile, in cases of sexual harassment, the victims are predominantly aged 10-20 years, with women constituting the majority. The perpetrators are often family members, highlighting a significant relationship between the victim and the offender within the domestic environment [17].

Blunt Trauma Cases Count by Education Level

Based on HDSS Sleman data, the highest number of blunt trauma injuries occurred among individuals who had completed secondary education, with a total of 205 respondents. In addition, the level of safety awareness and knowledge of injury prevention measures may be lower in this group compared with higher education groups. This can result in riskier behavior, such as neglecting to use protective equipment or not paying attention to safety warning signs [10]. This finding is consistent with a study conducted in Ghana, which indicated that accident victims with more severe injuries were often from higher educational and economic status groups [18]. In contrast, a study conducted in Long Beach (California) and Fort Lauderdale (Florida) found that accident rates were higher among middle-aged individuals, those with lower educational levels, unmarried individuals, and the unemployed [19].

Injury Patterns by Anatomical Topography and Severity

In the survey carried out, it is revealed that the lower extremities are the part of the body most frequently injured due to blunt trauma, with a total of 332 respondents. Furthermore, of the blunt trauma injury cases, many resulted in loss of motor reflexes in the lower extremities, 56 respondents. The impact or pressure exerted can lead to damage of nerves or other crucial structures that play a role in controlling motor reflexes [20]. However, statistical analysis using the

chi-square test indicates a significant correlation between lower extremity injuries and permanent wounds. This evidence demonstrates that, regardless of anatomical topography, nearly all permanent wounds resulting from blunt trauma are occur on the lower extremity. Permanent wounds are assessed by the extent of tissue damage, often involving the skin, subcutaneous tissue, muscles, and bones [21]. In some cases, these injuries can become permanent if the victim does not receive proper treatment [22].

Similar research on traffic accident victims in 2020 concluded that the most common injuries primarily located in the lower extremities [23]. However, in cases of domestic violence, the most common locations where injuries occur are in the back of the head and forehead [24]. On the other hand, although head and chest injuries are not as common as lower extremity injuries, chi square statistical analysis shows a significant correlation between head injuries and loss of sensory, as well as between chest injuries and losing limb. Head injury refers to a disruption in brain structure and function, which can lead to a reduced level of consciousness, which is a measure of an individual's awareness and responsiveness to environmental stimuli (sensory reflex) [20]. Correlation between chest injuries and losing limb supported by a study indicating that chest injuries can cause heart injury in 11% of cases [25]. Heart plays a crucial role in distributing blood to all parts of the human body. Therefore, any issues with the heart inevitably lead to complications in other organs [26].

Injury Pattern due to Accident

Road traffic accidents, particularly those involving motorcycles and other vehicles, were the leading cause of injuries, affecting 315 respondents. Data analysis revealed that these accidents frequently resulted in lower extremity injuries, reported by 216 respondents. Among these injuries, contusions and abrasions were the most prevalent, reported by 195 respondents. Statistical analysis using the chi-square test indicates a significant correlation between lower extremity injuries with contusion or abrasion and fracture. This evidence demonstrates that, regardless of anatomical topography, nearly all contusions or abrasions and fractures due to accident are occur on the lower extremity. In motor vehicle accidents, legs often get trapped or hit inside the vehicle, causing severe injuries. During accidents or falls, the body instinctively absorbs impact with the legs, making lower extremities especially vulnerable [27].

Similar research conducted at RSUP Prof. Dr. R. D. Kandou Manado revealed that the predominant injury pattern among respondents was abrasions on the extremities [28]. In contrast, research at the Forensic Medicine Installation at Sanglah General Hospital documented head and face injuries, including abrasions and fractures [29]. Although chest injuries are less common than lower extremity injuries, chi-square statistical analysis shows a significant correlation between

chest injuries and fractures. Chest injuries in accidents often result from the chest colliding with an object, most commonly the seat belt, leading to injuries that can range from contusions to fractures, depending on the force of the impact [30].

Injury Pattern due to Fall

Falls are the second most common cause of injury, affecting 193 respondents. According to the data, falls frequently result in lower extremity injuries, with 112 respondents affected. The most prevalent types of injuries reported were contusions or abrasions, occurring in 60 of these cases. With an asymptotic significance (2-sided) value lower than the established significance level of 0.05. This evidence demonstrates that, regardless of anatomical topography, nearly all contusions or abrasions resulting from fall are occur on the lower extremity.

Similar research findings also indicate that the lower extremity is the most frequently injured body part from stepladder falls [31]. In pediatric fall cases, a significant number of injuries are attributed to intracranial trauma, with half involving severe extracranial injuries. Notably, upper extremity fractures were common, accounting for 6.2% of these cases [32]. Although upper extremity injuries are not as common as lower extremity injuries, chi-square statistical analysis shows a significant correlation between upper extremity injuries and fractures. The body's positioning and natural reflexes to brace or balance itself during a fall or impact contribute to the high incidence of upper extremity fractures in fall cases [27].

Injury Pattern due to Hit or Thrown by Blunt Object

In contrast, incidents related to blunt object impacts or being thrown were the least frequent, involving 11 respondents. It can be deduced that these incidents often lead to head and lower extremity injuries, affecting 4 individuals each. Specifically, head injuries commonly included contusions, abrasions, and lacerations, affecting 2 individuals each. Similarly, lower extremity injuries predominantly consisted of contusions and abrasions, affecting 2 individuals. The most influential is the location of head injuries and lacerations with an asymptotic significance value (2 sides) lower than the previously determined significance limit, namely 0.05. This evidence demonstrates that, regardless of anatomical topography, all lacerations resulting from hit or thrown by a blunt object are occur on the head. A head impact involving rapid acceleration and a hard object can lead to severe injuries such as scalp tears, impression fractures, and hemorrhages within the brain membranes [30]. Similar studies have also shown that head injuries are the most frequent result of blunt force trauma, affecting 80.8% of victims, while 20% experience visceral organ ruptures [33]. Additionally, research conducted at RS. Sartika Asih found

that lacerations were the most common injury in cases of blunt force impact, with 17 cases (34%), and the legs were the most affected body part, with 18 cases (25%) experiencing injuries [20].

Almost all cases of accidents, falls, and hit or thrown by a blunt object result in victims experiencing bruises or abrasions. This occurs because contusions and abrasions are often associated with other types of injuries. A contusion is the consequence of crushing or ripping the dermis and subcutaneous tissues without breaking the skin where the applied force induces blood vessel rupture, leading to fluctuating bleeding in the subcutaneous region [25]. An abrasion is a superficial injury that occurs on the skin or visceral linings of the body, disrupting tissue continuity [36]. Lacerations resulting from hit or thrown by blunt object also cause damage to both external and internal tissues, which is strongly related to bruises and abrasions. In both open and closed fractures, almost all cases involve bruises, abrasions, or lacerations [30].

CONCLUSION

It was found that accidents were the main cause of blunt trauma injuries in 2021. Men and adults were the most affected groups, with those having completed secondary school being the largest contributors. From the data obtained, accidents frequently lead to lower extremity injuries among 216 respondents, with contusion or abrasion being the most prevalent type of injury reported by 195 respondents. Injury to the lower extremities can result in significant long-term functional impairments, often result in loss of motoric. Statistical analysis using the chi-square test indicates a significant correlation between lower extremity injuries with contusions or abrasions and permanent wounds.

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