



Characteristics of a trauma paediatric patient transported by emergency medical services: a retrospective analysis.

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Data Curation - B
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ABSTRACT

INTRODUCTION: Injuries represent a widespread health problem worldwide and are the leading cause of both mortality and morbidity among children worldwide. This study examines the temporal trends of injured children transported by ambulance with the retrospective analysis of prehospital medical treatment and care.

MATERIALS AND METHODS: We analysed all trauma patients transported by ambulance to the Emergency Department in the Paediatric Teaching Hospital of the University Clinical Centre of the Medical University of Warsaw in 2021. Analysis was restricted to a cohort of patients with arrival in ambulances before hospitalisation. A total of 981 patients met these criteria and were included in the analysis. Patient data was analyzed with respect of age, gender, location of the event, trauma mechanism, presence of alcohol or recreational drugs, suspicion of suicide, localisation and character of trauma, vital signs, signs and symptoms, pain assessment, treatment and procedures, and Glasgow Coma Scale (GCS) score. The relationships between the variables were examined using the dependence χ^2 test, while the strength was investigated using the Cramer's V coefficient.

RESULTS: Males comprised 58% of the patient population, with a predominance in all age groups. Head trauma was the most frequently diagnosed injury. Accidents were the primary cause of injury, occurring frequently both in domestic and public settings. The specific cause of the injury varied according to the age and gender. A slightly higher volume of patients was observed on weekends and during the day compared to weekdays and regular business hours. Most of the injured children were transported by paramedic emergency medical services. Pain (66.36%) was the most prevalent symptom, followed by bleeding (18.04%). Approximately 6.12% of the patients required hospitalisation for at least 24 hours. The relationship between the child's age and the mechanism of the injuries is statistically significant [$\chi^2 = 290,144$; degrees of freedom (df) = 27; $p < 0,05$] and the association is medium [Cramer's V coefficient = 0,314]. The relationship between the child's gender and the mechanism of injuries is statistically significant [$\chi^2 = 37,844$; degrees of freedom (df) = 9; $p < 0,05$].

CONCLUSIONS: Severe injuries in children are rare. Boys experience more injuries than girls. A significant portion of injuries occur at home. The mechanism of injury is correlated with age group and gender, but falls from height are the most common. Peak times are during the day and in the summer months, which should be taken into account for personnel planning. The improvement of the safety of children must continue.

KEY WORDS: Injury, trauma, paediatric, child, emergency medical service, emergency department.

INTRODUCTION

Injuries represent a widespread health problem worldwide and are the leading cause of both mortality and morbidity among children worldwide. Unintentional injuries include road traffic accidents, falls, burns, drownings, poisonings, and others. Intentional injuries are intentionally inflicted and are often associated with violence. These include domestic violence, sexual assault, aggravated assault, homicide, and suicide. Unintentional injuries are the leading cause of death for children and youth aged 1–19 in the United States [1]. In Poland, according to 2014 data, about 50% of deaths among children and adolescents aged 1-19 years were attributed to external causes, including unintentional and intentional causes [2]. Our objective is to deduce the prevalent types of injuries in children, as well as the precipitating factors associated with their occurrence. Based on the population our studied, we aim was to conclude the severity of injuries in children, how often they require hospitalisation, and how frequently they are associated with permanent health impairment. By analysing and reviewing other studies, we will be able to discuss the importance of accident prevention and enhancing prehospital care.

MATERIALS AND METHODS

This research involves a retrospective analysis of medical documentation from patients transported by ambulance to the Emergency Department (ED) of the Paediatric Teaching Hospital in Warsaw, Poland. Data for the study were collected between January 1, 2021, to December 31st, 2021. The inclusion criteria required paediatric patients (defined as a patient under 18 years of age) to present with injury suspicion of injury, or burns, and transportation to the emergency department by the emergency medical service (EMS). Our analysis was restricted to a cohort of patients with arrival in ambulances before hospitalisation. This selection bias reflects the origin of our data, derived from a registry established to identify potential participants for a previous investigation into paediatric trauma centres. Patients requiring treatment within a trauma center are unlikely to present to the hospital by private conveyance or independent ambulation. A total of 981 patients met these criteria and were included in the analysis. Patient data was analyzed with respect of age, gender, location of the event, trauma mechanism, presence of alcohol or recreational drugs, suspicion of suicide, localisation and character of trauma, vital signs, signs and symptoms, pain assessment, treatment and procedures, and Glasgow Coma Scale (GCS) score. The data collected were used to create a database and compared with the literature review conducted using PubMed resources. The data source is the documentation from the Emergency Department at the Clinical Centre of the Paediatric Teaching Clinical Hospital of the Medical University of Warsaw. The approval for access to patient documentation and publication has been received from the hospital director. Following the Declaration of Helsinki, the study was fully anonymised, ensuring no data could be used to identify patients. Ethics committee approval was received for this study from the Ethics Committee of the Medical University of Warsaw - decision number *AKBE/80/2022*. This work was supported and financed by a student mini-grant titled: *"Ocena aktywności Centrów Urazowych dla Dzieci w latach 2020-2021"* (Z/MG/21/22) from the Medical University of Warsaw, Żwirki i Wigury 61 Str., 02-091 Warsaw, Poland.

The relationships between the variables were examined using the dependence χ^2 test, while the strength was investigated using the Cramer’s V coefficient (>0.25 - very strong; >0.15 - strong; >0.10 - moderate; >0.05 - weak; >0 no or very weak). p-value<0.05 was considered statistically significant.

RESULTS

Age Distribution, Seasonal Trends, and Daily Patterns

In 2021, a total of 981 trauma patients were transferred to the Emergency Department (ED) by Emergency Medical Services (EMS) personnel. This represents 2.67% of the total admissions for that year, which amounted to 36,590 patients. The gender distribution of all patients was as follows: 412 (42%) women and 569 (58%) men and, in each age group, males dominated. To present the age distribution of trauma patients, we used the age division of children proposed by the Polish National Health Fund (NHF). The age distribution of the patients is presented in Table 1.

Table 1. The age and gender distribution of the patients.

NHF group	Age	Men [n]	Women [n]	Total	P-value
I	<2 years	87	71	158 (16,11%)	p=0.020
II	2-5 years	123	93	216 (22,02%)	
III	6-12 years	193	103	296 (30,17%)	
IV	>12 years	166	145	311 (31,7%)	

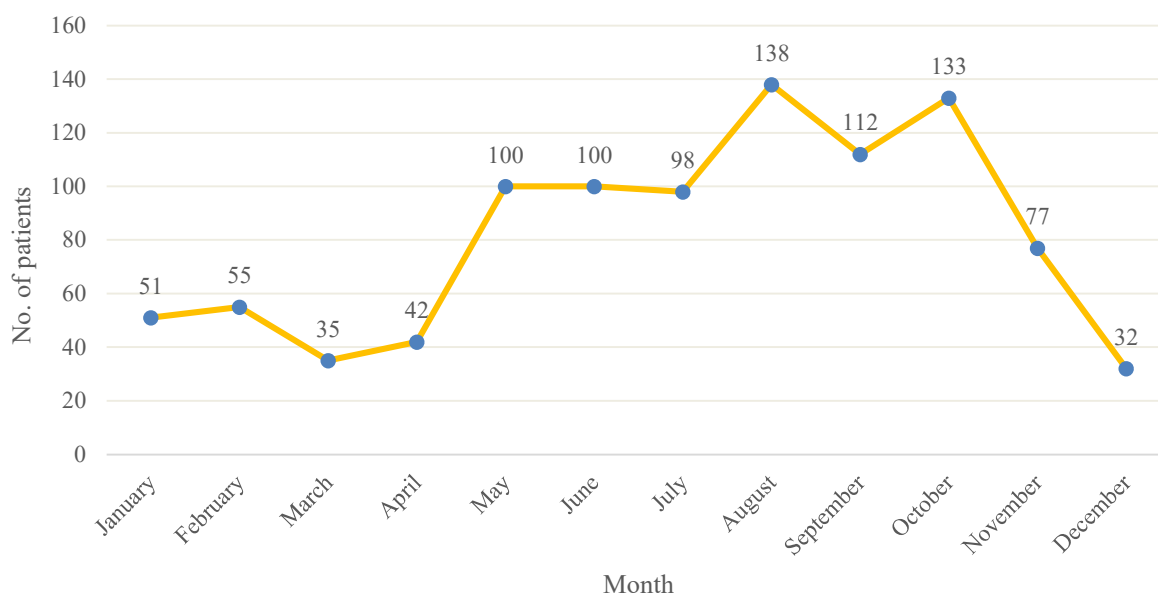


Figure 1. Number of cases in months.

The highest number of presentations in the emergency department was registered from May to October (Figure 1). Regarding the days of the week, it was found that the most frequent presentations in the emergency department were on Mondays (3.13 patients/day). Slightly more patients were seen on weekends (2.79 patients/day) than on weekdays (2.62 patients/day) (Figure 2). The vast majority of arrivals at the ED occurred during the day between 6 am and 10 pm (n=784, 79.92%). Data are available for 108 patients regarding their time of registration in the ED and for 8 patients regarding their date of admission.

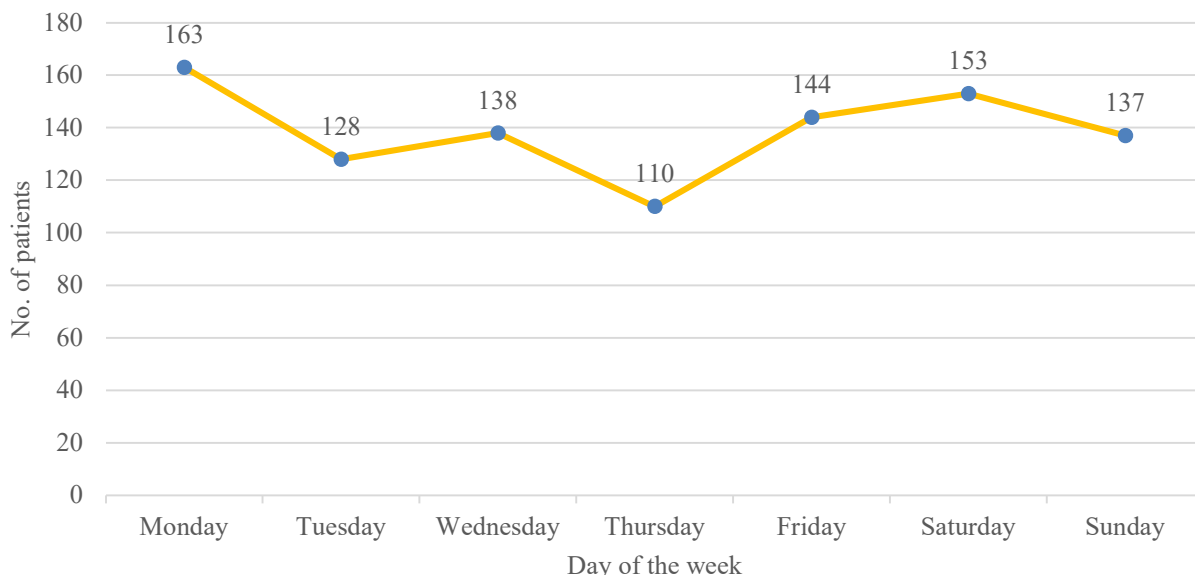


Figure 2. Number of cases by day of the week.

A significant proportion of injuries occurred at home 439 (44,75%) and in public places 280 (28,54%). The percentage of the incident is presented in Figure 3.

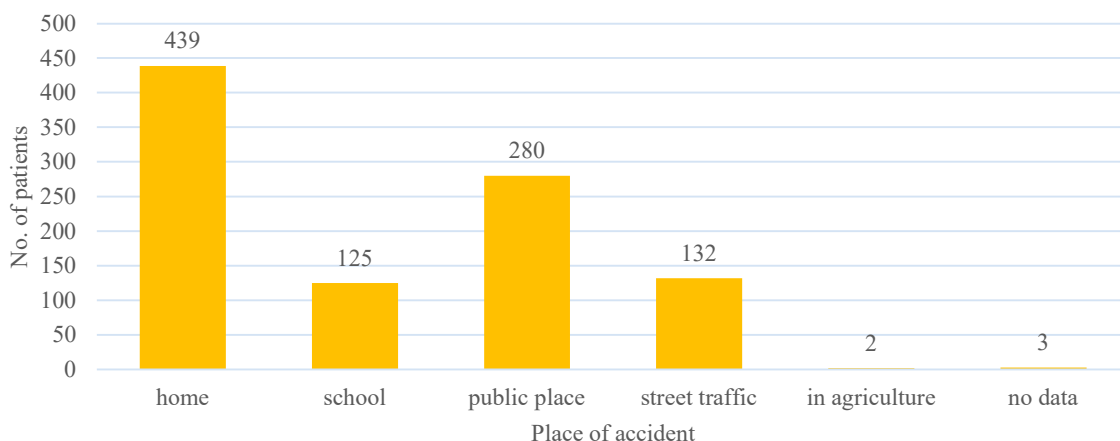


Figure 3. The location of the incident.

Taking into account the most common mechanisms of injury, falls from height affected 184 patients (18.76%), sports-related activities affected 151 children (15.39%), motor vehicle accidents affected 121 children (12.33%), collisions with objects affected 100 patients (10.19%), and falls from your own height affected 99 patients (10.09%). To better illustrate the mechanism of the injury, we decided to divide the patients into the age groups mentioned above and the gender groups.

Table 2. The number of patients and the cause of injury depend on age.

Type of accident	Children <2 years n = 158 (100%)	Children 2-5 years n = 216 (100%)	Children 6-12 years old n = 296 (100%)	Children >12 years n = 311 (100%)	P-value
motor vehicle accident	7 (4,43%)	22 (10,18%)	42 (14,19%)	50 (16,08%)	p=0.000
falls from height	71 (44,94%)	46 (21,3%)	36 (12,16%)	31 (9,97%)	p=0.000
collision with an object	13 (8,23%)	38 (17,59%)	32 (10,81%)	17 (5,47%)	p=0.000
fall from own height	13 (8,23%)	29 (13,43%)	30 (10,14%)	27 (8,68%)	p=0.286
force/violence	1 (0,63%)	4 (1,85%)	9 (3,04%)	16 (5,14%)	p=0.022
burns	17 (10,76%)	11 (5,09%)	4 (1,35%)	3 (0,96%)	p=0.000
suspicion of suicide attempt	0 (0%)	0 (0%)	2 (0,68%)	36 (11,58%)	p=0.000
sports-related activity	2 (1,26%)	10 (4,63%)	69 (23,31%)	70 (22,51%)	p=0.000
injury caused by contact with animals	0 (0%)	2 (0,93%)	4 (1,35%)	2 (0,64%)	too small sample size
others	34 (21,52%)	54 (25%)	68 (22,97%)	59 (18,97%)	p=0.392

Among the surveyed group of patients, the most common injury was head trauma, affecting 591 patients (60.24%). The number of injured areas is presented in Figure 4. In some cases, the injury did not affect only one area of the body; therefore, the total number of injuries is higher than the total number of patients. It is important to mention that most of the injuries were superficial (n = 313, 31.9%). An open wound/abrasion occurred in 211 (21.5%) cases and a fracture occurred in 78 (7.95%) cases.

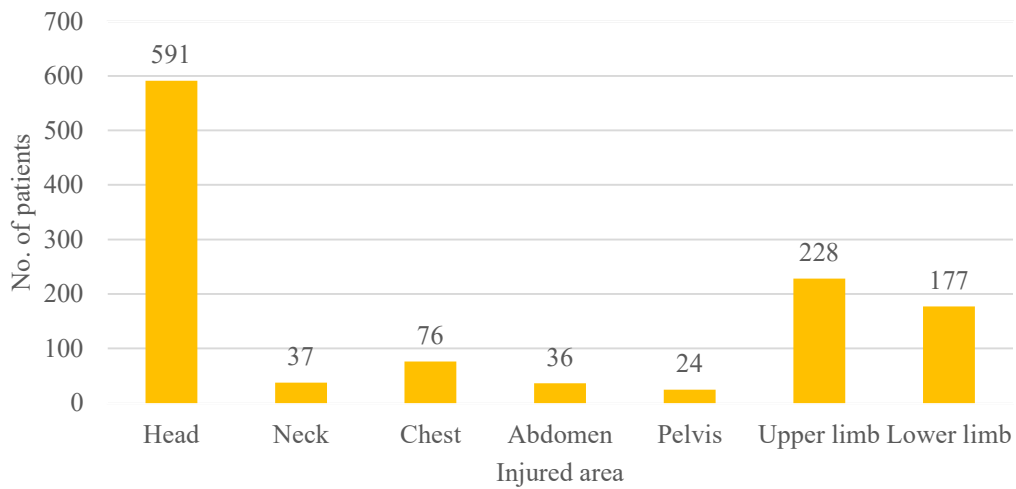


Figure 4. The location of the injury.

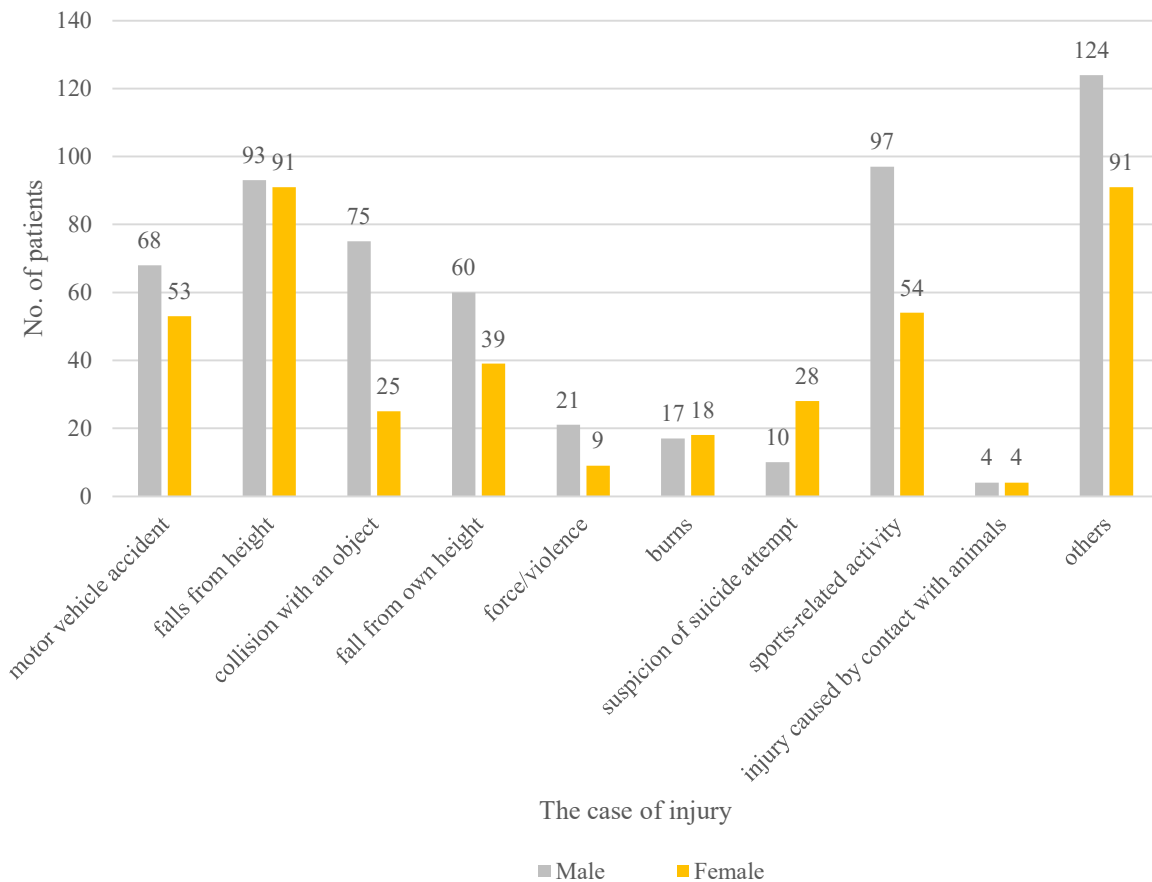


Figure 5. The cause of injury depending on the gender.

Age and Gender Differences in the Mechanisms of Injury

The analysis presented clearly indicates that the cause of the injury depends on the age and gender, presented in Table 2 and Figure 5. The relationship between the child's age and the mechanism of the injuries is statistically significant [$\chi^2 = 290,144$; degrees of freedom (df) = 27; $p < 0,05$] and the association is medium [Cramer's V coefficient = 0,314]. When comparing age groups, falls from height are the most common cause of injury in children under the age of 2 years (44.94%, $n = 71$) and between 2 and 5 years old (21.3%, $n = 46$), while sports-related activities are the most common cause of trauma in children between 6 and 12 years old (23.31%, $n = 69$) and those above 12 years old (22.5%, $n = 70$). Burns are the main cause of trauma in younger children, under 2 years of age (48.57%, $n = 17$) and between 2 and 5 years of age (31.43%, $n = 11$). In contrast, suspicion of suicide attempts, which are the cause of trauma mainly in children older than 12 years (94.74%, $n = 36$). The relationship between the child's gender and the mechanism of injuries is statistically significant [$\chi^2 = 37,844$; degrees of freedom (df) = 9; $p < 0,05$] but the association is weak [Cramer's V coefficient = 0,196]. A summary of the causes among children arriving at the emergency department by ambulance, divided by gender, is presented in Figure 5. Boys tend to suffer more often from collisions with objects (75%, $n = 75$), sports-related activities (64.24%, $n = 97$), and falls from their own height (55.05%, $n = 60$). On the contrary, the suspicion of suicide attempts occurs more frequently in girls (73.68%, $n = 28$).

Types of EMS Transport

Most of the injured patients, 837 (85%), were transported by paramedic EMS, which is a standard van-type ambulance used for emergency responses when a physician EMS unit is unavailable, and for lower-priority emergency calls. Such vehicles will not be used for consultations or for non-emergency transport. Standard personnel staffing will consist of paramedics (or specialised nurses) and a driver-Paramedic orderly. 126 (13%) children were transported to the ED by an EMS physician. This is used only for life-threatening responses. Standard personnel staffing consists of a doctor (with emergency medicine specialisation), a paramedic (or specialised nurse), and a driver/orderly. 12 patients were transported by helicopter emergency medical service (HEMS) [3]. Data on the type of transportation are presented in Figure 6.

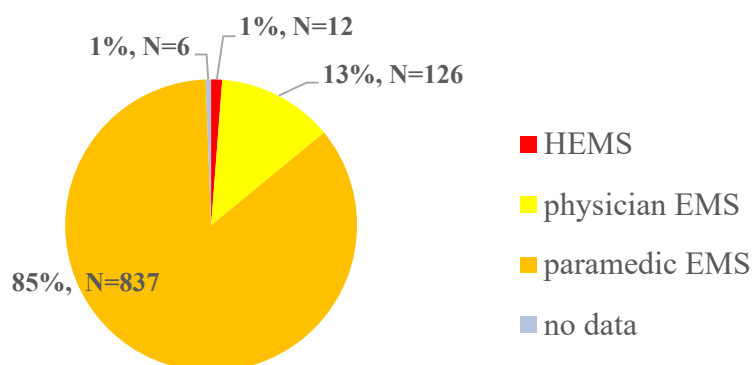


Figure 6. Types of transportation used in the emergency department.

Signs and Symptoms

The signs and symptoms of injured patients are presented in Figure 7. In the study, the findings revealed that among participants the most commonly reported symptoms are pain (n = 651, 66,36%) and bleeding (n = 177, 18,04%).

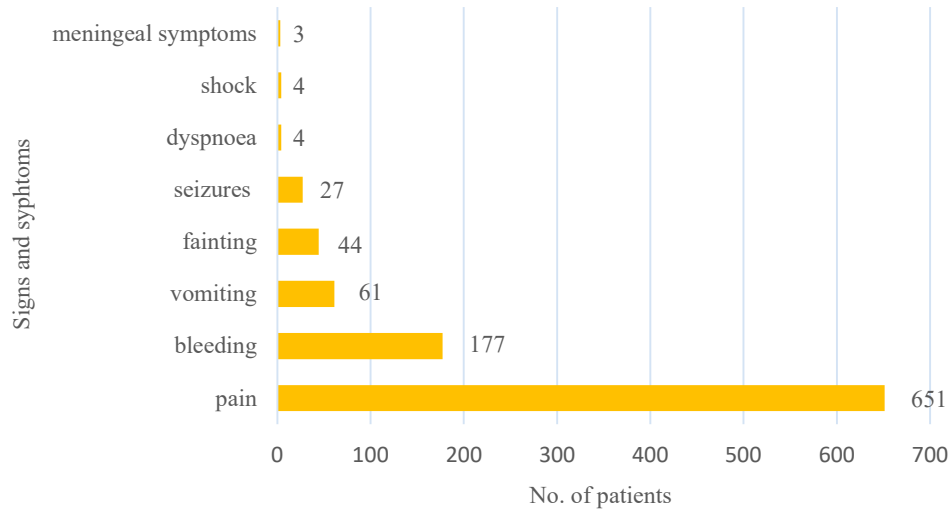


Figure 7. Signs and symptoms presented by injured children.

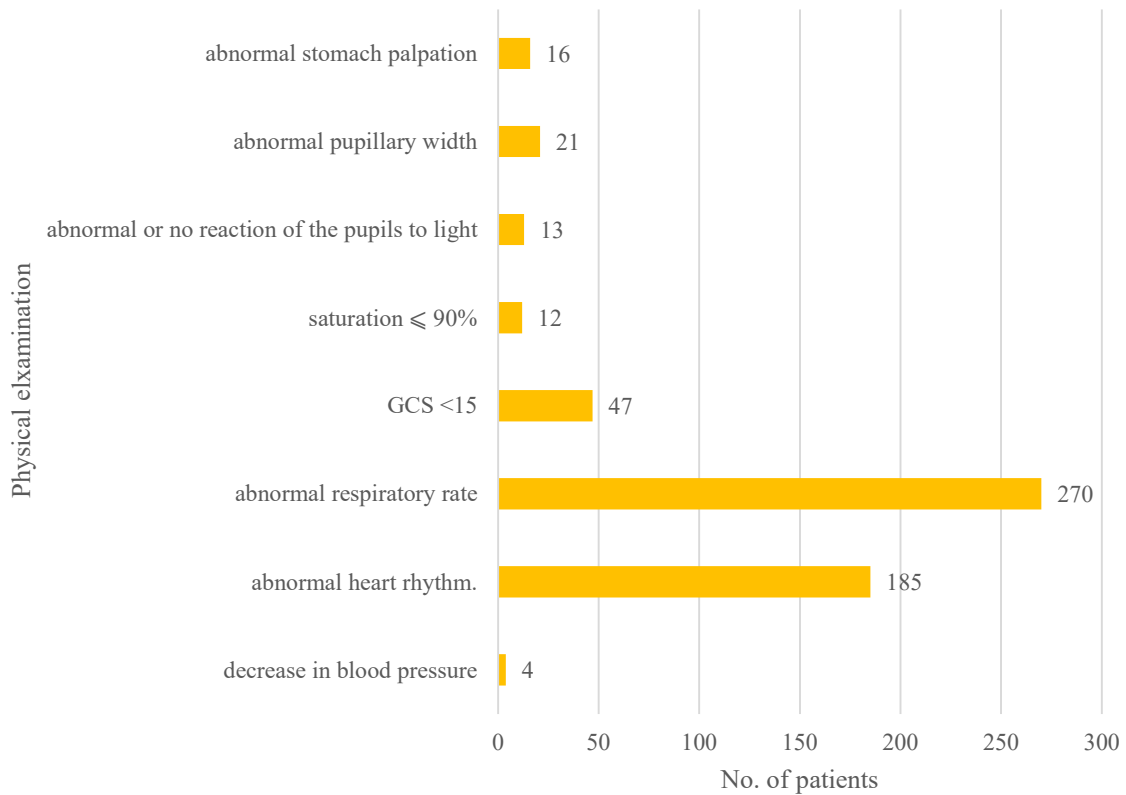


Figure 8. The results of the patient's physical examinations.

Children with trauma often had abnormal respiratory rates (n = 270, 27.52%) and abnormal heart rhythms (n = 185, 18.87%). Other deviations in the physical examination presented by the patients include a variety of different symptoms and signs: abnormal stomach palpation (n=16, 1,63%), abnormal papillary width (n=21, 2,14%), abnormal or no reaction of the pupils to light (n=13, 1,33%), saturation <90% (n=12, 1,22%), Glasgow Coma scale <15 points (n=47, 4,79%) and decrease in blood pressure (n=4, 0,4%), but their occurrence is not as common. The results of the patient examinations are shown in Figure 8.

Patient management

Several patients underwent more detailed diagnostics, 39 patients underwent ECG, 2 patients required USG FAST, and a trauma scan was performed. 665 (67.79%) of all visits resulted in some form of prehospital care. 205 (20.9%) children received pain therapy, 140 (14.27%) immobilisation, and 100 (10.19%) dressing. Only 5 patients needed intubation, and only 3 children required defibrillation. The data are presented in Figure 9.

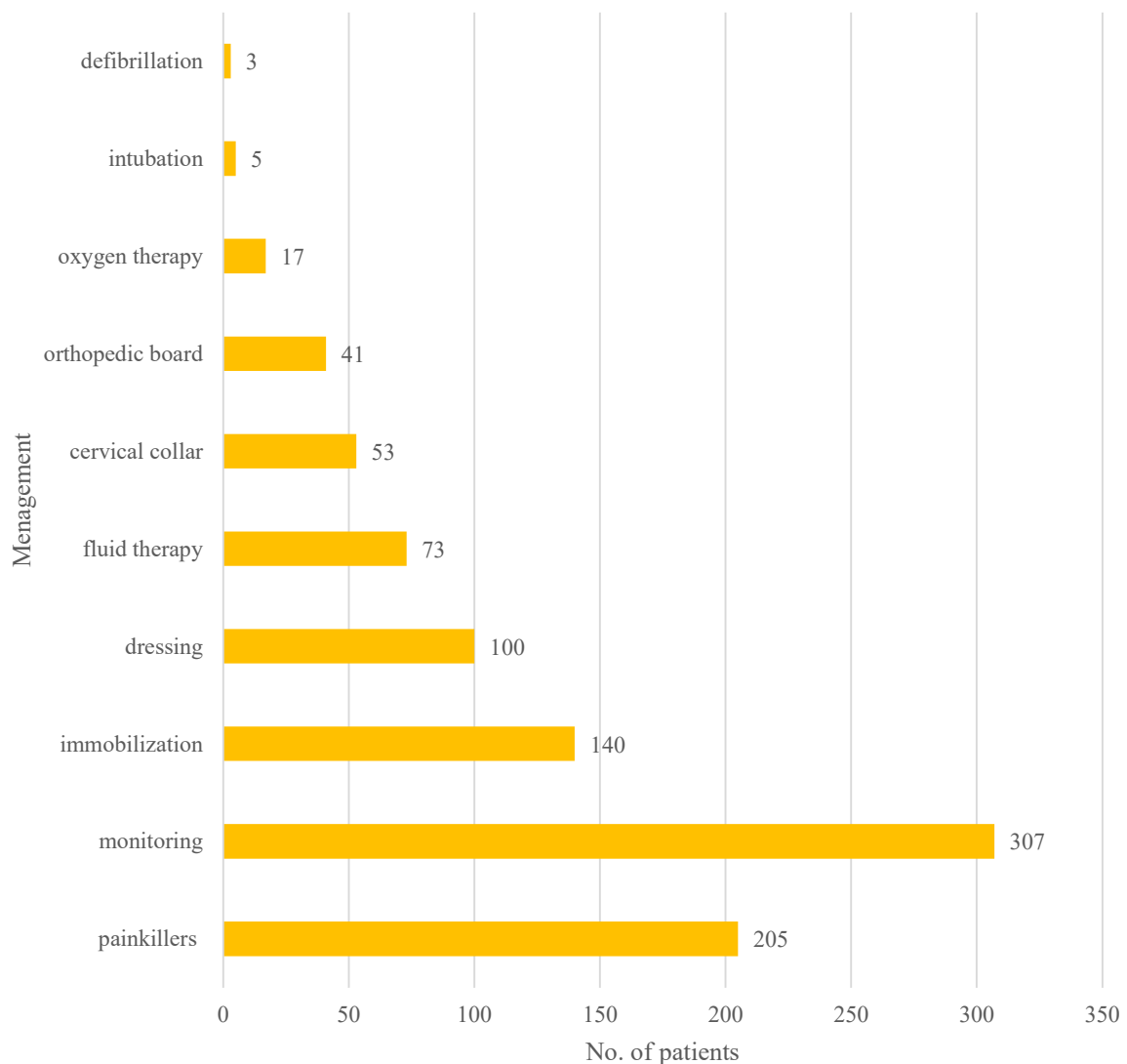


Figure 9. Applied patient management.

Only 27 patients were qualified for the Paediatric Trauma Centre (PTC), which is located in Pediatric Teaching Hospital. They meet certain criteria: minimum one specified anatomical injury, occurrence of multi-organ trauma, death of another patient in the same accident, fall from motor vehicle, crushing, falling from a height, long time of getting out of the vehicle, collapses or rubble, or the injury is accompanied by at least two of the following disturbances in physiological parameters: decrease of systolic blood pressure, abnormal heart rate, abnormal number of breaths, the state of consciousness assessed according to the criteria of the Glasgow Coma Scale (GCS) or the Children's Coma Scale (CCS) for children up to 3 years of age at no more than 13 points, arterial blood saturation not more than 90%.

We established that 60 (6,12%) patients were hospitalised for at least a day. 7 patients (0,71%) were transferred after examination to another facility. The average hospitalisation time for patients who were hospitalized is 11.01 days. 4 trauma patients were admitted to the intensive care unit. The average hospitalisation time in the Intensive Care Unit was 4.25 days. 21 patients (2,14%) underwent surgery. 7 children (0,71%) are patients with permanent health damage. No patient mortality was recorded during the study period; however, no comprehensive analysis of the complete length of hospital stay for some patients was carried out.

DISCUSSION

According to Sosada et al., 20 to 25% of the pediatric population is estimated to be injured each year that require medical intervention [4] and, as reported by the World Health Organisation, 40% of deaths in high-income countries are due to injuries [5]. Our study shows that in each age group, males dominated, which is in line with similar studies in paediatric populations varying from 58.4% to 64.3% in favour of males [6, 7, 8], We have seen a peak of trauma occurrence in ages 6-12. We suspect that it can be explained by a new pattern of activity, that Polish children are graduating from preschool to primary school. We observed the highest gender disproportion in the 6- to 12-year-old group (65.2%). According to Beth N. Rosen and Lizette Peterson [9], boys not only play outside more often, but also display more risky behaviours, which are reinforced by some parents and a lower quality of supervision [9]. The gender pattern is changing, and it is conjectured that it will disappear in the future [10].

Falls and traffic accidents were the leading mechanisms of injury according to CDC 2014 (Centers for Disease Control and Prevention) for the American population: 25.1% falls and 9.6% vehicle-related injuries, and for Polish adult patients: 38% falls and 22% vehicle-related injuries [11]. It is in line with the most common mechanisms in the Polish paediatric population (falls 28.85%), vehicle-related injury (12.33%) and with Cintean et al., who studied the German pediatric population et al., where falls accounted for 27.2% and road traffic accidents for 11.2% [7]. Our research found that younger children are significantly more likely to fall and vehicle-related injuries are more common in children older than 6. It is similar to the situation of paediatric accidents in the UK [8]. It is hypothesised that children may have difficulties in judgment of sounds and sights and have a much shorter attention span [12]. As they age, they become more mobile and take greater risks, which can lead to reduced road safety [12].

In our study, the main injury in all age groups was head trauma (60.24%). It is correlated with the results of the University Hospital for Paediatric Surgery No. 1 in Bydgoszcz (67,74%) and the Cinteau et al., and Ukrainian database [6, 7, 13]. This high rate of head trauma in children is due to the anatomy of the child. The head is relatively large and heavy compared to the rest of the body, increasing the risk of injury from falls, which is the primary mechanism of head injury. For the same reason, the head is more likely to be injured in a traffic accident than other parts of the body [4]. Another possible cause is the high level of anxiety of children's parents when head trauma occurs, even though these were most likely minor incidents, judging by the high GCS in most patients – only 4,79 % scored less than 15 points on the Glasgow Coma Scale.

The second group of injuries consisted of limb injuries (41.28%). Injuries to other areas of the body occurred much less frequently. The conclusion was very similar to the study of Germany and Ukraine [7, 13]. Compared to the Polish adult population, limb injuries were the leading cause (52%). However, head injuries were the second most common injury and consisted of 22.9% [11]. In our study, burns accounted for only 4% of all injuries; 47,22% of them occurred in children under 2 years of age, which corresponds to the assessment of childhood frequency in Poland (4,3%) [14, 15]. Although these occur due to careless behavior or accidental contact with hot liquid [14] or food [7], it is important to note that they can be related to abuse [16].

Most unintentional child injuries are minor and do not require hospitalisation. In our study, only 6.11% of the patients needed hospitalisation; 2,75% met the criteria for admission to the Paediatric Trauma Center. At the same time, the results of our research are identical to previous ones concerning paediatric trauma centers in Poland, where a very small number of patients are qualified each year [17]. In our opinion, the lack of use of clear algorithms to decide when paediatric trauma is needed to be treated in the hospital or not leads to unnecessary additional emergency department visits. Of all patients, just 0.71% sustained permanent health damage, compared to 10-15% in the adult population [11].

As a potential point of interest, we note that 66.36% of patients reported pain after the injury, and only 20.9% received pain medication. In our study, we did not compare pain severity with whether or not analgesic treatment was received, although this difference requires further work and clarification. At the same time, we know from other studies that pharmacotherapy is rarely used in children in other emergency situations, which may have been the case in our case [18].

It is worth mentioning the occurrence of seasonality: There is a considerable peak of injuries from April to October, plunging from October to December, and staying low until April. It can simply be explained by adequate, warm weather for outside activities and the beginning of fall in Poland in October, but further research is required. Additionally, a slight increase in treated patients from weekends (2,79 patients per day) to weekdays (2,62 patients per day) corresponds to the general trend in Germany, the UK, the USA and Australia [7, 19, 20, 21]. We may only theorise what causes this phenomenon.

LIMITATIONS - Data for this study was collected from a single hospital, which can limit the generalizability of the findings to other hospitals or regions. Some of the subgroups of patients in this study were small, which may have made it difficult to detect statistically significant differences between the groups. The study did not collect detailed information about the causes of injury, outcomes, or mortality. This information could have been used to identify additional factors that influence patient outcomes. In addition, the study only included patients who were brought to the hospital by ambulance. This means that the findings may not be generalisable to patients who were injured but did not seek medical transport. This study was retrospective; the data was collected after the events of interest had already occurred. This can make it difficult to draw causal inferences from the data. Furthermore, this study did not have a control group. The limitations of this study should be considered when interpreting the findings.

CONCLUSIONS

In each age group, boys experience more injuries than girls. The most common injury was head trauma, and the majority of injuries were superficial. The cause of the injury depends on the child's age and sex. Under 2 years of age and between 2 and 5 years of age, falls from height and burns are the leading cause of injuries. The most frequently reported symptom after trauma was pain. A significant portion of the injuries occurred at home. Falls from height were the most common injuries. When analysing days of the week, Mondays experienced the highest frequency of emergency department visits. Taking into account the months, from May to October the highest number of injuries was recorded. Peak times in the out-of-office hours and summer months should be taken into account in personnel planning.

Despite the relatively low mortality rates associated with trauma in paediatric patients, improving the safety of children should continue. Achieving this goal may be possible by teaching children about safety practices, rules of safe road and pedestrian crossing use, improving road safety, using appropriate protective gear, and parental supervision where necessary.

SUPPLEMENTARY INFORMATION

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Institutional Review Statement: The study was conducted according to the guidelines of the Declaration of Helsinki.

Informed Consent Statement: Not applicable

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

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