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Retrospective Analysis of Pediatric Head Trauma Patients

Pediyatrik Kafa Travması Hastalarının Retrospektif Analizi

İsmail İçlek[1], Batuhan Dereli[1], Yusuf Kılıç[1], Turan Çayır[1], Veysel Kıyak[2]

[1]Department of Neurosurgery, Muş State Hospital of Medicine, Muş, Turkey
[2]Department of Neurosurgery, Faculty of Medicine, Gaziosmanpasa University, Tokat, Turkey

Abstract

Aim: The purpose of this study was to increase the amount of epidemiological data regarding pediatric head traumas and emphasize the necessity of developing trauma prevention strategies.

Material and Method: The data of a total of 135 patients aged 0-18 referred to the Neurosurgery Clinic of Muş State Hospital between November 2022 and November 2024 were included retrospectively analyzed.

Results: Eighty one (60.0%) of the patients were male, and 54 (40.0%) were female. Falling from height (38.5%) was the most frequently encountered cause of trauma. According to their initial Glasgow Coma Scale (GCS) scores, 90.4% of the patients had mild (GCS 13-15), 3.7% had moderate (GCS 9-12), and 5.9% had severe (GCS 3-8) head traumas. Visits took place in the summer months at a rate of 43.7% and outside the working hours at a rate of 57.8%. There were 6 patients who required surgical intervention, and these patients had compression fractures and intracranial hematomas.

Conclusion: It should be kept in mind that pediatric head traumas are caused by preventable factors, and a significant proportion of these traumas can be prevented through appropriate precautions. The results of this study emphasize the need to increase the amount of epidemiological data related to pediatric head traumas and develop prevention strategies.

Keywords: Pediatric trauma, head trauma, epidemiology

Öz

Amaç: Bu çalışmanın amacı, pediatrik kafa travmalarına ilişkin epidemiyolojik veri miktarını artırmak ve travma önleme stratejileri geliştirilmesinin gerekliliğini vurgulamaktır.

Gereç ve Yöntem: Kasım 2022 ile Kasım 2024 arasında Muş Devlet Hastanesi Beyin Cerrahisi Kliniği'ne sevk edilen 0-18 yaş arası toplam 135 hastanın verileri retrospektif olarak incelendi.

Bulgular: Hastaların 81'i (%60,0) erkek, 54'ü (%40,0) kadındı. Yüksekten düşme (%38,5), en sık karşılaşılan travma nedeniydi. Başvuru anındaki Glasgow Koma Skalası (GKS) değerlerine göre hastaların %90,4'ü hafif (GKS 13-15), %3,7'si orta (GKS 9-12), %5,9'u ise ağır (GKS 3-8) kafa travmasına sahipti. Başvuruların %43,7'si yaz aylarında, %57,8'i ise mesai saatleri dışında gerçekleşmişti. Cerrahî müdahale gerektiren 6 hasta vardı ve bu hastalarda kompresyon kırıkları ile intrakraniyal hematomlar mevcuttu.

Sonuç: Pediatrik kafa travmalarının önlenebilir faktörlerden kaynaklandığı ve bu travmaların önemli bir kısmının uygun önlemlerle engellenebileceği unutulmamalıdır. Bu çalışmanın sonuçları, pediatrik kafa travmalarına ilişkin epidemiyolojik verilerin artırılması ve önleme stratejileri geliştirilmesi gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Pediyatrik travma, kafa travması, epidemiyoloji

Corresponding *(İletişim)*: İsmail İçlek, Department of Neurosurgery, Muş State Hospital of Medicine, Muş, Turkey
E-mail *(E-posta)*: i.iclek@yahoo.com
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INTRODUCTION

Pediatric head traumas (PHTs) are some of the most significant public health problems worldwide, and they are the most frequently encountered cause of morbidity and mortality in this age group.[1,2]

PHTs should be assessed separately from adult traumas and considered in the context of their own age group. There are several reasons for this, while the most important reasons include the larger head/body ratio of a child compared to an adult, the inadequate protection of intracranial structures by the thinner bone structure of a child's cranium, the mechanism of injury, and differences in long-term prognosis.[3,4] Most PHTs are caused by preventable factors, and the rates of these traumas and their subsequent complications can be minimized by taking the necessary precautions.[1] Falls from height are the most common form of injury, followed by motorized vehicle accidents.[5]

With today's technology, the diagnosis of traumas in general is made using X-ray imaging, ultrasonography, and computed tomography (CT) methods.[6] The gold standard method for the examination of PHT cases is cranial CT (CCT).[7] The Glasgow Coma Scale (GCS) is an internationally adopted scoring system that evaluates the neurological state of a patient. It has a score range of 3-15, and lower scores indicate an increased severity of trauma and a poorer neurological state.[8,9] Head traumas are examined under three categories based on the GCS scoring system: mild (GCS) 13-15), moderate (GCS 9-12), and severe (GCS 3-8).[8]

The review of the literature showed that the causes and mechanisms of head traumas show variations from country to country and even from one region to another in the same country. This once again highlights the importance of epidemiological studies on the topic. There is a very limited number of studies on PHTs in Turkey. For this reason, we aimed to share our clinical experiences and contribute to the literature by retrospectively analyzing the data of pediatric patients who were brought to our clinic with head traumas.

MATERIAL AND METHOD

After receiving the approval of the local ethics committee with the decision date 12/02/2025 and numbere 25-MOBAEK-014, The study was carried out retrospectively with 135 patients aged 0-18 years who were referred to the Neurosurgery Clinic of Muş State Hospital in Turkey between November 2022 and November 2024. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The sample included patients who were brought to the emergency service with head traumas and then referred to the Neurosurgery Clinic. The study excluded patients in the same age group who did not have head traumas and patients with head traumas who were older than 18 years old. The patients were divided into three groups at the ages of 0-2 years (infancy), 3-7 years (play age), and 8-14 years (school age). The data of all patients were reviewed in terms of age, sex, triage zone, time to first examination, cause of trauma, GCS score at the time of presenting, monitoring duration, affected cranial region, unit of initial monitoring, month of trauma, time (hours) of hospital visit, accompanying pathologies, and surgical operation requirements. The patients were also divided into three groups as follows: mild head trauma (GCS 13–15), moderate head trauma (GCS 9–12), and severe head trauma (GCS≤8). All patients were subjected to CCT scans in a neutral position, and their CCT results were recorded.

RESULTS

The patient population was found to be 60.0% (n=81) male and 40.0% (n=54) female. It was determined that the vast majority of patients (90.4%, n=122) had a GCS score between 13-15 upon admission, while 5.9% (n=8) had a GCS score of 8 or below, and 3.7% (n=5) had a GCS score between 9-12. **Tables 1-6** present the distributions of the patients based on their demographic characteristics.

Table 1.Age and sex distributions of the patients

Variables	Groups	Frequency	Percentage
Age (years)	0-2 (infancy)	63	46.7
	3-7 (play age)	35	25.9
	8-14 (school age)	24	17.8
	14 or older	13	9.6
Sex	Male	81	60.0
	Female	54	40.0

Among all groups created based on the ages of the patients, the 0-2 (infancy) age group had the highest rate(46.7%, n=63). This was followed by the 3-7 (play age) (25.9%, n=35) age group, the 8-14 (school age) (17.8%, n=24) age group, and the≥14 (9.6%, n=13) age group. **Figure 1** also shows the distributions of the patients based on their sex and age.

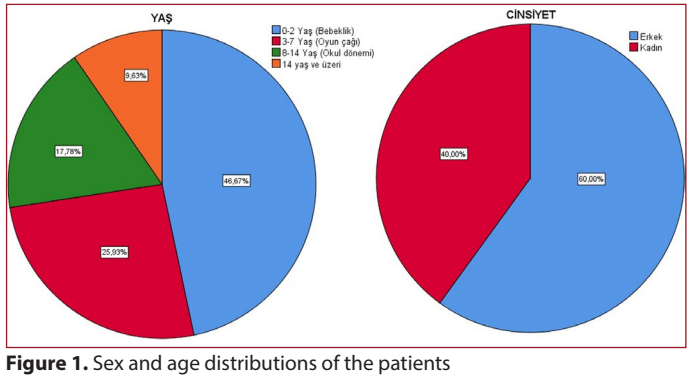

Figure 1. Sex and age distributions of the patients

Table 2.Triage information, examination times, and causes of trauma

Variables	Groups	Frequency (n)	Percentage (%)
Triage	Red zone	19	14.1
	Yellow zone	116	85.9
Time met (min) after presenting	12 or below	57	42.2
	13-25	27	20.0
	26-41	19	14.1
	42-65	17	12.6
	66 or above	15	11.1
Cause of trauma	EVTA	19	14.1
	IVTA	11	8.1
	FAI	2	1.5
	Assault	4	3.0
	At home	29	21.5
	Outside home	18	13.3
	Fall from height	52	38.5

EVTA: Extravehicular traffic accident, IVTA: Intravehicular traffic accident, FAI: fire arm injury

It was determined that most of the patients (85.9%, n=116) were assigned to the yellow zone after triage, while 14.1% (n=19) were assigned to the red zone. It was found that 42.2% (n=57) were seen within 12 minutes or less after they arrived at the hospital, 20.0% (n=27) were seen within 13-25 minutes, 14.1% (n=19) were seen within 26-41 minutes, 12.6% (n=17) were seen within 42-65 minutes, and66 minutes or more passed before 11.1% (n=15) were seen. The most frequently encountered cause of trauma was falling from height (38.5%, n=52), followed by traumas in the home environment (21.5%, n=29), EVTA (14.1%, n=19), traumas outside the home environment (13.3%, n=18), IVTA (8.1%, n=11), assault (3.0%, n=4), and FAI (1.5%, n=2).

Table 3.Initial Glasgow Coma Scale, monitoring durations, and affected regions of the patients

Variables	Groups	Frequency	Percentage
Presenting GCS	≤8	8	5.9
	9-12	5	3.7
	13-15	122	90.4
Monitoring duration (days)	1-2	69	51.1
	3-4	24	17.8
	5 or more	10	7.4
	Referred to another center	32	23.7
Affected cranial region	Frontal	50	37.0
	Frontoparietal	1	0.7
	Occipital	21	15.6
	Parietal	52	38.5
	Temporal	11	8.1

GCS: Glasgow Coma Scale

While 51.1% (n=69) of the patients were monitored for 1-2 days, 17.8% (n=24) were monitored for 3-4 days, 7.4% (n=10) were monitored for 5 days or longer, and 23.7% (n=32) were referred to another center. The most frequently affected cranial region was the frontal (37.0%, n=50) and parietal (38.5%, n=52) regions, followed by the occipital (15.6%, n=21), temporal (8.1%, n=11), and frontoparietal (0.7%, n=1) regions.

Table 4. First monitoring unit, trauma months, and hospital arrival times of the patients

Variables	Groups	Frequency (n)	Percentage (%)
First unit of monitoring	Emergency service	47	34.8
	Anesthesial CU	1	0.7
	Neurosurgery inpatient clinic	21	15.6
	Pediatric ICU	28	20.7
	General ICU	1	0.7
	ENT inpatient clinic	1	0.7
	Orthopedics inpatient clinic	4	3.0
	ICU referral	32	23.7
Trauma month	January	3	2.2
	February	5	3.7
	March	9	6.7
	April	9	6.7
	May	18	13.3
	June	22	16.3
	July	25	18.5
	August	12	8.9
	September	6	4.4
	October	9	6.7
	November	11	8.1
	December	6	4.4
Arrival time (hours)	00:00-08:00	11	8.1
	08:01-16:00	46	34.1
	16:01-00:00	78	57.8

Most of the patients were monitored for the first time in the emergency services (34.8%, n=47), followed by ICU referrals(23.7%, n=32), PICUs (20.7%, n=28), and neurosurgery inpatient clinics(15.6%, n=21). Other units of first monitoring were orthopedics inpatient clinics (3.0%, n=4) and anesthesia ICU, general ICU, and ENT inpatient clinic units (0.7%, n=1). Most traumas occurred in July (18.5%, n=25), followed by June (16.3%, n=22), May (13.3%, n=18), August (8.9%, n=12), March, April, and October (6.7%, n=9), November (8.1%, n=11), September and December (4.4%, n=6), February (3.7%, n=5), and January (2.2%, n=3). While 8.1% (n=11) of the patients were brought to the hospital at the hours of 00:00-08:00, 34.1% (n=46) were brought at 08:01-16:00, and 57.8% (n=78) were brought at 16:01-00:00. The units where the patients were monitored firth, the months of their visits, and their hours of presenting to the hospital are also presented in **Figure 2**.

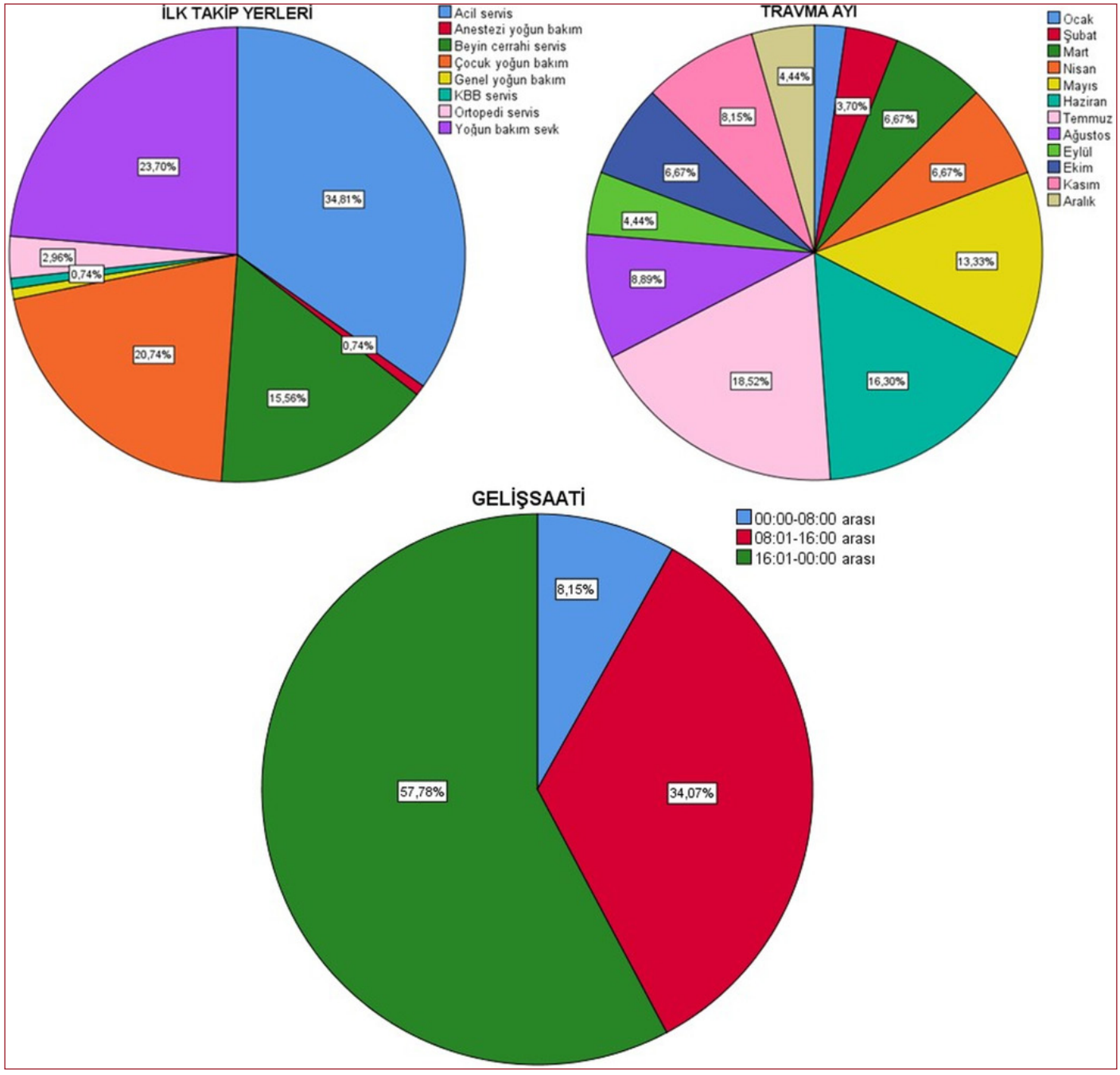

Figure 2. First monitoring unit, trauma months, and hospital arrival times

The types of traumas accompanying the head traumas of the patients the most were orbital fractures (8.1%, n=11) and extremity fractures (4.4%, n=6). While 3.7% (n=5) of the patients had mastoid fractures, 2.9% (n=4) had extremity fractures, thoracic trauma, and abdominal trauma, 2.2% (n=3) had orbital and maxillofacial fractures, 2.2% (n=3) had extremity fractures and spinal trauma, 2.2% (n=3) had sinus fractures, 1.5% (n=2) had abdominal trauma, 1.5% (n=2) had abdominal and thoracic trauma, 1.5% (n=2) had extremity fractures and abdominal trauma, 1.5% (n=2) had extremity fractures and thoracic trauma, 1.5% (n=2) had spinal trauma, 0.7% (n=1) had extremity fractures, thoracic trauma, and orbital trauma, 0.7% (n=1) had thoracic trauma, and 0.7% (n=1) had thoracic and spinal trauma.

Linear fractures were the most frequently observed pathology (30.4%, n=41) among the patients. Other pathologies included subgaleal hematomas (18.5%, n=25), compression fractures (7.4%, n=10), subdural hematomas (6.7%, n=9), linear fractures and subdural hematomas (5.9%, n=8), contusions (5.2%, n=7), linear fractures and epidural hematomas (3.7%, n=5), and contusions and traumatic subarachnoid hemorrhages (SAH) (3.7%, n=5). Less frequently encountered

pathologies were compression fractures with subdural hematomas (2.2%, n=3), linear fractures and traumatic SAH (2.2%, n=3),compression fractures and traumatic SAH (1.5%, n=2), epidural hematomas and traumatic SAH (1.5%, n=2), linear fractures, contusions, and traumatic SAH (1.5%, n=2), compression fractures and epidural hematomas (0.7%, n=1), compression fractures, epidural hematomas, and subdural hematomas (0.7%, n=1), linear fractures and contusions (0.7%, n=1), linear fractures and pneumocephalus (0.7%, n=1), linear fractures, traumatic SAH, and epidural hematomas (0.7%, n=1), subdural hematomas and traumatic SAH (0.7%, n=1), subdural hematomas, traumatic SAH, and contusions (0.7%, n=1), and traumatic SAH (0.7%, n=1).

As seen in Table 7, most of the patients (95.6%) did not require surgery. The reasons for the surgeries of the rest of the patients were compression fractures (2.2%, n=3), compression fracture, epidural hematoma, and subdural hematoma (0.7%, n=1), epidural hematoma (0.7%, n=1), and subdural hematoma (0.7%, n=1). It is seen that most of the patients were followed up without any surgical intervention, whereas those requiring surgeries mostly had compression fractures. The breakdown of the surgical procedures of the patients is displayed in **Figure 3**.

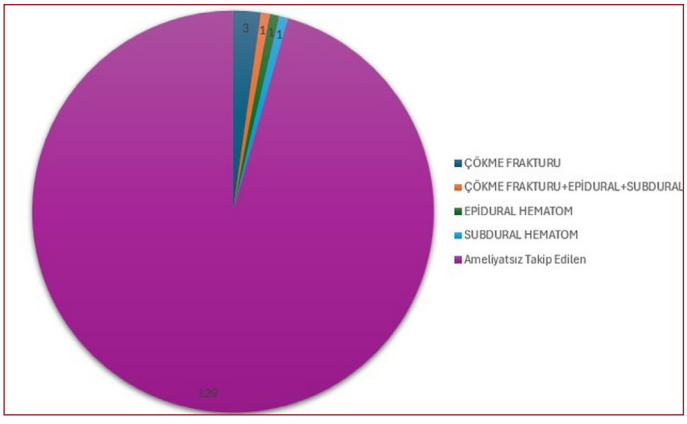

Figure 3. Surgical operations of the patients

DISCUSSION

Traumas at pediatric ages are some of the most significant public health problems and constitute the most prevalent cause of child deaths.[5,10,11] The most frequently affected body part in pediatric trauma cases is the head, and 80% of mortalities associated with multiple traumas were found to involve head traumas.[12,13] Although there has been a dramatic improvement in trauma-related brain damage rates in developed countries thanks to well-equipped and specialized ICUs, the adoption of a disciplined approach, and the minimization of preventable causes, head trauma cases continue to be a challenge in Turkey and the surrounding region for neurosurgery units despite some improvements in conditions.

One of the issues drawing attention in the literature is that falls from heights and traffic accidents, which are prominent causes of pediatric traumas, are among the causes that are preventable or minimizable with the appropriate precautions.[1,10,11,14] This prevention or minimization could only be possible by the accurate identification of the problem at its source and the development of rational solutions and recommendations for this source. Although there are several studies on this topic in general[1,15] there are not enough epidemiological studies in the region encompassing Turkey. In this study, by retrospectively analyzing the cases of 135 pediatric patients, important information was obtained about the epidemiology, etiology, and clinical outcomes of pediatric head traumas.

In our study, the 0-2 (infancy) age group constituted the higher rate of the patients (46.7%, n=63). This age group was followed by the 3-7 (play age)(25.9%, n=35), 8-14 (school age)(17.8%, n=24), and 14+ (9.6%, n=13) age groups. Male patients also constituted the majority (60.0%) of our sample. Male children were also found to have higher rates among trauma patients presenting to emergency services in the study conducted by Ceylan et al.,[16] in the study carried out on childhood accidents by Sieben et al.,[17] and in the study of injuries in the pediatric population performed by Wang et al.[18] These results were in agreement with our results. The finding of the highest rate of patients in the 0-2 age group in our study may be attributed to the fact that families in the region where our study was conducted are crowded in general, the care of infants aged 0-2 is usually shared between parents and other children in the household, and the region has a low sociocultural status. The rates of trauma cases gradually decreased in older age groups, in which children are expected to take on their own care and develop awareness.

Trauma patients who are referred to neurosurgery units from emergency services are usually assigned to the red and yellow zones after triage, and their tests, diagnoses, and treatments are completed in these zones.[19] The patients referred to us consisted of red and yellow zone patients, most of whom (85.9%) were assigned to the yellow zone. More than 50% of consultations evaluated by our unit were seen to within the first 30 minutes. The referrals of the patients from their respective zones following triage were compatible with other reports in the literature,[19] and the consulted patients were usually met within a reasonable time. The cases of the patients who could not be examined within the first 30 minutes could have been related to the cancellation of consultation after the emergency interventions of the patients or the prolongation of waiting times due to termination of access to computers after the examination of the patients by physicians who were contacted via telecommunication channels during their emergency on-call shifts and the subsequent cancellation of their consultations. The results of our study showed that the most prevalent cause of traumas was falling from a height at a rate of 38.5%. Similarly, falls from height have been reported to be the most prevalent causes of trauma in the literature.[3,13,14] Another study evaluating pediatric head trauma patients reported that motor vehicle accident-related trauma was more common.[20] However, the results were generally consistent with ours.

In our study, 90.4% of the patients were in the mild head trauma (GCS 13-15) group. This showed that pediatric head traumas in our region were usually mild cases, and the need for ICU admission was rare. According to the collected data, because the general status of the patients was good at the time of their visits, they were usually monitored at the emergency services (34.8%), and most (51.1%, n=69) were monitored for two days or less. Suresh et al. reported the rates of poor patient outcomes as 58.5% in the GCS 3-5 group, 35.2% in the GCS 6-8 group, 11.4% in the GCS 9-12 group, and 1.3% in the GCS 13-15 group.[21] In addition to this, the fact that 5.9% of the patients in our sample had severe head trauma (GCS 8 and below) demonstrated the importance of preventing mortality and morbidity through early diagnosis and appropriate treatment approaches. More than 50% of cranial fractures in pediatric patients are seen in the parietal and frontal bones, and they are mostly accompanied by contusion and hematoma.[22-24] In our sample, the most frequently seen condition was cranial fractures at a rate of 58.5% (n=79), accompanied by other parenchymal pathologies. The most frequently affected regions in our patients were the parietal (38.5%) and frontal (37.0%) regions, which were similar to those reported in the literature.

The months with the highest rates of traumas in our study were the summer months, and the busiest month for trauma cases was July (18.5%). This result may be attributed to the longer time spent by children outside in summer and their increased physical activity levels. Similarly, in the literature, the summer months have been revealed to be the period during which pediatric traumas have the highest rates.[5,10,13] During the summer months, due to school holidays, children spend more time outside, and they display higher levels of physical activity and risky behaviors. Moreover, the limited degree of supervision by families during the summer holidays in our region may be another factor raising the risk of trauma. Most patients whose cases were examined in our study were brought to the hospital at 16:01-00:00 (57.8%). Furthermore, while 8.1% (n=11) were brought at 00:01-08:00, and 34.1% (n=46) were brought at 08:01-16:00. Aydın et al. reported that 53.3% of patients presented to the emergency service at the hours of 08:00-16:00, whereas Sucu et al. stated that 45.3% of patients visited the emergency service at the hours of 12.00-18.00.[25,26] The higher rates of patients who were brought to the emergency services outside working hours in our study may be associated with the possibility that parents brought their children after they came home from work, and testing and treatment procedures at the emergency services are usually faster than those in regular outpatient clinics.

In this study, the most frequently encountered traumas accompanying the head traumas of the patients were extremity fractures, whereas the most frequent accompanying pathologies were maxillofacial injuries (**Table 5**). Işık et al.[27] provided similar results. These results highlighted the importance of a systemic examination in pediatric head trauma cases.

The number of patients examined in our study who required surgical interventions after their examinations at the emergency services was 6 (4.3%), and all these patients underwent the necessary operations (**Table 6**). The patients requiring surgery mostly had compression fractures and intracranial hematomas. It should be kept in mind that these cases require early diagnosis and intervention. The low rate of surgical intervention requirement in our study (4.3%) may be explained by the fact that there are not many elevated settlement areas that could result in relatively more severe traumas in the region, the region is not on the main traffic routes, and the city center is located far from the highway.

Table 5. Accompanying traumas of the patients

Variables	Groups	Frequency (n)	Percentage (%)
Accompanying Trauma	Abdominal Trauma	2	1.5
	Abdominal Trauma + Thoracic Trauma	2	1.5
	Extremity Fracture	6	4.4
	Extremity Fracture + Abdominal Trauma	2	1.5
	Extremity Fracture + Spinal Trauma	3	2.2
	Extremity Fracture+ Thoracic Trauma	2	1.5
	Extremity Fracture + Thoracic Trauma+ Abdominal Trauma	4	2.9
	Extremity Fracture + Thoracic Trauma+ Orbital Trauma	1	0.7
	Mastoid Fracture	5	3.7
	Orbital Fracture	11	8.1
	Orbital Fracture+ Maxillofacial Fracture	3	2.2
	Sinus Fracture	3	2.2
	Spinal Trauma	2	1.5
	Thoracic Trauma	1	0.7
	Thoracic Trauma+ Spinal Trauma	1	0.7
	Isolated Head Trauma	87	64.4

Table 6. Patient pathologies

Variables	Groups	Frequency (n)	Percentage (%)
Pathology	Compression Fracture + Subdural Hematoma	3	2.2
	Compression Fracture	10	7.4
	Compression Fracture + Epidural Hematoma	1	0.7
	Compression Fracture + Epidural Hematoma+ Subdural Hematoma	1	0.7
	Compression Fracture + Traumatic SAH	2	1.5
	Epidural Hematoma	5	3.7
	Epidural Hematoma+ Traumatic SAH	2	1.5
	Contusion	7	5.2
	Contusion + Traumatic SAH	5	3.7
	Linear Fracture	41	30.4
	Linear Fracture+ Traumatic SAH	3	2.2
	Linear Fracture+ Epidural Hematoma	5	3.7
	Linear Fracture+ Contusion	1	0.7
	Linear Fracture+ Contusion + Traumatic SAH	2	1.5
	Linear Fracture+ Pneumocephalus	1	0.7
	Linear Fracture+ Subdural Hematoma	8	5.9
	Linear Fracture+ Traumatic SAH + Epidural Hematoma	1	0.7
	Subdural Hematoma	9	6.7
	Subdural Hematoma+ Traumatic SAH	1	0.7
	Subdural Hematoma+ Traumatic SAH + Contusion	1	0.7
	Subgaleal Hematoma	25	18.5
	Traumatic SAH	1	0.7
Surgical Operation	Compression Fracture	3	2.2
	Compression Fracture+ Epidural Hematoma + Subdural Hematoma	1	0.7
	Epidural Hematoma	1	0.7
	Subdural Hematoma	1	0.7
	Follow-up without Surgery	129	95.6

SAH: Subarachnoid hematoma

Complications such as hydrocephalus and meningitis can also occur, particularly in those undergoing surgery following trauma. These complications may necessitate secondary surgery after primary surgery. It is known that ventriculoperitoneal shunt placement, particularly after hydrocephalus develops, can lead to other complications such as infection and obstruction.[28] However, due to the small number of patients undergoing surgery and the fact that patients with poor general condition are followed at advanced centers, we have not observed these complications in any of our patients.

Among the patients who were brought following traumas, none died at our hospital. The reason for this may be that because our hospital does not have a well-equipped pediatric ICU unit, patients whose general status is poor and who have low GCS scores are referred to higher-tier hospitals.

This study had certain limitations. First, this was a retrospective study. Second, the data were collected at a single center. This may limit the applicability of the results to the general population. It is recommended that future studies be performed with larger samples and multi-center designs. It is also needed to examine the long-term effects of traumas in prospective studies.

CONCLUSION

Consequently, it should be kept in mind that pediatric head traumas are caused by preventable factors, and a significant proportion of these traumas can be prevented through appropriate precautions. The results of this study emphasize the need to increase the amount of epidemiological data related to pediatric head traumas and develop prevention strategies..

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Tokat Gaziosmanpaşa University Non-Intervention Scientific Research Ethics Committee (Date: 07.01.2025, Decision No: 25-MOBAEK-014).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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