DOI: 10.4274/forbes.galenos.2025.80958
Forbes J Med

Original Article / Orijinal Araştırma

Retrospective Analysis of Pediatric Trauma Patients Under One Year Old Admitted to the Emergency Department

Acil Servise Başvuran Bir Yaş Altı Pediatrik Travmalı Hastaların Geriye Yönelik İncelenmesi

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Cite as: Kara G, Kıyan S. Retrospective analysis of pediatric trauma patients under one year old admitted to the emergency department. Forbes J Med. [Epub Ahead of Print]

ABSTRACT

Objective: This study aims to assess the demographic characteristics, mechanisms of presentation, and clinical issues of pediatric trauma patients under the age of one admitted to a third-level emergency department in Türkiye.

Methods: In this retrospective study, data from 2174 pediatric trauma patients from 2017 to 2019 were reviewed and analyzed using an electronic record system. The data included age, gender, type of admission, trauma mechanisms, and clinical outcomes. The statistical significance level was accepted as $p<0.05$.

Results: The findings indicate that 52.6% of the patients were male, with admissions occurring more frequently during summer months and on weekdays. The most common trauma incidents were related to falls from strollers or baby carriages, with head trauma being the most frequent injury type.

Conclusion: Pediatric traumas represent a critical and life-threatening risk to child health. In particular, head traumas, falls, and traffic accidents result in serious disabilities and fatalities among children. The data from this study provide essential descriptive information to support the development of preventive and emergency treatment strategies for pediatric trauma.

Keywords: Emergency department, pediatric trauma, head trauma, trauma scoring systems, falls

ÖZ

Amaç: Bu çalışma, Türkiye'de üçüncü seviye bir acil servise başvuran 1 yaş altı pediatrik travma hastalarının demografik özelliklerini, başvuru mekanizmalarını ve klinik sonuçlarını değerlendirmeyi amaçlamaktadır.

Yöntem: Geriye dönük olarak yapılan bu çalışmada, 2017-2019 yılları arasında 2174 pediatrik travma hastasının bilgileri elektronik kayıt sisteminden taranarak analiz edilmiştir. Yaş, cinsiyet, başvuru şekli, travma mekanizmaları ve klinik sonuçlar verileri oluşturmuştur. İstatistiksel anlamlılık düzeyi $p<0,05$ olarak kabul edilmiştir.

Bulgular: Bulgulara göre, hastaların %52,6'sı erkek olup, başvurular yaz aylarında ve hafta içi daha yoğundur. En sık görülen travma mekanizması bebek arabası veya pusetten düşme iken, en yaygın travma türü kafa travmasıdır.

Sonuç: Pediatrik travmalar çocuk sağlığı açısından önemli ve yaşamsal bir tehdit oluşturmaktadır. Özellikle kafa travmaları, düşmeler ve trafik kazaları çocuklarda ciddi morbiditeye ve mortaliteye neden olmaktadır. Bu nedenle bu çalışmanın bulguları, pediatrik travmaların önlenmesi ve acil tedavi süreçlerinin iyileştirilmesine yönelik çözümler geliştirmesinde temel tanımlayıcı veriler olarak kullanılabilir.

Anahtar Kelimeler: Acil servis, pediatrik travma, kafa travması, travma skorlama sistemleri, düşme

Received/Geliş: 20.11.2024
Accepted/Kabul: 17.02.2025
Epub: 14.03.2025

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INTRODUCTION

The continuity of anatomical-physiological and mental development in the pediatric population places this group in a high-risk category for trauma. Pediatric traumas cause tissue damage because of an impact or contact with mechanical, chemical, thermal, or environmental factors. Domestic and traffic accidents have been reported as the most important causes of trauma among children under 1 year of age. In children under 1 year of age, trauma is recognized as a cause of high morbidity and mortality.[1] The second place in mortality among children older than 1 month and under 1 year is occupied by traumas and their consequences. In developing countries, trauma is regarded as one of the primary factors causing high mortality and high medicinal expenditure in the pediatric age group.[2] The number of children who die of trauma is approximately equal to the number of deaths caused by either infectious diseases or cancers. Falling accidents, which are among the common trauma mechanisms of children aged below 1 year, usually translate to emergency department (ED) visits and admissions.[3] The incidence of falls in children below 12 years, which causes 25-34% of all pediatric trauma managed in the emergency trauma units, also accounts for 6% of trauma-associated morbidity and mortality in children.[4,5] Therefore, it would be essential to present the national and global statistics concerning the causes and clinical outcomes of pediatric trauma.

The occurrences of injuries in children are non-accidents, avoidable events.[6] Furthermore, trauma in this age group is not only associated with high morbidity and mortality but also requires comprehensive management strategies. It brings with it other health problems such as behavioral, mental, and reproductive health complications.[7]

This research aims to provide a cross-sectional descriptive chronology of children admitted to a higher-level tertiary care facility in Türkiye over the past two years. It also explores establishing the risk factors associated with the need for admission, and those linked to mortality among children to enhance planning in pediatric ED.

METHODS

The data of this study were obtained by retrospectively analyzing information on pediatric trauma patients under the age of 1 year, admitted to a third-level ED between 2017 and 2019, from the electronic file recording system, using International Classification of Diseases-10 diagnosis codes.

The study was approved by the Ege University Medical Research Ethics Committee (decision no: 20-6T/52, date: 10.06.2020). No sample selection was made in this study. Between 1 March 2017 and 31 December 2019, the population consisting of all pediatric trauma patients under 1 year of age who applied to the ED and met the study criteria was accepted as the sample of the study. A total of 2174 pediatric trauma patients were included in the study (Figure 1).

The data included age (months), gender, type of presentation, mechanisms of trauma, ED outcomes, Injury Severity Score (ISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS). Trauma mechanisms were grouped as in-vehicle traffic accidents, out-of-vehicle raffic accidents, bumps and bruises, simple extremity injuries, falls on level ground, and sharp injuries.

Statistical Analysis

The data obtained were analyzed using IBM SPSS V23 software, and the findings were expressed as mean and standard deviation, frequency and percentage. The Mann-Whitney U and Kruskal-Wallis tests were used to compare the non-parametric data, and the chi-square test was used to examine qualitative data. The significance level was taken as $p<0.05$.

RESULTS

In this study, 52.6% of the patients were male; mean age for males: 7.20±3.16 months, and females: 6.99±3.18 months (Table 1). Most admissions occur during the summer months and on weekdays (Table 2). A significant majority of patients (96.5%) presented on an outpatient basis. Falls from strollers, car seats, or baby carriages were identified as the most common trauma mechanism (Table 3).

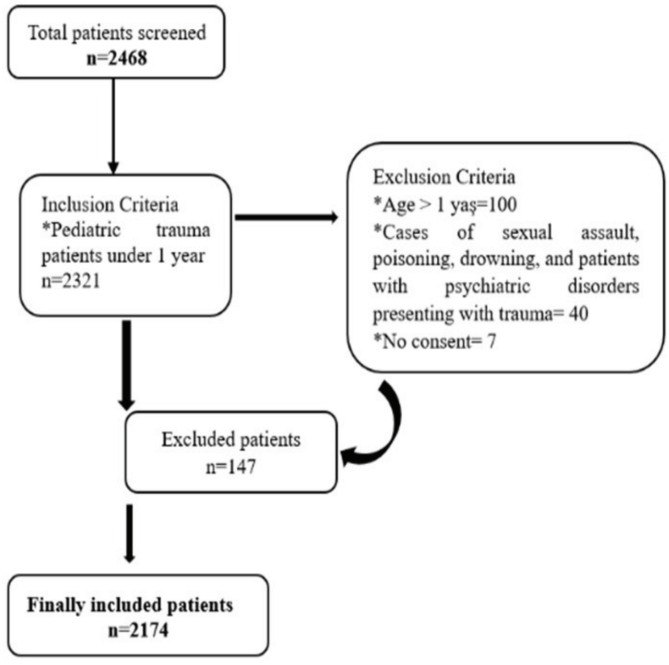

Figure 1. Flow diagram of the study sample

Table 1. Socio-demographic characteristics of patients		
Descriptive characteristics	**Number (n)**	**Percentage (%)**
Gender		
Male	1143	52.6
Female	1029	47.4
Age	Male: 7.20±3.16 months	Female: 6.99±3.18 months

Table 2. The characteristics of patients presenting to the emergency department		
Seasonal admission time		
Summer	700	32.2
Spring	578	26.6
Autumn	498	22.9
Winter	396	18.3
Admission days		
Weekdays	1461	67.2
Weekends	713	32.8
Mode of admission to emergency department		
Outpatient	2097	96.5
112/referral	64	2.9
Not applicable	11	0.6

Table 3. The characteristics of trauma mechanisms		
	n	**%**
Motor vehicle accident (inside/outside)	274	13.9
Impact, strain	587	27.8
Fall from same level	971	46.0
Fall from stroller, cradle, baby carriage	30	1.37
Sharp, penetrating object	131	6.02
Burn	56	2.71
Eye trauma	24	1.10
Other trauma	60	2.75
Body area affected by trauma		
Head trauma	1681	77.32
Extremity trauma	430	19.77
Thoracic trauma	98	4.50
Abdominal trauma	58	2.66
Neck trauma	31	1.42
Injury findings		
Hematoma/abrasion in soft tissue	1648	78.4
Burn	130	6.2
Cranial bone fracture	65	3.1
Oral injury	52	2.5
Intracranial hemorrhage	51	2.4
Presence of foreign body	49	2.3
Upper-lower extremity fracture	43	2.0
Nursemaid's elbow	39	1.9
Other	25	1.2

The radiological examination was performed in 67.5% of patients. The pediatrics and neurosurgery departments had the highest number of hospitalizations. Burn dressings were applied to 37.2% of the patients. A total of 82.9% of patients were discharged, while 4.8% were admitted to the pediatric intensive care unit (Table 4). In the study population, 46.1% of patients had an ISS of 0, 95.6% had a RTS of 8.00, and 44.2% exhibited a TRISS exceeding 99.10 (Table 5).

Falls from strollers, swaddles, or baby carriages were most common in children (mean age 6.35±3.09 months), and the difference in average age among fall mechanisms was statistically significant (p=0.04). The mean age of children with head trauma was found to be 6.86±3.15 months (p=0.05), and most of the children were boys. When the length of stay in the ED was analyzed according to gender, no statistically significant difference was found (p=0.20). The mean age of the children discharged from the ED was 7.20±3.10 months. The mean age of the hospitalized children was younger, at 5.29±3.61 months, and the differences between discharge and mean age were found to be statistically significant (p=0.04) (Table 6). Patients with thoracic and abdominal trauma were most frequently transported via pre-hospital emergency medical services, (112 ambulances), while those with head or extremity trauma most often presented on an outpatient basis (Table 7).

The length of stay in the ED was significantly longer in patients involved in vehicle-related accidents (571.69±473.42 minutes, minimum: 47.00 maximum: 1860.00) as shown in Table 8, (p<0.001).

In the study, an ISS score >2 was found in 56 of 79 patients who were hospitalized. The ISS score of 63.1% of the patients who were discharged was found to be either 1 or 0. The differences between ISS and ED outcomes were found to be statistically significant (p=0.04) (Table 9).

Table 4. The follow-up and treatment characteristics of patients

Radiological examinations	**n**	**%**
Computed tomography	523	24.5
X-ray	825	38.8
Ultrasonography	123	5.7
Hospitalized departments		
Pediatric health and disease service	52	2.4
Neurosurgery	11	0.5
Pediatric surgery	5	0.2
Pediatric intensive care	5	0.2
Plastic surgery	2	0.1
Orthopedics and traumatology	2	0.1
Ophthalmology	1	0.0
Referred to another hospital	27	1.2
Procedures performed in the emergency department		
Suturing	85	26.2
Sedation	36	11.1
Reduction	39	12.0
Burn dressing	121	37.2
Foreign body removal	14	4.3
Cast/splint	30	9.2
Emergency department discharge outcomes		
Hospitalization	105	4.82
Discharge	1800	82.9
Unauthorized leave	258	11.9
Treatment refusal	16	0.7
Referral to another hospital	27	1.2

Table 5. The trauma scores of patients		
Injury severity score		
ISS=0	980	46.1
ISS=1	839	39.4
ISS>2	309	14.5
Revised trauma score		
6.60	1	0.1
7.00	1	0.1
8.00	43	2.0
Trauma and injury severity score		
<97.80	7	0.32
97.82	4	0.24
98.96	2	0.12
99.00	12	0.72
>99.10	20	0.92
*The percentages vary due to missing data and multiple examinations, ISS: Injury Severity Score		

Table 6. The analysis of the descriptive findings of trauma according to age and gender variables									
	Age (months)				**Male**		**Female**		
Trauma mechanisms	**n**	**Mean**	**SD***	**p**	**n**	**%**	**n**	**%**	**p**
Fall from stroller, cradle, or baby carriage	971	6.35	3.09		529	54.5	442	45.5	
Falls from the same level	587	7.64	3.02		312	53.2	275	46.8	
Impact, strain, minor injuries	274	7.47	3.24		127	46.4	147	53.6	
Burn	131	9.05	2.43		79	60.3	52	39.7	
Eye injury	56	7.05	3.17	**0.04**	28	50.0	28	50.0	0.29
In-vehicle traffic accident	34	6.09	3.60		16	47.1	18	52.9	
Sharp or penetrating object, firearm	30	8.30	3.14		16	53.3	14	46.7	
Other	24	7.75	3.47		13	54.2	11	45.8	
Out-of-vehicle traffic accident	5	7.80	3.35		2	40.0	3	60.0	
Head trauma									
Yes	1698	6.86	3.15	**0.05**	923	54.4	775	45.6	**0.02**
No	412	8.07	3.04		201	9.2	275	12.6	
Discharge	1800	7.20	3.10		953	52.9	847	47.1	
Unauthorized leave	258	6.93	3.32		125	48.6	132	51.4	
Hospitalization	79	5.29	3.61	**0.04**	49	62.0	30	38.0	0.20
Treatment refusal	16	7.38	3.38		9	58.3	7	43.8	
Referral to another hospital	3	9.33	0.58		2	66.7	1	33.3	
SD: Standard deviation									

Table 7. Distribution of trauma areas by body region in patients admitted to the emergency department							
Trauma by body region	**Admission type**						**p**
	Outpatient		**112/referral**		**Total**		
	Number (n)	**Percentage (%)**	**Number (n)**	**Percentage (%)**	**Number (n)**	**Percentage (%)**	
Head trauma	1645	80.4	52	82.5	1697	80.5	0.795
Extremity trauma	417	20.4	14	22.2	431	20.5	0.846
Thoracic trauma	87	4.3	11	17.5	98	4.6	**0.052**
Abdominal trauma	49	2.4	9	14.3	58	2.8	**0.053**
Neck trauma	28	1.4	3	4.8	31	1.5	-

Table 8. Length of stay in the emergency department by trauma mechanism in patients						
Trauma mechanisms	**n**	**Mean**	**SD***	**Min.**	**Max.**	**p**
Fall from stroller, cradle, or baby carriage	971	229.31	240.32	1.00	2640.00	**<0.001**
Falls from the same level	585	153.32	125.09	1.00	1699.00	
Impact, strain, minor injuries	274	124.65	120.63	1.00	827,00	
Burn	131	88.75	87.02	6.00	615.00	
Eye injuries	56	84.93	82.82	4.00	440.00	
In-vehicle/out-of-vehicle traffic accident	39	571.69	473.42	47.00	1860.00	
Sharp or penetrating object injury	30	100.60	95.12	1.00	367.00	
Other	24	112.04	177.78	6.00	670.00	
SD: Standard deviation, Min.: Minimum, Max.: Maximum						

Table 9. Emergency department outcomes of patients according to ISS scores									
Injury Severity Score	**Hospitalization**		**Discharge**		**Unauthorized leave**		**Treatment refusal**		**p**
	Number (n)	**Percentage (%)**	**Number (n)**	**Percentage (%)**	**Number (n)**	**Percentage (%)**	**Number (n)**	**Percentage (%)**	
0	3	0.1	865	34.6	106	4.2	5	0.2	**0.04**
1	20	0.8	712	28.5	102	4.1	5	0.2	
>2	56	2.2	221	8.8	24	1.9	5	0.2	
Total	79	3.2	1798	71.9	232	10.2	15	0.6	
ISS: Injury Severity Score									

DISCUSSION

The objective of this research was to examine the demographic data, mode of presentation, and the outcome of children aged less than one year who suffered trauma who were admitted to a level three ED in Türkiye. This study's results support the notions that children are at higher risk of trauma, particularly head trauma, owing to their anatomical and physiological features. Studies from Canada also note that head trauma is the most frequently observed trauma in infants and children under the age of one.[8] On the other hand, another study authored in the United States has established that the morbidity rate from head traumas in children is greater than those in adults or the elderly.[9]

This research has noted, however, that there is an increase in the number of admissions in the summer months and on weekdays. In relation to child supervision, there may be changes occurring where children are engaged in outdoor activities, go on family holidays, and their parents go to work. A study conducted in Türkiye has shown that during summer, more children experience falls as they are frequently outdoors.[10] In Italy, it was observed that admissions due to trauma were 30% more frequent during summer months compared to other months.[11] Since this research included children aged up to one year, there was a belief that parental supervision could create a relationship with seasonal and weekday variables.

According to this study, the most common source of injury was identified as falls from strollers, cradles, and baby carriages. This was interpreted as involving a higher risk due to the gross motor and balance deficits of children under the age of one and some factors related to the adult or carer for the child. Further, a study on children from China, indicated that baby carriages were the most common cause of trauma in children less than a year old.[12] This is also consistent with a report from the World Health Organization where domestic accidents were ranked among the leading causes of all injury occurrences in children.[13] Therefore, it is advised based on the guidelines released by the Canadian Pediatric Society that parents should be informed of safety measures when using baby carriages and cradles.[14]

Children or infants are often sighted to fall or, especially during early developmental stages. Likewise, in the current work, it was evident that the mode of fall and the mean age of children differed significantly statistically. The findings are supported by the studies in the literature.

According to a studies exposed to factors which increase their risks of falling which include their physiological activities as well as curiosity towards their environment and trying new motor skills.[15] From my understanding, this range of children usually tries to walk, crawl or sit and as such end up falling quite a lot in the process of learning those skills. Moreover, falls are common, especially in cases where children are taken from strollers, laps, or from surfaces such as beds. Nygren et al.[16], pointed out the hazards of misusing such child safety equipment. It is therefore commendable for parents to always ensure that they make proper use of such safety equipment and provide substantial supervision of their children. The frequency and seriousness of falls in childhood require parents and carers to be more aware of this issue. Safety measures must always be put in place, mostly when the child is between 6-12 months, for this seems to be the primary period in which children are learning to crawl or walk and thus are likely to fall quite a lot. Safety measures like safety gates, bed rails, and prams that are appropriately sized would go a long way in reducing falls. Furthermore, awareness of the issue can be improved by parents' educational programs. Such measures will play an important role in reducing childhood injuries.

The male-dominated sample of head injured children presenting at the accident and ED has been documented in this study. According to studies, infant boys are more active in both mastering their surroundings as well as utilizing them, thus having a greater risk of incurring injuries.[17] It has also been noted in the literature that head trauma is one of the injuries that can have very serious effects on the brain. Also, Haarbauer-Krupa et al.[18] noted that the most common causes of head trauma in children are falling from height and impact with hard surfaces.

The patients' gender was not a factor regarding the differences in the length of stay while awaiting treatment in the ED. However, there is evidence that these numbers vary significantly with the seriousness of the injury. Children's assessment of treatment they might need is greatly dependent on the factors that triggered the falls.[19,20] The analysis suggests that the average age of children who were hospitalized was younger than those who were discharged after treatment. This group of children is at a greater risk of admission because of their relatively small body sizes, as younger children are more susceptible to falls. Pickett[21] explains that young children have a head disproportionate in size to the rest of the body, and thus frequently sustain head injuries during falls that may require extensive medical care.

The highest admission rates among clinics where patients presented with trauma were in the pediatrics and neurosurgery departments. This goes in line with our observation that head traumas are common but also that they can lead to serious health complications.

Head injury in children was also suggested as a reason for prolonged hospitalization, relative to other types of injuries, in a broad-based study.[22] Also, a study noted that the death rate among children undergoing neurosurgery was greater than that of other clinics.[23] Given the above, there are clear implications that hospitals which deal with such children require adequate training, age-appropriate devices, and qualified medical personnel certified by the ministry of health of the country in charge of imaging, monitoring, and transportation of the children with traumatic injuries.[24]

It has also been recognized in earlier literature that children who suffer from vehicle-related accidents, both inside and outside the vehicle, of which, in this study, children were the passengers have longer hospital stays. The post-traumatic disability pertaining to traffic accidents is known to be exceptionally complicated, requiring more work in the ED.[25] It has been documented that up to 70% of children involved in a traffic accident qualify for specialized treatment in the ED.[26] Moreover, in the US, it has been reported that the cost of pediatric trauma due to car accidents was higher than that of other injuries.[27] Additional reasons for extended stays can include thorough examinations, specialized treatments, blood transfusions, lucid state duration, and court cases.

ISS is an objective measurement tool that assesses the severity of trauma in patients and is closely related to clinical outcomes.[7,27] A review of the literature has shown

that high ISS scores significantly increase the rates of hospitalization, need for intensive care and mortality.[7,23,28] The findings of this study also support that patients with low ISS scores can mostly be discharged, while patients with high ISS scores require hospitalization, advanced treatment and follow-up.

In cases of fatal accidents in which both parents die, the lack of social services assistance might delay the release of children who otherwise would have been placed in an appropriate foster home or with a close relative.

The findings of this study primarily focused on physical injuries associated with pediatric trauma, which is a limitation. However, pediatric trauma cases often necessitate various testing, treatment, monitoring, and utilization of labor that can lead to high healthcare costs. Additionally, these cases may cause psychological challenges for families, including family guilt, decreased trust in caregivers, or even legal proceedings evaluating parental competence. Future research should consider these aspects as they were recognized as important areas for study during this research. A study from the United States estimated the annual cost of pediatric trauma to be approximately $5 billion.[28] Based on the findings of this study, there is a need to raise awareness among both parents and young adults regarding child safety, negligence, and their consequences. The success of parental education programs in Canada, which have reduced child injuries by 20%, demonstrates the efficacy of preventive programs, which should be implemented worldwide.[14,29]

Furthermore, a study conducted in Norway emphasized that trauma risk differs among socio-economic groups, and these factors should be considered in future research.[30] Future studies conducted in multiple centers could enable a more detailed analysis of pediatric trauma profiles in different regions.

Study Limitations

The limitations of this study include restrictions inherent in a retrospective design. Although extensive cases were addressed in a tertiary ED, the fact that this study was conducted in a single center limits the generalizability of its findings. On the other hand, since this study was planned as a, it was weak in terms of determining the relationship and effect between variables.

CONCLUSION

In conclusion, pediatric traumas represent a significant threat to child health. Therefore, the findings of this study can be used as foundational descriptive data in developing solutions aimed at preventing pediatric traumas and improving emergency care processes. It is essential to enhance child safety awareness, strengthen parental education, and implement enforceable child safety standards. Future studies examining pediatric trauma cases should include detailed evaluations of variables related to different age groups, socio-economic factors, and trauma mechanisms. Moreover, incorporating assessments of parents' psychological experiences and the role of institutional social support systems could be beneficial in studying trauma cases comprehensively.

Ethics

Ethics Committee Approval: The study was approved by the Ege University Medical Research Ethics Committee (decision no: 20-6T/52, date: 10.06.2020).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Concept: G.K., S.K., Design: S.K., Data Collection or Processing: G.K., Analysis or Interpretation: G.K., S.K., Literature Search: G.K., S.K., Writing: G.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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

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