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ARAŞTIRMA / RESEARCH

Evaluation of forensic fall from height cases aged two years and younger

İki yaş ve altındaki adli yüksekten düşme olgularının değerlendirilmesi

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Abstract

Purpose: Childhood trauma is often caused by accidental or neglected falls. In this study, we aimed to evaluate demographic and clinical factors to determine the incidence of falls from height in children under two years old.

Materials and Methods: The study included 106 forensic cases who presented to the emergency department after falling from a height of one meter or more as a result of an accident or negligence between January 1, 2016 and December 31, 2021. According to the level of fall height, the cases were divided into two groups as below 3 meters and above. Clinical findings, hospitalization, and mortality status were used to group patients.

Results: Of the 106 cases included in the study, 59(55.7%) were male. The mean age of the patients was 12.89±6.80 months and the mean height level was 3.67±2.85 m. The mean height of the low and high groups was 1.78±0.71, 6.92±2.09 meters, respectively. Cranial fracture was present in 21(19.8%) patients in the high group and all traumatic parenchymal brain lesions except contusion were seen in the high group. Pediatric surgery and neurosurgery hospitalizations were in the first place with 6(5.7%) cases in the low group, and intensive care hospitalization with 15 (14.2%) cases in the high group. While the operation was performed in 11 (10.4%) cases in the high group, none in the low group. Four (3.8%) of the nine (8.5%) fatalities occurred in the emergency department.

Conclusion: Especially cases of falling from height under the age of two are common and are an important cause of morbidity and mortality. Fall height level is an important marker in terms of clinical and prognosis. Informing and educating caregivers and parents can prevent accidents and neglect in advance.

Keywords:. Fall from height, emergency department, childhood, trauma, child neglect, mortality

Öz

Amaç: Çocukluk çağı travması genellikle kaza veya ihmal sonucu düşme nedeniyle meydana gelir. Bu çalışmada iki yaş altı çocuklarda yüksekten düşme insidansını, demografik verileri ve klinik sonuçlarıyla değerlendirmeyi amaçladık.

Gereç ve Yöntem: Çalışmaya 1 Ocak 2016 ile 31 Aralık 2021 tarihleri arasında bir kaza veya ihmal sonucu 1 metre ve üzeri yükseklikten düşerek acil servise başvuran 106 adli olgu dahil edildi. Düşme yüksekliğine göre olgular 3 metre altı ve üstü olarak iki gruba ayrıldı. Hastalar ayrıca klinik bulgular, yatış ve mortalite durumlarına göre de gruplandırıldı.

Bulgular: Çalışmaya dahil edilen 106 olgunun 59'u (%55.7) erkekti. Hastaların yaş ortalaması 12,89±6,80 ay, ve ortalama yükseklik 3,67±2,85 m idi. Alçak ve yüksek seviye düşme gruplarının ortalama düşme yükseklikleri sırasıyla 1,78±0,71 ve 6,92±2,09 metre idi. Yüksek grupta 21(%19,8) hastada kranial fraktür izlendi ve kontüzyon dışında tüm travmatik parankimal beyin lezyonları sadece yüksek grupta görüldü. Alçak grupta 6'şar (%5.7) olgu ile çocuk cerrahisi ve nöroşirürji yatışları ilk sıradayken, yüksek grupta 15(%14.2) olgu ile yoğun bakım yatışı en fazlaydı. Yüksek grupta 11(%10,4) kişiye operasyon uygulanırken, alçak grupta operasyon yapılan olgu yoktu. Mortalite ile sonuçlanan 9(%8.5) olgunun dördü (%3.8) acil serviste öldü.

Sonuç: Özellikle iki yaş altında yüksekten düşme vakaları sık görülmekte beraber önemli bir morbidite ve mortalite nedenidir. Düşme yüksekliğinin seviyesi, klinik ve prognoz açısından önemli bir belirteçtir. Bakıcıları ve ebeveynleri bu konuda bilgilendirmek ve eğitmek, kazaları ve ihmalleri önceden önleyerek primer korunma sağlayabilir.

Anahtar kelimeler: Yüksekten düşme, acil servis, çocukluk, travma, çocuk ihmali, mortalite

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INTRODUCTION

Trauma is the second leading cause of death after infection in the 1-4 age period in underdeveloped and developing countries, and it takes the first place after 4 years of age[1]. Childhood accidents are among the major causes of mortality and morbidity all over the world and are a serious public health problem all over the world[2]. According to the World Health Organization (WHO), 2000 babies die annually due to accidents, that is, neglect and 10,000 children are exposed to disability due to accidents[3]. In the study conducted by Barcelos et al. in Brazil, it was found that a total of 122,000 children were injured between 2013 and 2014, and 4,578 of these children died[4]. The fact that children are not aware of the dangers, they are more active and the safety measures suitable for their development are not taken in the areas where they live are among the reasons why accidents and falls are more common in children[5]. Inadequate knowledge, attitudes and behaviors of parents about children's safety, problems under the supervision of children, and lack of regulations to ensure child safety in the home are among the factors that cause home accidents and falls[6]. Easy arrangements that can be made in the physical environment and regular training for mothers who spend a lot of time with their children can be prevented by raising their awareness[7].

Falls from height are a leading cause of mortality and morbidity in children and are largely preventable. Most childhood traumas are the result of falls from a height. Children have distinct anatomical and physiological features, and their injuries and causes of death differ from those of adult patients. In addition, age, the mechanism of falling, the structure of the ground, the position of falling, and the height level are significant factors affecting mortality and morbidity[8]. In the literature, the concept of height in the definition of falling from a height has been defined in a variety of ways, with the term "high", typically referring to places that exceed waistline level[9]. While falls from a height appear to be a common cause of trauma after motor vehicle accidents in all age groups, appears to be the most common cause of trauma among children[10]. In developed nations, childhood traumas are the leading cause of child mortality[11]. In developing countries, it ranks second after infectious disease and malnutrition-related deaths[12]. Falls are the leading cause of visits to emergency departments for injuries across all age groups[13]. Children fall from a height due to accident or negligence, whereas adults fall due to suicide, accident, or criminal activity.

The rate of hospitalized children due to falls in pediatric trauma centers accounts for 25-34% of all pediatric traumas and 6% of children who died as a result of trauma[11]. Each year, approximately 140 children under the age of 15 die from falls in the United States, and more than three million children visit the emergency department due to falls[14].

In our study, we evaluated the clinical outcomes of children younger than 2 years old who presented to the emergency department after falling from a height due to accident, neglect, or abuse, based on their demographic characteristics and height. Although there have been some studies on falling from height recently, we think that a condition that is so prone to morbidity and mortality should be further investigated and evaluated. In particular, we did not find any study on the younger age group of children under the age of 2 who are completely innocent in this regard, and we thought it would be beneficial to deal with this issue.

We structured our work around the hypothesis; "H0: Age, gender, and height of fall are not associated with clinical outcomes, hospitalization and mortality in cases of falls under the age of two as a result of child neglect. H1: In cases of falls under the age of two as a result of child neglect, age, gender, and the level of fall height have a significant relationship with clinical outcomes, hospitalization and mortality". We showed the effect of gender and level of fall height on clinical findings, hospitalization status, and mortality. We aimed to contribute to the literature by revealing the importance of falling from height in cases under the age of two, a special age group, and the importance of height level. In addition, clinical findings and mortality data of these cases will be an incentive in the planning of primary preventive practices.

MATERIALS AND METHOD

Study design

In this observational, retrospective and, cross-sectional study, 106 patients aged 0-2 years who were evaluated for falling from height in the emergency medicine department of the Bağcılar Training and Research Hospital, University of Health Sciences between January 1, 2016, and December 31, 2021,

were included. The patients' demographic characteristics, fall levels, clinical and imaging findings, hospitalization, discharge, and mortality status were recorded and assessed. An ethics committee approved the research with the date/no 06.01.2022/15, by Istanbul Medipol University non-interventional clinical research ethics committee. Informed consent was provided for the patients as required. The study was carried out by the Helsinki Declaration for Human Research and meets the ICMJE Criteria, including all relevant legislation.

Our hospital is a tertiary hospital that meets all pediatric traumas. The clinical data, imaging and consultation records of the patients can be evaluated from the hospital data system. The records are reliable in the electronic data system, and patients with missing records are currently excluded from the study. All applications are made by experts in the field, and the data and documents are very reliable.

Sample

As our hospital is also a pediatric trauma center, there are numerous instances of falls that apply. In the literature, the definition of falling from a height varies[9]. Cases of one meter (m) or higher were evaluated according to this definition in our study and scanned from the patient registry system. The sample size of 6748 patients who were admitted to our emergency department due to trauma under the age of two between 2016-2021 was calculated with the G*Power Version 3.1.6 program, with a 5% margin of error and a 90-99% confidence interval from the population of 2469 cases of falls from height. The sample size was calculated as 106 patients, with an acceptable error of (+/-) 5%, population size of 2469, and confidence level of 95%. In a period of five years, of 2,469 fall patients under the age of two, 684 were excluded because they were under 1 meter. More than one meter of fall was the cause of admission for 1,785 patients. It was determined that 224 of the cases had been evaluated forensically. 106 patients with no missing data records who were admitted due to a fall from a height and forensic reports related to accident, abuse, or neglect were included in the study. Children under the age of two and those who fell from less than one meter were omitted from the study. Patients with missing demographic, clinical, and forensic case information in the data recording system were eliminated from the study, as were those with comorbidities and congenital defects.

Study groups

All patient ages were recorded in months, and fall heights were determined in meters. Low [three meters or less (≤3m)] and High [greater than three meters (>3m)] levels were evaluated to classify patients according to the severity of fall height. In most research, the fall limit is assumed to be 1 m, however there may be exceptions. The formulation of the 3m reference value in the study is based on the fact that the severity of major injuries increases after this level while evaluating patients and that the average height of the first floor in the local population's buildings is 3m. Based on their clinical and radiological findings, the patients were separated into groups. Six groups were formed based on the findings of cranial injury: no, contusion, epidural, subarachnoid, contusion&subarachnoid, and contusion & epidural. Five groups were determined based on the hospitalization status of the patients: no hospitalization, pediatric surgery, neurosurgery, orthopedics, and intensive care. According to their mortality status, patients were divided into three groups: emergency department, inpatient service, and no mortality. In addition, two groups were defined depending on the presence of all other clinical and radiological characteristics.

All patients' information was retrieved from the hospital's software system and patient files. An electronic database at our hospital keeps track of each patient's admission dates as well as their diagnoses and other medical information.

Statistical analysis

For data analysis, the SPSS 20 (SPSS Inc., Chicago, IL, USA) package program was utilized. For continuous variables, descriptive statistics were presented as mean standard deviation or median (minimum-maximum), whereas for nominal variables, descriptive statistics were presented as number of cases and percentage (%). The groups were compared using the Mann Whitney U Test and the Kruskal-Wallis Test. Mann Whitney-U test was used in the relationship between age and fall height with height category, and Kruskal Wallis test was used in the relationship with mortality. Chi-square analysis was used to investigate the relationships between groups of nominal variables. Chi-square analysis was used to evaluate the correlations of height categories with gender, clinical findings, operation, hospitalization and mortality. Chi-square analysis was also used to evaluate the correlation of

mortality with gender, clinical findings, and operation. A boxblot analysis of mortality and fall groups based on height in meters was conducted. When interpreting the results, values below the significance threshold of 0.05 were considered statistically significant.

RESULTS

The mean age of the 106 patients included in the study was 12.89±6.80 months (p=0.002) and the mean height level was 3.67±2.85 m (p=0.001). The mean age of 67 (63.2%) subjects in the Low group was 11.31±7.02 months, and the mean height was 1.78±0.71 m. The mean age of 39 (36.8%) patients in the High group was 15.59±5.51 months, and the mean height was 6.92±2.09 m. Four (3.8%) of the 9 (8.5%) fatal individuals died in the emergency department. The average height of individuals who died in the emergency department after falling was 9.75±2.63 m (p=0.001) (Table 1). The distribution of fall height according to the groups is given in Fig 1.

Table 1. Distribution of age and height values in groups

		N (%)	Age (month) Mean ±SD	p-value	Height (m) Mean ±SD	p-value
Height Category	≤3m (Low)	67(63.2)	11.31±7.02	**0.002**	1.78±0.71	**0.001**
	>3m (High)	39(36.8)	15.59±5.51		6.92±2.09	
Mortality	No	97(91.5)	12.71±6.86	0.671	3.30±2.57	**0.001**
	Yes (ED)	4(3.8)	14.50±6.56		9.75±2.63	
	Yes (IS)	5(4.7)	15.00±6.56		6.00±1.41	
All Patients		106(100)	12.89±6.80		3.67±2.85	

ED: Emergency Department, IS: Inpatient Service, m: meter; Mann Whitney-U test was used for Height category and Kruskal Wallis test was used for Mortality. A value of p<0.05 was considered significant.

When the patients were evaluated according to the fall groups, a cranial fracture was found in 21(19.8%) and pneumocephalus was found in 6 (5.7%) of the high group. In addition, traumatic lesions were observed in the brain parenchyma in 18 (17%) patients. In the Low group, there was no finding other than contusion. In the high group, every type of traumatic parenchymal lesion except contusion was observed. In 8 (7.5%) of these cases, subarachnoid hemorrhage was observed (p=0.001). Eighteen (17%) patients were diagnosed with pneumothorax, while just 2 (1.9%) were in the low category (p=0.001). Despite the presence of hemothorax in 3 (2.8%) cases and pneumomediastinum in 1 (0.9%) cases, no rib fractures were identified. In addition, 24 (22.6%) lung contusions, 16 (15.1%) abdominal free liquid, and 9 (8.5%) liver injury were.

observed (p=0.001). Lower extremity fracture was found in 11 (10.4%) of all cases (p=0.001), and pelvis fracture was found in 4 (3.8%) cases (p=0.008). While 47 (44.3%) of the patients were hospitalized, their distribution was 19 (17.9%) pediatric surgery, 16 (15.1%) intensive care unit, 9 (8.5%) neurosurgery and, 3 (2.8%) orthopedics (p=0.001). Mortality was observed in 9 (8.5%) patients. Of these, 4 (3.8%) died in the emergency department, while the others died in inpatient service. There were no deaths in the low group (p=0.001). (Table 2).

Mortality reported in 9 (8.5%) patients with cranial fracture, 3 (2.8%) with pneumocephalus, and 3 (2.8%) with epidural hemorrhage (p=0.001). There was no association between pneumothorax, hemothorax, pneumomediastinum, and rib fracture with mortality. Also detected in 1 (0.9%) liver and 3 (2.8%) spleen injuries (p=0.015). Mortality was documented in three (2.8%) patients with lower extremity fractures, but not in patients with fractures of the upper extremities or pelvis (Table 3). The distribution of mortality by height level is shown in Fig 2.

Table 2. Categorizing the variables according to the height category below 3 meters and above

Variables		≤3M (Low) n(%)	>3M (High) n(%)	Total n(%)	P value
Gender	Female	30(28.3)	17(16)	47(44.3)	0.906
	Male	37(34.9)	22(20.8)	59(55.7)	
Cranial Fracture	No	59(55.7)	18(17)	77(72.6)	**0.001**
	Yes	8(7.5)	21(19.8)	29(27.4)	
Pneumocephalus	No	66(62.3)	33(31.1)	99(93.4)	**0.005**
	Yes	1(0.9)	6(5.7)	7(6.6)	
Cranial Hemorrhage	No	63(59.4)	21(19.8)	84(79.2)	**0.001**
	Contusion	4(3.8)	2(1.9)	6(5.7)	
	Epidural	0(0)	4(3.8)	4(3.8)	
	Subarachnoid	0(0)	8(7.5)	8(7.5)	
	Contusion & Subarachnoid	0(0)	3(2.8)	3(2.8)	
	Contusion & Epidural	0(0)	1(0.9)	1(0.9)	
Pneumothorax	No	65(61.3)	23(21.7)	88(83)	**0.001**
	Yes	2(1.9)	16(15.1)	18(17)	
Hemothorax	No	67(63.2)	36(34)	103(97.2)	**0.021**
	Yes	0(0)	3(2.8)	3(2.8)	
Rib Fracture	No	67(63.2)	39(36.8)	106(100)	**-**
	Yes	0(0)	0(0)	0(0)	
Lung Contusion	No	62(58.5)	20(18.9)	82(77.4)	**0.001**
	Yes	5(4.7)	19(17.9)	24(22.6)	
Pneumomediastinum	No	67(63.2)	38(35.8)	105(99.1)	0.188
	Yes	0(0)	1(0.9)	1(0.9)	
Abdominal Free Fluid	No	66(62.3)	24(22.6)	90(84.9)	**0.001**
	Yes	1(0.9)	15(14.2)	16(15.1)	
Liver Injury	No	66(62.3)	31(29.2)	97(91.5)	**0.001**
	Yes	1(0.9)	8(7.5)	9(8.5)	
Spleen Injury	No	65(61.3)	32(30.2)	97(91.5)	**0.008**
	Yes	2(1.9)	7(6.6)	9(8.5)	
Other Abdominal Injury	No	67(63.2)	38(35.8)	105(99.1)	0.188
	Yes	0(0)	1(0.9)	1(0.9)	
Upper Extremity Fracture	No	62(58.5)	34(32.1)	96(90.6)	0.363
	Yes	5(4.7)	5(4.7)	10(9.4)	
Lower Extremity Fracture	No	65(61.3)	30(28.3)	95(89.6)	**0.001**
	Yes	2(1.9)	9(8.5)	11(10.4)	
Pelvis Fracture	No	67(63.2)	35(33)	102(96.2)	**0.008**
	Yes	0(0)	4(3.8)	4(3.8)	
Vertebra Fracture	No	66(62.3)	36(34)	102(96.2)	0.158
	Yes	1(0.9)	3(2.8)	4(3.8)	
Hospitalization	No	52(49.1)	7(6.6)	59(55.7)	**0.001**
	Pediatric Surgery	6(5.7)	13(12.3)	19(17.9)	
	Neurosurgery	6(5.7)	3(2.8)	9(8.5)	
	Orthopedics	2(1.9)	1(0.9)	3(2.8)	
	Intensive Care	1(0.9)	15(14.2)	16(15.1)	
Operation	No	67(63.2)	28(26.4)	95(89.6)	**0.001**
	Yes	0(0)	11(10.4)	11(10.4)	
Mortality	No	67(63.2)	30(28.3)	97(91.5)	**0.001**
	Yes (ED)	0(0)	4(3.8)	4(3.8)	
	Yes (IS)	0(0)	5(4.7)	5(4.7)	
All Patients		67(63.2)	39(36.8)	100(100)	

ED: Emergency Department, IS: Inpatient Service, M: meter; Chi-square test was used for all parameters. A value of $p<0.05$ was considered significant.

Table 3. Analysis of variables according to mortality

		No n(%)	Yes(ED) n(%)	Yes(IS) n(%)	P value
Gender	Female	42(39.6)	3(2.8)	2(1.9)	0.448
	Male	55(51.9)	1(0.9)	3(2.8)	
Cranial Fracture	No	77(72.6)	0(0)	0(0)	0.001
	Yes	20(18.9)	4(3.8)	5(4.7)	
Pneumocephalus	No	93(87.7)	2(1.9)	4(3.8)	0.001
	Yes	4(3.8)	2(1.9)	1(0.9)	
Cranial Hemorrhage	No	84(79.2)	0(0)	0(0)	0.001
	Contusion	6(5.7)	0(0)	0(0)	
	Epidural	1(0.9)	1(0.9)	2(1.9)	
	Subarachnoid	3(2.8)	3(2.8)	2(1.9)	
	Contusion & Subarachnoid	2(1.9)	0(0)	1(0.9)	
	Contusion & Epidural	1(0.9)	0(0)	0(0)	
Pneumothorax	No	82(77.4)	2(1.9)	4(3.8)	0.194
	Yes	15(14.2)	2(1.9)	1(0.9)	
Hemothorax	No	95(89.6)	3(2.8)	5(4.7)	0.023
	Yes	2(1.9)	1(0.9)	0(0)	
Rib Fracture	No	97(91.5)	4(3.8)	5(4.7)	-
	Yes	0(0)	0(0)	0(0)	
Lung Contusion	No	78(73.6)	2(1.9)	2(1.9)	0.045
	Yes	19(17.9)	2(1.9)	3(2.8)	
Pneumomediastinum	No	96(90.6)	4(3.8)	5(4.7)	0.954
	Yes	1(0.9)	0(0)	0(0)	
Abdominal Free Fluid	No	86(81.1)	1(0.9)	3(2.8)	0.001
	Yes	11(10.4)	3(2.8)	2(1.9)	
Liver Injury	No	89(84)	4(3.8)	4(3.8)	0.540
	Yes	8(7.5)	0(0)	1(0.9)	
Spleen Injury	No	91(85.8)	3(2.8)	3(2.8)	0.015
	Yes	6(5.7)	1(0.9)	2(1.9)	
Other Abdominal Injury	No	96(90.6)	4(3.8)	5(4.7)	0.954
	Yes	1(0.9)	0(0)	0(0)	
Upper Extremity Fracture	No	87(82.1)	4(3.8)	5(4.7)	0.599
	Yes	10(9.4)	0(0)	0(0)	
Lower Extremity Fracture	No	89(84)	3(2.8)	3(2.8)	0.047
	Yes	8(7.5)	1(0.9)	2(1.9)	
Pelvis Fracture	No	93(87.7)	4(3.8)	5(4.7)	0.825
	Yes	4(3.8)	0(0)	0(0)	
Vertebra Fracture	No	94(88.7)	3(2.8)	5(4.7)	0.016
	Yes	3(2.8)	1(0.9)	0(0)	
Operation	No	89(84)	3(2.8)	3(2.8)	0.047
	Yes	8(7.5)	1(0.9)	2(1.9)	
All Patients		97(91.5)	4(3.8)	5(4.7)	

ED: Emergency Department, IS: Inpatient Service, M: meter
Chi-square test was used for all parameters. A value of $p<0.05$ was considered significant.

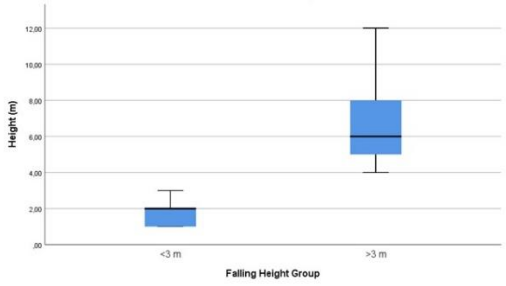

Figure 1.Distribution of falling height group by height

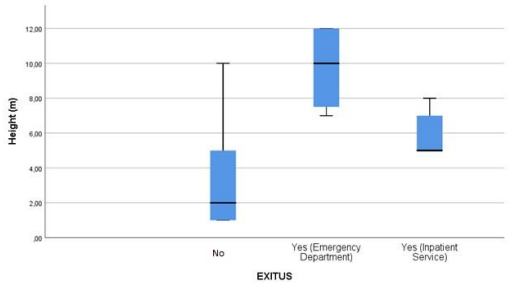

Figure 2. Distribution of exitus status by height

DISCUSSION

Trauma, which is the main cause of mortality and morbidity among children, is one of our country's and the world's most critical health concerns[15]. The construction of an algorithm is complicated by the different sources of traumas that can result in death and permanent disability and the fact that they occur from infancy to adulthood. The presence of anatomical and physiological variations produces unique diseases in children following trauma. Climate, culture, development, season, time of day, and age all affect the incidence of trauma in children[16]. In the study, pediatric patients under the age of 2, which is the most vulnerable period in children, who were exposed to injuries as a result of accident, negligence, carelessness or deliberate fall from a height were evaluated. In different studies, the rate of pediatric age group among forensic cases admitted to the emergency department was reported as 18%, 21.6%, 27.7% and 31%[17-20].

A study discovered that young age, male gender, and poor socioeconomic level were persistent risk factors for fall injuries in children aged 0 to 6 years old. Chaudhary et al.[21] evaluated 1086 cases of falling children aged 0-4 years, and reported that 59.7% of the cases were male, while Rajagopal et al.[22] reported that 63.7% of 102 patients between the ages of 0-14 who fell from the balcony or window in their 8-year evaluation were male. In the study conducted by Fidancı et al.[23] in the 0-17 age group, 210 child falls, whose mean age was 44.5±45.01 months and 60% of whom were male, were evaluated. Among these, 16 (7.6%) cases were reported falling over 90 cm height. Although the 0-2 age group falling over 1m was evaluated in our study, it was found that the male ratio was 55.7%, which was close to similar studies.

The etiology of trauma in children is very wide, among which the most mortal outcomes are related to falls from height. Falls are a common cause of childhood injuries and are the leading cause of injury-related hospitalizations in children under 5 years of age[24,25]. In their studies evaluating forensic cases in children, Özdemir et al.[26] reported that 22(5.3%) cases and Çınar et al.[17] 7(6%) cases had falls from a height. Günal et al. reported 132 cases between the ages of 0-6 in their study evaluating 304 children with blunt trauma, and 52 of them (39.3%) were caused by falling from a height[27]. In our study, the mean age of the cases was approximately 13 months, and all of them fell from a height of more than 2 meters.

The rate of hospitalized children due to falls in pediatric trauma centers accounts for 25 to 34 percent of all pediatric traumas and six percent of children who died as a result of trauma[11]. In the study of Kart et al.[28] on 262 cases of patients hospitalized for trauma in pediatric surgery, 55 (21%) cases were under the age of two. The majority of these, with 31 (56.4%) cases, were due to falling from a height. Mortality was reported as 1.5% in all cases. Each year, approximately 140 children under the age of 15 die from falls in the United States, and more than three million children visit the emergency departments due to falls[14]. Age, the manner of falling, the structure of the ground, the position of falling, and the height level are significant factors affecting mortality and morbidity. In general, falls from heights result in a higher mortality rate than falls from low places. The reported fatality rates for falls from greater than 12 meters and 18 meters are 50% and 100%, respectively[29]. Liu et al.[30] determined the mortality rate attributable to falls from a height of 6 meters to be 22.7%, and Velmohos et al.[31] determined the mortality rate attributable to falls from a height of 9 meters to be 9.6%. Al et al.[32] found the mean fall height to be 3.2±2.4 meters, and Yağmur et al.[33]

found 4.5±2.6 meters. In our study, the mean fall height was 3.67±2.85 m. The height group had a mean height of 6.92±2.09 m, and injury and mortality rates were high. While the mean height in the group with no mortality was 3.30±2.57 m, the mean height of the patients who developed mortality in the emergency department was 9.75±2.63 m. Mortality was observed in a total of 9 (8.5%) patients. We think that the high mortality rate in our study is due to the fact that we included patients below 1 m and kept the threshold value higher.

Falling from a height can result in head trauma, face trauma, chest trauma, abdominal organ injuries, genitourinary system injuries, pelvic fractures, extremities fractures, patella, tibia, radius, and ulna fractures[34]. The evaluation to be made according to the trauma area will guide the approach to the patients. One of the reasons for the differences between adults and children in cases of falling from a height is that extremity fractures are at the forefront due to the reflex of protecting with their hands while falling. In children, it can be thought of as a proximal shift of the center of gravity because the head occupies more volume than the body. Therefore, head traumas are of greater importance in the pediatric age group. As the age increases, head circumference in children decreases with the development of the body, so extremity trauma becomes more common[35]. The fact that 113 (79.5%) of the patients with head and facial injuries in the study of Fidancı et al.[23] were under the age of 5 also supports this. Skull fractures are seen in children less than 5%, and it is necessary to fall from a height of more than 1 meter for skull fracture to occur[36]. In another study, major injuries were found to be head trauma (57%), extremity (16%), and abdominal trauma (11%)[37]. In the study of Akın et al.[38] on head injuries, 400 children with head trauma were evaluated, 42 (10.5%) of them were grouped as falling from a height, and 9 of these patients had cranial fracture and 3 had intracranial hemorrhage. This shows that head trauma in falls from a height will cause major findings in pediatric patients. In our study, 27.4% of patients had a cranial fracture, and 20.8% exhibited symptoms of cerebral contusion or hemorrhage. We believe that our height exceeding 1 meter and the precarious position of the under-2-year-old group contributed to the increased prevalence of head trauma and lesions in our cases.

Chest trauma is an important cause of morbidity and mortality associated with falls from height, according to the literature. In a comprehensive study conducted by Yoruk et al.[39], 53 (22.2%) cases of pneumothorax, 46 (19.2%) cases of hemothorax, and 40 (16.7%) cases of hemopneumothorax due to falls from a height were identified. In addition, subcutaneous emphysema and intrathoracic lesions were observed in 55 (23 %) and 63 (26.3%) cases, respectively. In 145 (60.7%) cases, rib fractures were observed, followed by clavicle fractures in 24 (10%), sternum fractures in 8 (3.3%), and scapula fractures in 4 (1.7%) cases. In 54 (22.6%) cases, it was reported that additional body parts were also injured. In our study, falls from a height were the most common cause of pulmonary contusions in thoracic injuries. We believe that the lack of rib fractures in any of the cases, regardless of height, is due to the flexibility of the ribs in children younger than 2 years.

Among the organs exposed to trauma, extremities also come to the fore. Calcaneus fractures are usually the result of falling from a height, and vertebral compression fractures may coexist. In fractures of the radius and ulna, injuries to the wrist and elbow joints may occur together. In a study evaluating falls from a height of 1 m or more between the ages of 0-18, trauma lesions were observed in the extremities in 25% of the cases[8]. In the study of Chaudhary et al.[21] in which they examined 1086 cases of falls between 0-4 years of age, there were 213 femur fractures and 295 humeral fractures. While femur fracture was more common in younger ages, humeral fracture increased in frequency with increasing age. In our study, extremity trauma findings were relatively few. This may be due to the inability of children under the age of 2 to develop extremity reflexes to defend themselves during falls. In addition, the fact that upper extremity and vertebral fractures are not related to height may be related to the falling position. However, also in our study, while upper extremity injuries did not show much variation with height, lower extremity injuries increased significantly as height increased.

Another important injury group in falls from height is intra-abdominal organ lesions and hemorrhages. In particular, liver injuries are the most common organ injury. 660 fatal falls were studied and the critical height for abdominal injury was reported to be 15 m. In addition, 15 meters is a possible height limit for situations accompanied by two or more bodily injuries[40]. In another study, abdominal lesions were found at a level of 14% in falls from a height[8]. In our study, 9% of our cases had spleen injury and 9% liver

injury, while other organ injuries were seen in only one patient.

When evaluating patients, it is important to keep in mind that the likelihood of multiple trauma is high and that additional illnesses may be present. Treatment of a severely injured patient necessitates quick injury evaluation, discovery of life-threatening problems, and beginning of treatment.

The most important limitations were the retrospective nature of the study, the single-center study, and the inclusion of only cases under the age of 2 years. In addition, the fact that it consisted of patients 1 m and above caused the number of cases included in the study to be low. Another limitation is the difficulties in viewing the imaging of all patients in the automation system.

Trauma resulting from falling from a height in children under the age of two is a serious cause of morbidity and mortality affecting all systems. The causes of their development and etiology are entirely predictable and avoidable. Caregivers should be given age-appropriate recommendations and population-targeted education based on the injury and demographic patterns identified in this study. In order to effectively prevent falls in young children, parents and caregivers should be educated on recommended best practices for indoor and outdoor supervision and care. Prevention methods for windows and balconies, for example, should take into account the most common causes of falls from a height, as well as the design of the items themselves. Remember that child neglect is a form of abuse, and do not ignore the legal process involved in the incident.

Both similar studies and our study have shown that falls from height are an important cause of mortality and morbidity in children. It causes serious organ and system injuries. We can see the serious consequences of this, even for children under the age of 2 who still need care and attention. It is obvious how negatively the clinical and mortal outcomes progress with the increase in the height level, especially in falls from a height. In these patients, morbidity and mortality will be reduced with fast and accurate intervention in the emergency services, and the main important issue is that necessary preventive studies should be carried out for this age range that cannot act on its own will. We think that more comprehensive prospective studies on the cases of falls from height in this age range, especially including the etiology, can contribute to the literature. In particular, by shedding light on the reasons, further research on how to do both physical condition arrangements and parent training will be very useful.

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