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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Clinical Features and Age-Related Injury Patterns of Fall-Related Trauma in Children Aged 0–36 Months

0–36 Aylık Çocuklarda Düşmeye Bağlı Yaralanmaların Yaşa Özgü Özellikleri

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ABSTRACT

Aim: This study aimed to evaluate the clinical characteristics of fall-related emergency department presentations in children aged 0–36 months, to describe age-related injury patterns, and to assess the diagnostic approaches used.

Material and Methods: This study was designed as a cross-sectional, descriptive, retrospective chart review. Children under 36 months of age who presented to the emergency department due to falls between January 2024 and December 2024 were retrospectively analyzed. Demographic data, injury site, diagnostic evaluations, type of injury, and clinical outcomes were obtained from the electronic medical record system. Forensic cases and non-fall-related traumas were excluded. For statistical analysis, categorical variables were compared using the chi-square test, and the results were presented as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. A p-value of <0.05 was considered statistically significant.

Results: A total of 161 patients were included; the mean age was 17.27±7.58 months, and 60.2% were male. Presentations increased during summer months. The most common injury site was the head (50.9%), followed by upper (23.6%) and lower extremities (14.3%). Head injuries predominated in the 0–12-month group (74.5%), whereas upper extremity injuries were more common in the 13–24-month group (31.5%). Imaging was performed in 68.9% of patients, most frequently plain radiography. The fracture rate was 13%, with upper extremity fractures being the most common. Most patients (95%) were discharged with outpatient management, and serious injuries were infrequent.

Conclusion: Falls constitute a significant cause of emergency department visits in children aged 0–36 months but generally follow a mild clinical course. Age-dependent injury patterns reflect developmental motor differences. The low rate of serious injury suggests that most falls in this age group are associated with relatively low-energy mechanisms. These findings contribute to a better understanding of fall-related injuries in early childhood and highlight the importance of caregiver awareness and home safety measures.

Keywords: Falls, pediatric trauma, emergency department, head injury

ÖZ

Amaç: Düşme, çocukluk çağında en sık görülen travma mekanizmalarından biri olup özellikle 0–36 ay grubunda hızla gelişen motor becerilere rağmen dengenin tam sağlanamaması nedeniyle önemli bir morbidite nedenidir. Bu çalışma, 0–36 ay arası çocuklarda düşmeye bağlı acil servis başvurularının klinik özelliklerini, yaşa göre yaralanma paternlerini ve tanısal yaklaşımları değerlendirmeyi amaçlamaktadır.

Gereç ve Yöntemler: Bu çalışma kesitsel, tanımlayıcı, geriye yönelik kayıt incelemesi olarak tasarlanmıştır. Ocak 2024–Aralık 2024 tarihleri arasında acil servise düşme nedeniyle başvuran, yaşı 36 ayın altında olan çocuklar retrospektif olarak incelendi. Demografik veriler, travma bölgesi, tanısal tetkikler, yaralanma tipi ve klinik sonuçlar elektronik kayıt sistemi üzerinden değerlendirildi. Adli olgular ve düşme dışı travmalar dışlandı. İstatistiksel analizlerde kategorik değişkenler Ki-kare ile karşılaştırılmış, sonuçlar frekans ve yüzde olarak sunulmuştur. Sürekli değişkenler ortalama ± standart sapma olarak ifade edilmiştir. p<0,05 değeri istatistiksel olarak anlamlı kabul edilmiştir.

Bulgular: Toplam 161 hasta değerlendirildi; yaş ortalaması 17,27±7,58 ay olup olguların %60,2'si erkekti. Başvurular yaz aylarında artış gösterdi. Kafa travması %50,9 ile en sık yaralanma bölgesiydi; 0–12 ay grubunda %74,5 oranıyla baskınken, 13–24 ay grubunda üst ekstremite yaralanmaları artış gösterdi (%31,5). Hastaların %68,9'unda görüntüleme yapılmış olup en sık tercih edilen yöntem direkt grafiydi. Fraktür oranı %13 olarak bulunmuş olup, fraktürlerin en sık lokalizasyonu üst ekstremiteydi. Olguların %95'i taburcu edildi, ciddi yaralanma oranı düşük bulundu.

Sonuç: Düşmeler, 0–36 ay arası çocuklarda acil servis başvurularının önemli bir nedenini oluşturmakla birlikte, genellikle hafif klinik seyir göstermektedir. Yaşa bağlı yaralanma paternleri, gelişimsel motor farklılıkları yansıtmaktadır. Düşük ciddi yaralanma oranı, bu yaş grubundaki düşmelerin çoğunlukla görece düşük enerjili mekanizmalarla ilişkili olduğunu düşündürmektedir. Bu bulgular, erken çocukluk döneminde düşmeye bağlı yaralanmaların daha iyi anlaşılmasına katkı sağlamakta ve bakım veren farkındalığı ile ev içi güvenlik önlemlerinin önemine işaret etmektedir.

Anahtar Kelimeler: Düşme, pediyatrik travma, acil servis, kafa travması

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Introduction

Children constitute a vulnerable population with respect to trauma due to incomplete anatomical and physiological maturation, a natural tendency to explore their environment, and an underdeveloped perception of danger. Traumatic injuries account for a substantial proportion of pediatric morbidity and mortality, with falls representing one of the most common mechanisms (1,2).

Falls are largely preventable and occur most frequently in children aged 0–36 months, a period characterized by rapid motor development and incomplete balance control (2–4). During this stage, the acquisition of motor skills such as sitting, crawling, walking, and climbing increases environmental exploration and, consequently, the risk of household injuries (5). Limited risk awareness, together with inadequate safety measures and insufficient caregiver knowledge, further contributes to the occurrence of fall-related injuries (6,7). Although most falls are minor, those resulting in head trauma remain an important cause of morbidity and mortality in childhood (8). Therefore, identifying risk factors and improving preventive strategies are essential.

This study aimed to evaluate fall-related emergency department presentations in children aged 0–36 months, to describe age-specific injury patterns, and to assess diagnostic approaches in the emergency setting.

Material and Methods

Following approval from the institutional ethics committee (Approval No: BAEK-445), this retrospective study was conducted at a 450-bed tertiary care hospital. Although our institution does not have a dedicated pediatrics department or pediatric intensive care unit, pediatric trauma patients are managed in the emergency department. Children aged 36 months and younger who presented to the emergency department between January 1, 2024, and December 31, 2024, were retrospectively evaluated using data obtained from the hospital's electronic medical record system.

A total of 353 patients were screened during the study period. Of these, 44 were excluded due to non-traumatic presentations, 67 due to trauma mechanisms unrelated to falls (e.g., burns, foreign bodies, radial head subluxation, collisions), 21 as forensic cases (e.g., traffic accidents, assault, suspected abuse), and 60 due to incomplete data. The final analysis included 161 patients. The study aimed to evaluate injuries resulting from accidental falls in a homogeneous population; therefore, patients with non-fall-related trauma and those classified as forensic cases were excluded.

The primary outcome was the presence of serious injury, defined as imaging-confirmed fracture, the need for hospitalization, and/or surgical intervention. Secondary outcomes included the anatomical site of injury, imaging utilization, type of injury, and clinical outcome (discharge or hospitalization). Soft tissue injury was defined as superficial injury without bone or internal organ involvement (e.g., contusions, abrasions, lacerations, minor hematomas) and was diagnosed clinically, with imaging support when necessary. Head trauma was defined based on clinical examination findings and supported by imaging when indicated.

Fall mechanisms were categorized according to available records, including fall location (bed, couch/furniture, stairs, caregiver's arms, ground level) and fall height (ground level vs. elevated surface). Due to the retrospective design, detailed mechanistic variables were not consistently available; cases with missing information were classified as "unknown" and excluded from relevant subgroup analyses.

Patients at risk for non-accidental injury were evaluated based on routine clinical practice and medical records. Those classified as forensic cases by emergency physicians were excluded. No additional retrospective standardized screening for non-accidental injury was performed.

Patients were grouped into three age categories based on developmental milestones (0–12, 13–24, and 25–36 months) (4), reflecting differences in mobility and motor development.

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows, version 21.0 (SPSS 21.0). Descriptive statistics were used to evaluate the data, with continuous variables presented as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. Associations between categorical variables were evaluated using cross-tabulations and the Pearson chi-square test. For 3×5 contingency tables with small expected cell counts, the Fisher–Freeman–Halton exact test was used. When a significant association was detected, pairwise comparisons of column proportions were performed using the Z test with Bonferroni correction to identify the source of the difference. No imputation was performed for missing data; analyses were conducted using available data, and cases with missing values were excluded from the relevant subgroup analyses (complete-case analysis). A p value <0.05 was considered statistically significant.

Results

A total of 353 patients aged 0–36 months were screened during the study period, of whom 161 were included in the final analysis after excluding 192 cases (Figure 1). The mean age was 17.27 ± 7.58 months, and 60.2% of patients were male (n = 97). Patient presentations were more frequent during the summer months, with the highest number of cases observed in July (16.1%) and the lowest in January (3.1%). Overall, the distribution of presentations by season was 18.0% in spring, 35.4% in summer, 27.3% in autumn, and 19.3% in winter. Overall, 59.6% of cases (n = 96) were associated with injury, with rates of 62.9% (n=61) in boys and 54.7% (n=35) in girls.

Falls were categorized as same-level falls (n=85, 52.8%) and falls from height (n=76, 47.2%). Among patients with falls from height, the specific mechanism of injury could not be determined in 18 cases. Therefore, mechanism-specific analysis was performed in the remaining 58 patients. Among these, falls most commonly occurred from furniture, including couches/chairs (n=21, 36.2%) and beds (n=21, 36.2%), followed by stairs (n=7, 12.1%), strollers (n=4, 6.9%), caregiver's arms (n=3, 5.2%), and playground slides (n=2, 3.4%).

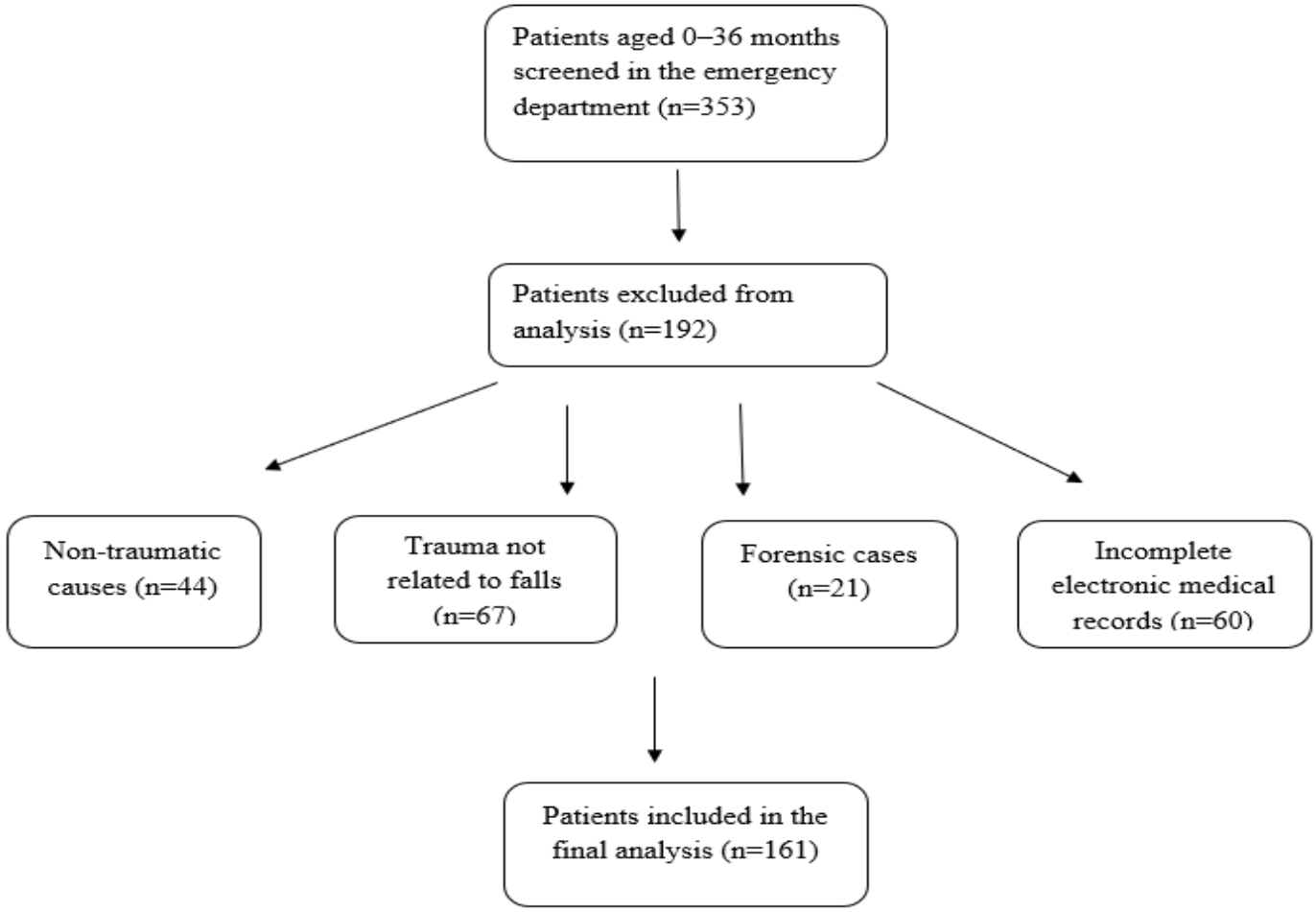

Figure 1. Flow diagram of patient inclusion and exclusion.

Injury Site	n	%
Head	82	50.9
Upper extremity	38	23.6
Lower extremity	23	14.3
Face	13	8.1
Multiple sites	5	3.1
Total	161	100

Table 1. Distribution of injuries according to trauma site

Head trauma was the most common injury site, identified in 50.9% of cases (n = 82), followed by upper extremity (23.6%) and lower extremity injuries (14.3%). Facial injuries occurred in 8.1% of patients, while multiple-site injuries were observed in 3.1% (Table 1). Among patients with head trauma, no cases of altered consciousness or abnormal neurological findings were identified. Imaging revealed a single linear parietal fracture (1.2%), and the patient was admitted for observation.

Head injuries were most prevalent in the 0–12-month age group and decreased with increasing age. Upper extremity injuries were more frequent in the 13–24-month group, whereas lower extremity injuries increased with age and were most common in the 25–36-month group. Facial injuries were predominantly observed in the 13–24-month group, and multiple-site injuries were uncommon across all age groups. The distribution of injury sites differed significantly according to age group ($p < 0.05$) (Table 2). Injury rates were 63.5% (n = 54) in same-level falls and 55.3% (n = 42) in falls from height, with no significant difference between the groups ($p = 0.286$). In contrast, injury rates differed significantly across age groups, being 46.8% in the 0–12-month group, 62.9% in the 13–24-month group, and 72.0% in the 25–36-month group ($p = 0.026$). Injury rates also varied significantly by season, with the highest proportion observed in spring (62.1%) ($p = 0.009$).

Injury Site, n (%)	0-12 Months (n=47)	13-24 Months (n=89)	25-36 Months (n=25)	p value
Lower extremity	4 (8.5)[a]	12 (13.5)[a]	7 (28.0)[a]	0.008*
Multiple sites	1 (2.1)[a]	4 (4.5)[a]	0 (0.0)[a]	
Head	35 (74.5)[a]	37 (41.6)[b]	10 (40.0)[b]	
Upper extremity	5 (10.6)[a]	28 (31.5)[b]	5 (20.0)[a,b]	
Face	2 (4.3)[a]	8 (9.0)[a]	3 (12.0)[a]	

Table 2. Distribution of injury sites according to age groups
Different superscript letters (a, b) indicate statistically significant differences between age groups. Groups sharing the same letter do not differ significantly. *Fisher-Freeman-Halton exact test

Type of Evaluation	n (%)
XR	78 (48.4)
CT	25 (15.5)
CT + XR	7 (4.3)
CT + US + XR	1 (0.6)
No imaging performed	50 (31.1)
Laboratory tests	8 (5.0)
Total	161(100.0)

Table 3. Types of Imaging studies and laboratory testing rates
XR, Plain Radiography; CT, Computed Tomography; US, Ultrasonography
Percentages were calculated based on the total study population (n = 161). Laboratory testing was not mutually exclusive with imaging modalities

During the diagnostic evaluation, imaging was not performed in a substantial proportion of patients, while plain radiography was the most commonly used modality. Computed tomography was used less frequently, either alone or in combination with other imaging modalities (Table 3). All patients presenting to the emergency department with fall-related injuries involving the lower extremity, upper extremity, or multiple body regions underwent imaging. Among patients presenting with fall-related head trauma (n = 82), 27 (32.9%) underwent computed tomography (CT) imaging.

Imaging findings were mainly extremity fractures, followed by less frequent skull, clavicle, nasal, and pelvic fractures, as well as a small number of pneumothorax cases. Most patients were diagnosed with soft tissue injuries and managed conservatively, while a smaller proportion had no detectable injury (Table 4). A single notable case of pneumothorax associated with an iliac wing fracture was identified following a fall from an elevated surface, representing an uncommon injury pattern in this age group. Among patients without detected injury, some were discharged based on normal clinical evaluation without imaging, whereas others had normal imaging findings; none required medical or surgical treatment.

Type of Injury	n	%
No identifiable injury	65	40.4
Soft tissue injuries	72	44.7
Scalp hematoma	27	16.8
Sprain	19	11.8
Laceration	13	8.1
Abrasion	8	4.9
Contusion	5	3.1
Fractures and other significant injuries	24	14.9
Upper extremity fracture	10	6.2
Radial head subluxation	3	1.9
Parietal bone fracture	1	0.6
Clavicle fracture	2	1.2
Pneumothorax with iliac wing fracture	1	0.6
Nasal fracture	3	1.9
Lower extremity fracture	4	2.5
Total	161	100

Table 4. Distribution of diagnosed injuries

When the association between imaging utilization and clinical variables was analyzed, the rate of imaging was 78.1% (n=75) in patients with injuries and 55.4% (n=36) in those without injuries (p=0.002). Imaging rates were 65.9% (n=56) in same-level falls and 72.4% (n=55) in falls from height (p=0.375). Likewise, when age group and fall level were evaluated together, imaging rates were similar across groups (p=0.058) (Table 5).

Of the cases, 153 patients (95.0%) were discharged from the emergency department. One patient (0.6%) left the hospital after refusing treatment, two patients (1.2%) were referred to a higher-level center, and five patients (3.1%) were hospitalized. Of the five patients who were hospitalized, three were admitted for observation due to head trauma, and two were admitted for surgical management of fractures. Two patients were referred to another tertiary care center due to the unavailability of pediatric surgery and pediatrics specialists at our institution. Additionally, a 21-month-old patient who was placed under observation for head trauma left the emergency department against medical advice.

Variable	No imaging n (%)	Imaging n (%)	p value
Injury			
No	29 (44.6%)	36 (55.4%)	p=0.002
Yes	21 (21.9%)	75 (78.1%)	
Fall Level			
Same-level falls	29 (34.1%)	56 (65.95)	p=0.375
Falls from height	21 (27.6%)	55 (72.4%)	
Age group × fall level			
0–12 months			
Same-level	9 (56.3%)	7 (43.7%)	
From height	12 (38.7%)	19 (61.3%)	
13–24 months			
Same-level	14 (25.5%)	41 (74.5%)	p=0.058
From height	8 (23.5%)	26 (76.5%)	
25–36 months			
Same-level	6 (42.9%)	8 (57.1%)	
From height	1 (9.1%)	10 (90.9%)	

Table 5. Imaging utilization according to clinical variables

Discussion

In this study, emergency department presentations due to fall-related injuries among children aged 0–36 months were evaluated. This period represents a critical developmental stage characterized by rapid neurodevelopmental and motor changes; therefore, patients were stratified into narrower age groups to enable a more detailed assessment of age-specific injury patterns. The proportion of trauma cases resulting in injury was 59.6%, and the higher proportion observed in male children (60.2%) is consistent with previous reports (7,8). This difference may be

attributed to greater activity levels, increased environmental exploration, and a higher tendency for risk-taking behaviours among boys.

The higher frequency of emergency department presentations during the spring and summer months may be attributed to increased outdoor activity among children, particularly in environments such as balconies and gardens. Similar seasonal patterns have been reported by Rajagopal et al. (9) and Günal Y. (10). In our country, higher ambient temperatures and longer daylight hours during these seasons are associated with prolonged outdoor exposure and increased physical activity, while caregiver supervision may be relatively reduced. Together, these factors suggest that environmental conditions and supervision patterns contribute to the increased incidence of pediatric fall-related trauma.

In our study, 52.8% of falls occurred at the same level, while 47.2% were from height. Among falls from height, household furniture—particularly beds, couches, and chairs—represented the most common sources. This finding is consistent with the literature indicating that early childhood falls predominantly occur in the home environment and are frequently associated with furniture (11,12). Similarly, Kokulu et al. (13) reported that falls from beds and similar furniture are the leading cause of falls in infants. Rapid motor development, immature balance and coordination, and an increased tendency to explore the environment are key factors contributing to fall risk in this age group. Accordingly, falls are recognized as one of the most common mechanisms of injury in early childhood and account for a substantial proportion of emergency department presentations (14). Although less frequent, mechanisms such as falls from a caregiver's arms and stairs have been associated with more severe injuries (15), and similar patterns were observed in our cohort.

Analysis of injury site distribution showed that head trauma was the most common type of injury. This finding is consistent with previous studies reporting the head as the most frequently affected region in early childhood (16). This pattern may be explained by anatomical and developmental factors, including a relatively large head-to-body ratio and immature protective reflexes (4,17). However, the absence of altered consciousness or abnormal neurological findings, together with the low rate of clinically significant imaging results, suggests that most head injuries were minor in severity.

Evaluation of age-related injury patterns showed that upper extremity injuries were more frequent in the 13–24-month age group. This may be associated with the acquisition of motor skills such as walking and running, leading children to use their hands for protection during falls. In contrast, the increase in lower extremity injuries in older age groups may reflect greater mobility and increased interaction with the environment. Overall, these findings suggest that injury patterns are closely related to developmental characteristics.

The absence of a significant difference in injury rates according to fall level suggests that injury severity cannot be explained solely by the mechanism of trauma. In contrast, the differences observed across age groups highlight the influence of developmental stages on injury patterns. Seasonal variation, on the other hand, may be related to environmental exposure and levels of physical activity (18).

In our study, imaging practices appear to be primarily guided by clinical evaluation. The frequent use of plain radiographs, particularly for extremity injuries, underscores their role as the first-line imaging modality in this age group. In contrast, the more limited use of computed tomography reflects an approach aimed at minimizing unnecessary radiation exposure in young children (19). The relatively low use of advanced imaging in patients with head trauma, together with the infrequent detection of clinically significant findings, suggests that most cases follow a mild clinical course. Overall, these findings indicate that imaging decisions in fall-related injuries during early childhood are individualized and based on clinical assessment rather than routine application (20).

The predominance of soft tissue injuries and the absence of detectable injury in a substantial proportion of patients indicate that most falls result in low-impact trauma. The high frequency of scalp hematomas and sprains further suggests that these injuries are often confined to superficial tissues. In contrast, fractures and other clinically significant injuries were less common, with upper extremity fractures being the most frequently observed. The limited number of skull, clavicle, and nasal fractures indicates that severe traumatic injuries are relatively uncommon in this age group. Nevertheless, the presence of rare but more serious conditions, such as pneumothorax, highlights that fall-related trauma may present across a broad clinical spectrum (21).

Most patients were managed conservatively and discharged without the need for specific treatment. The association between imaging utilization and the presence of injury indicates that imaging decisions are largely guided by clinical findings (20,22). However, the lack of a significant relationship when evaluated together with fall level and age further supports the role of clinical judgment in imaging decisions (23).

In our study, the vast majority of patients were managed on an outpatient basis and discharged (95%), and no mortality was observed. Nevertheless, considering that falls are among preventable causes of trauma, it is essential to increase parental awareness regarding fall risks, particularly in children who have recently begun to walk, and to enhance home safety measures. In this context, strengthening preventive healthcare practices and parental education programs is of considerable importance (24,25).

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the retrospective and single-centre design may limit generalizability. Selection bias may have occurred, as only patients presenting to the emergency department were included, potentially excluding milder cases not seeking medical care. Information bias is also possible due to reliance on medical records, which may contain incomplete or inaccurately documented data, particularly regarding fall mechanisms and circumstances; in some cases, the exact mechanism could not be clearly determined. Although fall mechanisms were identified and incorporated into the analysis, detailed mechanistic variables such as fall height, surface type, and environmental

conditions were not consistently available across all cases, limiting a more comprehensive interpretation of injury patterns.

Ascertainment bias may have influenced the detection of injuries, as imaging decisions were based on clinical judgement rather than standardized criteria, potentially leading to under- or over-detection of certain injuries. Furthermore, although forensic cases were excluded, it remains unclear whether a systematic non-accidental injury (NAI) screening protocol was applied, and no standardized retrospective screening was performed, which may have introduced misclassification bias. The absence of post-discharge follow-up data represents an important limitation, particularly given that the majority of patients were discharged from the emergency department, restricting the assessment of delayed complications or missed injuries.

In addition, subgroup analyses, particularly for the 25–36-month age group, may be underpowered due to relatively small sample size. Finally, the lack of standardized information regarding data collection procedures, data validation, and the management of missing data may further affect the reliability of the findings.

Conclusion

In this study, fall-related injuries among children aged 0–36 months presenting to the emergency department were found to be predominantly mild in severity. The head was the most frequently affected region, followed by upper and lower extremity injuries. Injury patterns differed significantly across age groups, and this distribution was consistent with developmental characteristics of early childhood.

In addition, imaging utilization was associated with clinical evaluation and was generally applied in a selective manner. The low rate of serious injuries and the limited need for hospitalization further support that most cases in this age group have a favorable clinical course. These findings provide descriptive data that may contribute to a better understanding of the clinical characteristics and age-related distribution of fall-related injuries in early childhood. Future multicenter, prospective studies may contribute to a more detailed analysis of injury mechanisms and to the development of effective preventive strategies.

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