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ORIGINAL RESEARCH

Etiology of pediatric forensic cases: comparison of emergency department admissions in childhood and adolescence

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Abstract

Background: This study aimed to examine the etiology of pediatric forensic cases by analyzing emergency department visits for forensic reasons among older children (ages 5–10 years) and young adolescents (ages 10–14 years), and to highlight the differences between the two age groups. **Methods**: Children presenting as forensic cases to the Emergency Department of Sakarya Training and Research Hospital (STRH EDs) between 01 January 2018 and 31 December 2021 were retrospectively analyzed. The study population was divided into the Older Childhood Age Group (OCAG) and Young Adolescence Age Group (YAAG). Data were evaluated in terms of demographic characteristics, presentation time, clinical outcomes and diagnostic categories. Statistical analyses were conducted using IBM SPSS (version 21.0) software. **Results**: In total, 1165 patients were analyzed. No significant differences were observed between the OCAG (n = 355) and the YAAG (n = 810) in terms of gender, presentation time and seasonality. However, significant differences were observed in hospitalization rates and the nature of traumatic or medical conditions. In the OCAG, the most common cases were assault, poisoning and falls, whereas in the YAAG, early pregnancy, substance use, assault and self-harm were more common. Traffic accidents, firearm injuries, and assaults were more frequent among boys, whereas sexual abuse were more common among girls. **Conclusions**: Forensic cases show significant differences between older childhood and young adolescence. Raising awareness of pediatric forensic cases, identifying at-risk groups, and guiding future prevention and intervention efforts are essential for the protection of children and adolescents.

Keywords

Age groups; Clinical forensic medicine; Emergency department; Pediatric forensic cases

1. Introduction

The concept of a forensic case generally encompasses incidents involving external factors, resulting from negligence or lack of caution, or those involving intentional acts, such as homicide and suicide [1]. Various injuries, accidents, abuse and suicide attempts leading to deterioration in physical or mental health or death presenting to the emergency department (ED) are evaluated within this scope [2]. EDs serve as primary points of contact and intervention for forensic cases, providing a critical data source for determining the etiology of such incidents [1, 2].

Forensic cases account for approximately 3%–8% of all ED admissions [3]. Because these cases encompass a broad etiological spectrum, they can affect any age group, but they are most common in the younger age group [3–5]. Studies have shown that forensic cases in the pediatric age group range between 1.7% and 31%. Contrary to general expectations, a marked decrease in forensic cases during childhood has not been observed, indicating that children are exposed to forensic incidents as frequently as adults [1, 6, 7]. According to data from the Turkish Statistical Institute (TUIK) in 2022, the number of forensic incidents involving children is increasing annually, and 69.4% of deaths under the age of 18 years are due to forensic causes, such as injuries and poisoning [8]. The age range of 5–14 years is particularly significant because it is a period when children first begin to interact with the external world, rely less on their families, engage with the social environment, and exhibit early signs of adolescence. Considering their anatomical, physiological and psychological development, these children are vulnerable to various social, psychological and health issues, including forensic incidents, which may affect their future well-being [2, 3]. The United Nations Educational, Scientific and Cultural Organization defines the age of 5 years as the beginning of school age, and the World Health Organization (WHO) defines the age range of 5–10

years as older childhood. This stage is when children take their first steps into social life and experience a dynamic period of physical and mental development [9]. WHO classifies 10–14 years of age as young adolescence, marked by rapid physical, cognitive and psychosocial growth [10]. Although previous studies have indicated an age-related increase in the frequency of forensic cases in the 5–15 years age range differences in the etiologies between these age groups have not been clearly delineated [2, 7, 11].

This study aimed to investigate the etiologies of pediatric forensic cases, analyze ED admissions associated with forensic causes during the older childhood (5–10 years) and young adolescence (10–14 years) periods, and elucidate the differences between these two age groups.

2. Materials and methods

2.1 Study type

This retrospective, cross-sectional and descriptive study was conducted between 01 January 2018 and 31 December 2021. The study sample consisted of children who presented to the Emergency Department of Sakarya Training and Research Hospital (STRH EDs) and were classified as forensic cases.

2.2 Definitions

STRH is a tertiary hospital located in the provincial center. It provides emergency services in two separate units: the Pediatric ED, where nontraumatic pediatric cases (0–18 age group) are treated, and the Adult ED, which serves trauma patients across all age groups. During the study period, a total of 68,782 forensic cases presented to STRH EDs with 64,065 in the Adult ED and 4717 in the Pediatric ED. The number of forensic cases aged 5-14 years admitted to both EDs was 1663 (2.4%), of which 1165 patients who met the inclusion criteria were analyzed (Fig. 1).

2.3 Inclusion criteria

- Patients aged 5–14 years with a forensic admission record.
- Patients with accessible data via the Electronic Information System (EIS).

2.4 Exclusion criteria

- Patients under 5 years or over 14 years of age.
- Patients whose data were not accessible through the EIS.

2.5 Data collection

The cases were divided into two groups according to the WHO definition [10].

Group 1: Older Childhood Age Group (OCAG) (5–<10 years).

Group 2: Young Adolescence Age Group (YAAG) (≥10–14 years).

Patients' demographic data (age and gender), time of presentation (during working hours, outside of working hours and season), clinical outcomes, and diagnostic categories (medical, traumatic and forensic admission-discharge examination) were retrieved from the hospital's EIS and compared between the two groups.

2.6 Statistical analysis

Data were analyzed using IBM SPSS (version 21.0) statistical software (Chicago, IL, USA). The Kolmogorov-Smirnov test was used to assess the normality of continuous variables. Continuous variables were expressed as median and interquartile range (IQR). Categorical variables were expressed as number and percentage (n (%)), and statistical analyses of categorical variables between groups were conducted using the chi-square test. All tests were performed with a two-sided 5% significance level. Absolute and relative effects at each endpoint were reported with corresponding 95% confidence intervals.

3. Results

The median age of patients included in the study was 12 (9–13) years. Of the cases, 355 (30.5%) were in the OCAG and 810 (69.5%) were in the YAAG, with a predominance of males (58.7%). An analysis of presentation characteristics by age group revealed no significant differences between the groups regarding gender, time, month, season and admission year. However, significant differences were observed between the groups regarding hospitalization rates and the proportion of traumatic presentations versus medical presentations (p = 0.027 and p = 0.002, respectively) (Table 1).

When the cases were evaluated according to the diagnoses, the most common diagnoses were assault (n = 371, 31.8%), poisoning (n = 215, 18.5%), and falls (n = 172, 14.8%) (Table 2). When the diagnoses were evaluated according to gender; traffic accidents, firearm injuries, assaults and penetrating injuries were significantly more common in boys (p = 0.009, p = 0.044, $p < 0.001$ and p = 0.002, respectively), whereas sexual abuse, and self-harm were significantly more common in girls ($p < 0.001$ and $p < 0.001$, respectively). When the diagnoses were analyzed according to age groups, poisoning, falls, animal attacks and burns were significantly more prevalent in the OCAG ($p < 0.001$, $p < 0.001$, $p < 0.001$ and p = 0.001, respectively), whereas early pregnancy, forensic admission/discharge examinations, substance and alcohol use, assault and self-harm were significantly more prevalent in the YAAG (p = 0.001, p = 0.001, p = 0.021, $p < 0.001$, $p < 0.001$ and p = 0.079, respectively) (Table 2).

4. Discussion

The ED continues to be the primary point of contact for forensic cases. This study aimed to contribute to the literature on pediatric forensic cases, raise awareness, identify high-risk groups, and provide a resource for future prevention and intervention efforts. Pediatric forensic cases from OCAG and YAAG admitted to a tertiary hospital ED were examined. Assault, poisoning and falls were identified as the most common causes of forensic cases. The results also showed a male predominance among forensic pediatric cases. Previous studies have emphasized the predominance of male patients, even considering it a risk factor, attributing this trend to higher

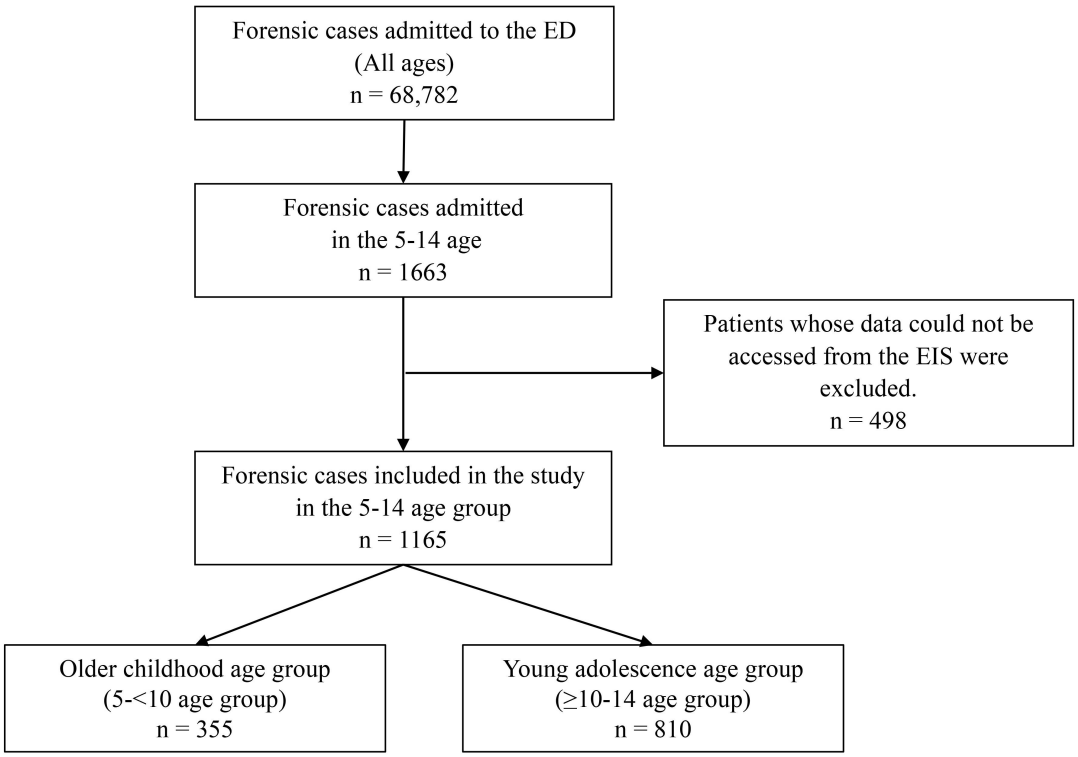

FIGURE 1. Participant flowchart. ED, Emergency department; EIS, Electronic Information System.

TABLE 1. Comparison of demographic data by age group.

Categories	Total (n = 1165)	Age Groups		*p* value
		OCAG (n = 355)	YAAG (n = 810)	
Gender; n (%)				
Girl	481 (41.3)	146 (41.0)	335 (41.4)	0.899
Boy	684 (58.7)	210 (59.0)	474 (58.6)	
Time of Presentation; n (%)				
Working Hours	473 (40.6)	136 (38.2)	337 (41.7)	0.269
Out of Hours	692 (59.4)	220 (61.8)	472 (58.3)	
Distribution of Forensic Cases by Season; n (%)				
Spring	325 (27.9)	93 (26.1)	232 (28.7)	0.465
Summer	257 (22.1)	83 (23.3)	174 (21.5)	
Autumn	324 (27.8)	107 (30.1)	217 (26.8)	
Winter	259 (22.2)	73 (20.5)	186 (23.0)	
Clinical Outcome, n (%)				
Hospitalization	182 (15.6)	43 (12.1)	139 (17.2)	0.027
Discharged	983 (84.4)	313 (87.9)	670 (82.8)	
Diagnostic Categories; n (%)				
Medical	358 (30.7)	108 (30.3)	250 (30.9)	0.002
Traumatic	731 (62.7)	238 (66.9)	493 (60.9)	
Other	76 (6.6)	10 (2.8)	66 (8.2)	

OCAG, Older Childhood Age Group; YAAG, Young Adolescence Age Group.

TABLE 2. Diagnosis according to gender and age group.

Diagnoses; n (%)		Gender		*p* value	Age Groups		*p* value
		Boy (n = 684)	Girl (n = 481)		OCAG (n = 355)	YAAG (n = 810)	
Forensic Admission/ Discharge Examination	76 (6.5)	46 (6.7)	30 (6.2)	0.810	10 (2.8)	66 (8.1)	0.001
Medical							
Poisoning	215 (18.5)	123 (18.0)	92 (19.1)	0.646	98 (27.6)	117 (14.4)	<0.001
Medical Self-harm	97 (8.3)	16 (2.3)	81 (16.8)	<0.001	5 (1.4)	92 (11.4)	<0.001
Early Pregnancy	21 (18.8)	-	21 (4.4)	<0.001	-	21 (2.6)	0.001
Substance or Alcohol Use	18 (1.5)	9 (1.3)	9 (1.9)	0.477	1 (0.3)	17 (2.1)	0.021
Sudden Change of Consciousness	1 (0.1)	1 (0.1)	-	0.402	-	1 (0.1)	0.508
Foreign Body Ingestion	1 (0.1)	1 (0.1)	-	0.402	1 (0.2)	-	0.131
Drowning in Water	2 (0.2)	2 (0.3)	-	0.235	1 (0.3)	1 (0.1)	0.548
Hypothermia	1 (0.1)	1 (0.1)	-	0.402	1 (0.1)	-	0.131
Arrest	1 (0.1)	1 (0.3)	1 (0.2)	0.802	1 (0.3)	1 (0.1)	0.548
Traumatic							
Assault	371 (31.8)	271 (39.6)	100 (20.8)	<0.001	86 (24.2)	285 (35.2)	<0.001
Falling	172 (14.8)	95 (13.9)	77 (16.0)	0.316	79 (22.3)	93 (11.5)	<0.001
Penetrating Sharps Injury	50 (4.3)	40 (5.8)	10 (2.1)	0.002	14 (3.9)	36 (4.4)	0.698
Traffic Accident	36 (3.1)	29 (4.2)	7 (1.5)	0.009	14 (3.9)	22 (2.7)	0.265
Burn	35 (3.0)	17 (2.5)	18 (3.7)	0.226	20 (5.6)	15 (1.9)	0.001
Firearm Injury	10 (0.9)	9 (1.3)	1 (0.2)	0.044	2 (0.6)	8 (1.0)	0.470
Sexual Abuse	18 (1.5)	3 (0.4)	15 (3.1)	<0.001	4 (1.1)	14 (1.7)	0.443
Electric Shock	9 (0.8)	5 (0.7)	4 (0.8)	0.847	2 (0.6)	7 (0.9)	0.592
Animal Attack	14 (1.2)	8 (1.2)	6 (1.2)	1.000	11 (3.1)	3 (0.4)	<0.001
Traumatic Self-harm	7 (0.6)	1 (0.1)	6 (1.2)	0.017	-	7 (0.9)	0.079
Foreign Body Impact	6 (0.5)	4 (0.6)	2 (0.4)	0.692	3 (0.8)	3 (0.4)	0.297
Mechanical asphyxia	2 (0.2)	2 (0.3)	1 (0.2)	0.779	2 (0.4)	1 (0.1)	0.144

OCAG, Older Childhood Age Group; YAAG, Young Adolescence Age Group.

activity levels, early engagement with life, and perceived social freedoms among males [2, 12, 13]. Additionally, the present study revealed that the hospitalization rate for these cases was low, with most patients discharged following ED intervention. This underscores the importance of emergency medicine in identifying the subset of cases requiring minimal hospitalization despite the high number of admissions.

Understanding the causes of forensic cases may serve as a starting point for proactive planning to protect older children and adolescents [14]. Previous studies report that falls are the most common cause of ED visits, with 85% of trauma cases involving adolescent males [12–17]. Additionally, admissions due to assault increase with age [15]. Consistent with the findings of previous studies, the present study found that the most common forensic cases presenting to the ED were assault, poisoning and falls. Gender-based analysis revealed that boys experienced higher rates of assault, traffic accidents and firearm injuries. However, attributing these findings solely to male temperament and social characteristics may be misleading. Forensic cases involving girls may be under-reported because of societal biases and discrimination. A more comprehensive analysis that accounts for these sociocultural factors is necessary to accurately assess the complex interplay among gender, risk-taking behaviors and trauma-related healthcare use.

The distribution of diagnoses according to age is a critical component of the epidemiology of forensic cases. Adolescence is a developmental stage that is marked by significant physical, emotional, and cognitive changes [16]. Adolescents may experience complexities in their emotions, relationships and thoughts, which can lead them to engage in various risky behaviors [17]. Previous studies have indicated that early pregnancy, substance abuse, violence, and self-harm are common forensic cases during adolescence [2, 18]. The present study found that early pregnancy, substance abuse, violence and self-harm were more prevalent in the YAAG, whereas the OCAG, often under parental supervision, mainly experienced cases such as poisoning, falls, animal attacks and burns. This phenomenon can be attributed to ongoing brain development in adolescents, which can lead to problems such

as risky behaviors, impulsive decision-making, and increased susceptibility to peer influences. Addressing these complex issues requires a multifaceted approach involving healthcare providers, educators, parents and the broader community.

The results demonstrated that boys were more frequently affected, and the most common cases were assault, poisoning, and falls. Additionally, because of increased risk-taking behaviors and impulsive decision-making tendencies in the YAAG, forensic cases, such as violence, self-harm, and substance abuse, were more prevalent in this age group. However, forensic cases among girls may be under-reported because of societal gender norms and discrimination.

The limitation of this study is that its retrospective design leads to lower data quality compared to prospective studies. Additionally, the retrospective data collection method may introduce bias in sample selection and issues related to missing data, which limits the generalizability of the study results to a broader population. The data used in this study were solely obtained from the Electronic Health Record System (EHR), which may have led to missing or inaccessible data for some patients. Seasonal variations and timing of presentations are potential factors that could influence the results; however, these factors were not considered, and the analysis was limited to demographic data only.

5. Conclusions

Forensic cases show significant differences between older childhood and young adolescence. This study demonstrated that assault, poisoning, and falls are the most common causes, with male patients more frequently affected—especially in cases involving violence and risk-taking behaviors, which were more prevalent in the young adolescent group. Most cases were managed in the ED without the need for hospitalization, emphasizing the vital role of emergency care. Raising awareness of pediatric forensic cases, identifying at-risk groups, and guiding future prevention and intervention efforts are essential for the protection of children and adolescents. Under-reporting of cases involving girls due to societal biases should also be considered in future research. Age- and gender-specific strategies, supported by improved data systems, are necessary to better understand and manage pediatric forensic cases.

AVAILABILITY OF DATA AND MATERIALS

The data of this original review are available from the corresponding author, upon reasonable request.

AUTHOR CONTRIBUTIONS

NA and FG—contributed to the writing of the main review. NGG, ED, SA and MAB—collected the data. YY and MÖ—added significant intellectual content to the manuscript by critically revising it. All authors approved the final version to be published.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The protocol and other relevant documents for participants were approved by Sakarya University Ethics Committees: 02 February 2022 (Document Number: E-71522473-050.01.04-102109-17). Since the research subjects are minors, informed was obtained from the patients' parents.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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