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Characteristics of unintentional injuries in hospitalized children and adolescents – national retrospective study

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SUMMARY

Introduction/Objective Unintentional injuries is a global health issue among children and adolescents. The aim of this study was to examine the characteristics of unintentional injuries divided according to different age groups and sex among the children and adolescents who have been hospitalized in public hospitals of the Republic of Srpska, Bosnia and Herzegovina.

Methods A retrospective analysis of the e-base of the Agency for Certification, Accreditation and Health Care Quality Improvement of the Republic of Srpska data were collected from 10 public hospitals for patients aged ≤ 19 years, who have been hospitalized for unintentional injuries in the period of January 2018 and December 2020.

Results The study identified 1336 patients who were hospitalized for unintentional injuries, most of whom were boys (67.4%). Falls were the most frequent cause of hospitalization in children of all age categories (aged 1 (70.6%), 1–4 (59.1%), 5–9 (68.5%)) and adolescents aged 10–14 (64.1%), while road traffic injuries were the leading cause of hospitalization in adolescents aged 15–19 (62.6%). The cause of injury for the hospitalized patients were significantly related to age ($p < 0.001$) and sex ($p < 0.05$) groups. According to the nature of the injury in relation to the area of the body, the most frequent injuries were to the head (41.1%), caused by traffic accidents and falls.

Conclusion Since falls and road traffic injuries were the leading causes of hospitalization, preventive measures should be taken to reduce the frequency of these injuries.

Keywords: unintentional injury; child; adolescent; hospitalization

INTRODUCTION

Injuries among children and adolescents are one of the main public health issues globally. Many of them result in pain, disability or death. The majority of these injuries falls into unintentional injuries (90%) [1]. Although these injuries are preventable, they are still prevalent especially in low-income countries where children are more likely to experience and die from unintentional injury [2]. An unintentional injury is defined as an “injury occurring due to non-premeditated acute transfer of mechanical, chemical, thermal or electrical energy or radiation” [3, 4], and the leading causes are road traffic injuries, falls, burns, poisonings and drowning [1, 5, 6, 7]. Over 40,000 children die every year in Europe due to an unintentional injury, with several thousand times more victims who live with varying degrees of disability or injury-related consequences [8]. On the other hand, according to the World Health Organization (WHO) data, it is estimated that tens of millions of children across the globe require hospital care for non-fatal injuries, with a large number of these injuries treated at home and as such remain unregistered [1]. Unintentional injuries that require hospital treatment of children leave consequences

psychological, physical and economic for the family and society [9]. Those most at risk of injury are children aged 1–4 and adolescents aged 10–19. Small children, aged 1–4, are especially prone to injury due to their lack of experience, strength and physical skill, in combination with increased curiosity and hyperactivity, while the sudden increase in risk of injury in the age group of 10–19 is associated with engaging in risky behavior [10]. Since children and adolescents are vulnerable categories of population, the risk of unintentional injury in that period are mainly defined through individual factors such as age, development stages of growing up and sex. Additional risk factors that have a significant impact on the occurrence of injury include other factors in the child’s social and physical environment [11, 12]. A comprehensive evaluation of the characteristics of unintentional injuries in hospitalized children and adolescents is vital and the foundation for assessing the size of this problem in our country.

The aim of this study was to examine the characteristics of unintentional injuries divided according to different age groups and sex among the children and adolescents who have been hospitalized in public hospitals (PHs) of the Republic of Srpska, Bosnia and Herzegovina.

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METHODS

A cross-section study was carried out, including a retrospective analysis of the e-base of the Agency for certification, accreditation and health care quality improvement of the Republic of Srpska (RS ASKVA). A retrospective analysis of the RS ASKVA e-base collected data from all 10 PHs in the Republic of Srpska (eight PHs at the secondary and two at the tertiary level of health care), for the period of January 1, 2018 and December 31, 2020. The search included patients aged ≤ 19 , both sexes, with at least one verified diagnosis of unintentional injury at reception. The unintentional injuries were identified using the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10), marked with codes from group XIX (S00-T98) [13]. For patients who had at least one S or T code diagnosis, it was vital to search for additional diagnoses, which involved five external causes of unintentional injury from group XX – External causes of morbidity and mortality (V01-Y98), ICD-10. This study referenced causes the mechanisms of which brought about unintentional injuries according to WHO, so the search included: Road traffic injuries - RTI (V01–V04, V06, V09–V80, V87, V89, V99), Fire/Burns (X00-X09, X10-X19), Poisonings (X40-X49), Falls (W00-W19) and Drowning (W65-W74) [1]. The search excluded all patients whose injuries were verified as intentional (violence, suicide, self-harm). For the purposes of this study, the following data was collected: age, sex, level of health care according to the type of PH, clinic/department, treatment, characteristics of unintentional injuries, length of hospitalization and treatment outcome. The patients were categorized according to age groups into children (aged < 1 , 1–4, 5–9) and adolescents (aged 10–14 and 15–19). The characteristics of unintentional injuries were defined according to external causes and nature of injury, and they were analyzed according to age groups and sex. The external causes included road traffic injuries, burns, poisonings, falls and drownings according to the ICD-10 codes mentioned earlier. The nature of the injury was classified according to the injured areas of the body (head; neck; thorax; abdomen, lower back, lumbar spine, pelvis and external genitals; upper limbs; lower limbs; multiple body regions; unspecified) for injuries caused by falls and road traffic injuries, then percentage of Total Burned Surface Area for burns (%TBSA: $< 10\%$; 10–19%; 20–29%) and causes of unintentional poisoning (medication; non-medicinal substances). Treatment outcome was categorized into 1) healed, 2) transferred to another institution and 3) fatal.

The statistical processing of the data was carried out using SPSS Statistics for Windows Version 25.0 (IBM Corp., Armonk, NY, USA), with a 95% statistical significance confidence interval. The statistical analysis encompassed descriptive statistics (mean value, standard deviation, median, frequency, percentage). Differences among the causes of unintentional injuries and the groups of children according to age were tested using the Kruskal–Wallis test, and according to sex and nature of injury using the χ^2 test, while the correlation was tested using Cramer's – V and Contingency Coefficient – C.

The study was approved by the Ministry of Health and Social Welfare of the Republic of Srpska (no: 11/04-500-565/19, dated September 25, 2019), Agency for Certification, Accreditation and Health Care Quality Improvement of the Republic of Srpska (no: 11/2.01-801/19 dated September 26, 2019) and the Human and Biological Material Research Ethics Committee of the Faculty of Medicine at the University of Banja Luka (no: 18/4.3/20 dated February 7, 2020).

RESULTS

Over a three-year period (2018, 2019, and 2020), across ten PHs in the Republic of Srpska, the study identified a total of 1,336 (602, 521, and 213, in that order) children and adolescents hospitalized for unintentional injuries. The average age was 10.1 ± 5.9 years (ranging from 0–19). The largest patient group was in the age of 15–19 (29.4%). The group of adolescents aged 10–19, whose average age was 14.8 ± 2.9 , was more frequently hospitalized (53.8%) than children aged 0–9. There was a difference according to sex when it comes to hospitalization, where boys were admitted more frequently (67.4%) than girls. The majority of the patients were treated in institutions of the tertiary level of health care (62.8%), in comparison to the secondary level. The majority of the children and adolescents were treated in surgical clinics/departments (85%). Out of a total of 1336 hospitalized patients, a little over a third required surgical treatment ($n = 443$, 33.2%), 19 cases required ventilation (1.4%), and 65.4% underwent non-surgical treatment. Over the three-year period, a total of 4,866 days of hospital stay was spent due to unintentional injuries/poisonings (2.163/1.809/914 days of hospital stay in the observed period, in that order), where the average length of hospital stay was 3.7 days (± 5.8 days), and the largest group was that with a stay of 1–7 days. The majority of children and adolescents recovered during hospitalization and were discharged home (95.1%), while there were 0.5% fatalities, all from road traffic injuries. General and clinical characteristics of patients who were hospitalized for unintentional injuries are presented in Table 1.

The leading causes attributed to hospitalization for unintentional injuries are falls (55.5%), followed by road traffic injuries (34%), burns (5.2%), poisonings (5.1%) and three cases of drowning (0.2%). The results showed that there are variations among causes whose mechanisms resulted in unintentional injuries, and age. In all age groups (< 1 year (70.6%), 1–4 yrs. (59.1%) and 5–9 yrs. (68.5%)), the highest number of hospitalizations were caused by falls, which is also true for adolescents in the age group of 10–14 (64.1%). In adolescents aged 15–19, of all the observed causes, the highest number of hospitalizations were caused by injuries sustained in road traffic injuries (62.6%), followed by those from falls (33.6%). The share of burns (5.2%) and poisonings (5.1%) in the overall sample of hospitalizations were equally distributed. Burns were more present among children aged 0–9 (84.3%), with the most cases occurring in those under the age of 1 (23.5%)

Table 1. General and clinical characteristics of patients who were treated for unintentional injuries

Variables	n	%
Age (years) (n = 1336; M = 10.1 ± 5.9)		
>1	51	3.8
1–4	252	18.9
5–9	314	23.5
10–14	326	24.4
15–19	393	29.4
Group (years)		
Children (0–9) M = 4.6 ± 2.9	617	46.2
Adolescent (10–19) M = 14.8 ± 2.9	719	53.8
Sex		
Male	900	67.4
Female	436	32.6
Level PH		
Secondary	497	37.2
Tertiary	839	62.8
Clinics/departments		
Surgical	1135	85
Non-surgical	177	13.2
ICU	24	1.8
Treatment		
Surgical intervention	443	33.2%
Non-surgical intervention	874	65.4%
Ventilation	19	1.4%
LOS (day) (M = 3.7 ± 5.8)		
1–7	1172	87.7
8–14	128	9.6
15–21	20	1.5
> 22	16	1.2
Outcomes		
Recovery/Home	1270	95.1
Transferred to another hospital	59	4.4
Fatal	7	0.5

M – mean value; SD – standard deviation; PH – public hospital; ICU – intensive care unit; LOS – length of hospital stay

and those aged 1–4 (16.3%). Hospitalization due to poisoning occurred more among children aged 0–9 (72.1%) than among adolescents. For children aged 1–4, poisoning is

the number three cause of hospitalization (15.5%). Three cases of drowning were recorded for the age group of 5–9. In hospitalized patients, there is a statistically significant difference ($p < 0.001$) among causes that resulted in injury according to age groups of children and adolescents. The group of adolescents aged 15–19 was the most exposed to causes of injury with varying mechanisms which resulted in hospitalization (median = 5) in comparison with other groups. The causes of unintentional injuries which resulted in hospitalization according to age are presented in Table 2.

When it comes to distribution among the sexes, boys were treated in hospitals significantly more because of injuries caused by road traffic injuries (67.2%), burns (67.1%), falls (69.1%) and drowning (66.7%), while unintentional poisonings were evenly distributed in both sexes (50%). The obtained results have shown that there was a statistically significant difference between boys and girls when it comes to the causes whose mechanisms resulted in unintentional injuries ($\chi^2 = 10.3$, $p = 0.035$, $p < 0.05$).

When it comes to injuries caused by falls and road traffic injuries, three most common positions were found in relation to the area of the body: the head, upper extremities and lower extremities. In hospital treatment, head injuries had the highest percentage among all age groups at 41.8%, constituting 68.4% of the cases in children under the age of 1. Head injuries are followed by injuries of the upper extremities with a total share of 28%, with the highest percentage of such injuries in the group of children aged 5–9 (47.6%). The share of lower extremity injuries was 12.2%. There was a statistically significant correlation between the injured body area and the age of the children, where adolescents (aged 10–19) were more exposed to injuries in varying body areas which resulted in hospitalization ($p < 0.001$). Cramer’s V coefficient indicates a weak correlation between the injured body area and the age of the children and adolescents ($V = 0.225$, $p < 0.001$), while the Contingency Coefficient speaks in favor of moderate correlation between the observed variables ($C = 0.411$, $p < 0.001$). The most frequent among burns were those that covered under 10% TBSA (61.4%), and the most vulnerable were children aged

Table 2. The causes of unintentional injuries which resulted in hospitalisation according to age

Variables	Age (in years)					Total	p value	
	< 1	1–4	5–9	10–14	15–19			
	Children		Adolescents					
Causes of UI	ICD-10 code							
Road traffic injuries	V01-V04, V06, V09-V80, V87, V89, V99	n	2	23	81	102	246	454
		%	3.9	9.1	25.8	31.3	62.6	34
Fire/Burns	X00-X09	n	12	41	6	6	5	70
	X10-X19	%	23.5	16.3	1.9	1.8	1.3	5.2
Poisonings	X40-X49	n	1	39	9	9	10	68
		%	2	15.5	2.9	2.8	2.5	5.1
Falls	W00-W19	n	36	149	215	209	132	741
		%	70.6	59.1	68.5	64.1	33.6	55.5
Drowning	W65-W74	n	0	0	3	0	0	3
		%	0	0	1	0	0	0.2
Total		n	51	252	314	326	393	1336
		%	100	100	100	100	100	100

I – unintentional injury; ICD-10 – International Classification of Diseases – revision 10; p – Kruskal-Wallis test

Table 3. The nature of injury for hospitalized children and adolescents according to age

Nature of injury	Age (in years)					Total	χ^2 test p value
	< 1	1–4	5–9	10–14	15–19		
	Children			Adolescents			
Injured body area (road traffic, falls n = 1.195)							
Head	n	26	91	103	111	168	499
	%	68.4	52.9	34.8	35.7	44.4	41.8
Neck	n	0	2	0	4	14	20
	%	0	1.2	0	1.3	3.7	1.7
Thorax	n	0	1	4	11	14	30
	%	0	0.6	1.4	3.5	3.7	2.5
Abdomen, lower back, lumbar spine, pelvis and external genitals	n	0	8	15	15	42	80
	%	0	4.7	5.1	4.8	11.1	6.7
Upper limbs	n	0	34	141	121	39	335
	%	0	19.8	47.6	38.9	10.3	28
Lower limbs	n	2	16	16	39	73	146
	%	5.3	9.3	5.4	12.5	19.3	12.2
Multiple body regions	n	0	0	4	1	3	8
	%	0	0	1.4	0.3	0.8	0.7
Unspecified body or limb sites	n	10	20	13	9	25	77
	%	26.3	11.6	4.4	2.9	6.6	6.4
%TBSA Fire/Burns (n = 70)							
< 10% TBSA	n	10	23	2	5	3	43
	%	83.3	56.1	33.3	83.3	60	61.4
10–19% TBSA	n	2	14	3	1	1	21
	%	16.7	34.1	50	16.7	20	30
20–29% TBSA	n	0	4	1	0	1	6
	%	0	9.8	16.7	0	20	8.6
Causes of poisoning (n = 68)							
Poisoning by non-medicinal substances	n	0	17	5	5	4	31
	%	0	43.6	55.6	55.6	40	45.6
Poisoning by medication	n	1	22	4	4	6	37
	%	100	56.4	44.4	44.4	60	54.4

TBSA – total burned surface area

under 1 (83.3%) and 1 to 4 (56.1%), where the difference was not statistically significant ($p = 0.487$). Medication was the most common cause of poisoning (54.4%) resulting in hospitalization, in relation to non-medicinal substances (chemicals, pesticides, cleaning supplies and alcohol), but not at a statistically significant level ($p = 0.782$). Unintentional poisoning was most frequent in children aged 1–4, with a higher percentage of medication poisonings in the same group (56.4%). Since there were three cases of non-fatal drownings, further statistical analysis of the nature of the injury was not possible due to the sample size. The results of the nature of injury for hospitalized children and adolescents according to age are shown in Table 3.

With regards to sex, boys were more prone to injury in all body areas (68.4%): head (64.7%), neck (85%), thorax (76.7%), abdomen, lower back, lumbar spine, pelvis and external genitals (55%), upper limbs (74.3%) and lower limbs (74.0%), multiple body areas (87.5%) and unspecified body or limb sites (59.7%) in relation to girls ($\chi^2 = 24.8$, $p = 0.001$, $p < 0.05$). The difference between boys and girls in relation to %TBSA ($\chi^2 = 0.98$, $p = 0.614$) and causes of unintentional poisonings ($\chi^2 = 0.54$, $p = 0.462$) was not statistically significant ($p > 0.05$).

DISCUSSION

The conducted study found that the leading causes of hospitalization whose mechanisms resulted in unintentional injuries were falls, in 55.5% of the cases, followed by road traffic injuries 34.0%. That falls are the leading cause of hospitalization among children is corroborated by several prior studies [14, 15]. Looking at age groups, falls were identified as the leading cause of hospitalization in children (0–9 years) and adolescents aged 10–14. The obtained results are congruent with data from Scotland for 2020/21, where 43% of the hospitalizations for children aged under 15 for an unintentional injury were the result of a fall [16]. Our study also showed variations among the causes of hospitalization within adolescents. For adolescents aged 15–19, the leading cause of hospitalization is attributed to road traffic injuries, which constituted 62.6% of the total number of cases. The obtained results are similar to those of a national study conducted in Sweden, where the highest absolute differences in risk of traffic injuries were found precisely among adolescents aged 15 to 19 [17]. Road traffic injuries included in this study were responsible for all fatal outcomes which mostly affected adolescents aged 15–19

(85.7%). In Europe, road traffic injuries are the leading cause of death for children between 5 and 19 years of age. The European Academy of Pediatrics is putting in efforts to prevent morbidity and death in children, inviting policy creators to actively work on “vision zero”, where no child would perish in traffic [18]. Injury patterns in adolescents differ from those in younger age groups, because the adolescence period is a developmental transition point for risk of injury, thanks to factors such as increased independence and increased tendency to assume risk [19]. The high incidence of injury in traffic in adolescents is partly the consequence of the lack of experience and maturity. In addition, adolescence is characterized by increased independence from parents, peer pressure, use of alcohol, use of mobile phones [20], as well as numerous other factors that include emotions, behavior, complex cognitive processes, culture, and other factors [21].

When it comes to differences among the sexes in all the age groups, our study showed that significantly more boys were hospitalized for unintentional injuries (67.4%) in comparison to girls, which is congruent with prior studies [22, 23].

Analyzing the nature of injury caused by falls and road traffic injuries, this study indicates that out of the total hospitalizations, the most frequent were head injuries (41.8%) compared to all other areas of the body, and that the most prone to such injuries were children under the age of 1 (68.4%). After head injuries, the next most frequent injuries were those of upper (28%) and lower extremities (12.2%). Prior studies showed that head injuries are a frequent cause of hospital admission, and that small children had a higher probability of sustaining a head injury compared to older children [24]. The size of the child’s head, their soft and elastic bones in the skull, and weaker support structures of the neck, which contribute to head impact, are characteristics which distinguish them from adults, at the same time making them more susceptible to injury [25].

The results of the conducted study showed that the most hospital admissions for burns, out of the entire sample, were for those with under 10%TBSA (61.4%), which is congruent with prior studies [26, 27]. Children aged 0–4 were the group with the majority of hospitalization for burns, which were the second highest cause of hospitalization in the age group. Prior studies indicate that the first five years

of childhood are at high risk for exposure to burns [28], which is often attributed to their curiosity to explore their environment, but also to their lack of instinct to understand danger from specific objects, and the lack of supervision by their parents/guardians [26].

Our data indicated that medication is responsible for 54.4% of unintentional poisonings, where the most exposed were children aged 0–4. This finding corroborates the results of several studies conducted in various countries and various scenarios, where this particular age group is dominated by accidental medication poisoning [29, 30]. The reasons could be that small children spend a significant portion of their time at home, where exposure to risk is associated with access to poisonous substances and medication. Improper storage of medication, lack of parental awareness of the toxicity of reagents, and carelessness with risks and the lack of supervision, all contribute to the incidence of accidental poisoning in childhood [30].

CONCLUSIONS

This study showed that among patients hospitalized due to unintentional injuries, there were significant differences in cause and nature of injury according to age groups and sexes. In children aged 0–9 and adolescents aged 10–14, the most frequent cause of hospitalization are injuries caused by falls, while traffic accidents are the leading cause of hospitalization among adolescents aged 15–19. Boys were significantly more hospitalized due to unintentional injuries caused occurring due to external causes. The most dominant injuries across all age groups were head injuries, caused by falls and traffic accidents. Therefore, undertaking preventive measures aimed at reducing injuries from falls and traffic accidents would be of crucial importance.

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Карактеристике ненамерних повреда међу болнички леченом децом и адолесцентима – национална ретроспективна студија

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САЖЕТАК

Увод/Циљ Ненамерне повреде представљају глобални јавноздравствени проблем међу децом и адолесцентима.

Циљ истраживања је био испитати карактеристике ненамерних повреда према различитим добним групама и полу међу децом и адолесцентима који су болнички лечени у јавним болницама Републике Српске.

Метод Ретроспективном анализом е-базе Агенције за сертификацију, акредитацију и унапређење квалитета здравствене заштите Републике Српске прикупљени су подаци из 10 јавних болница за пацијенте доби ≤ 19 година који су хоспитализовани због ненамерних повреда у периоду од јануара 2018. до децембра 2020. године.

Резултати Идентификовано је 1336 пацијената, од којих су већина били дечаци (67,4%), који су хоспитализовани због

ненамерних повреда. Падови су били први узрок хоспитализације деце свих добних категорија (< 1 године (70,6%), 1–4 године (59,1%), 5–9 година (68,5%)) и адолесцената 10–14 година (64,1%), док су саобраћајне незгоде биле водећи узрок хоспитализација у групи адолесцената доби 15–19 година (62,6%). Узроци повреда хоспитализованих пацијената значајно су повезани са добним ($p < 0,001$) и полним ($p < 0,05$) групама. Према природи повреде у односу на регију тела, најчешће су биле повреде главе (41,1%) настале услед саобраћајних незгода и падова.

Закључак С обзиром на то да су падови и саобраћајне незгоде водећи узроци хоспитализације, потребно је предузети превентивне мере за смањење ових повреда.

Кључне речи: ненамерне повреде; деца; адолесценти; хоспитализација