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Childhood injuries, their etiologies, and preventive measures

Çocuk yaralanmaları, nedenleri ve önlemler

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Amaç: Çocukluk çağındaki yaralanmaların sosyal, ekonomik, kültürel etkenleri ortaya konarak alınabilecek tedbirler araştırıldı.

Çalışma planı: Eylül-Aralık 2007 tarihleri arasında yaralanma sonucu acil servise başvuran 120 çocuk hasta (75 erkek, 45 kız; ort. yaş 8.3; dağılım 0-14) değerlendirildi. Hasta veya yakınlarından çocuğun yaşı, kardeş sayısı, yaralanma zamanı, nedeni, şekli ve yeri, hastaneye geliş şekli ve zamanı, ailenin eğitim ve sosyokültürel düzeyi, daha önce benzer bir yaralanma geçirip geçirmediği sorgulandı.

Sonuçlar: Hastaların yaklaşık onda biri (%10.8) hastaneye yatırılarak tedavi edildi. Yirmi hasta (%16.7) geçmişte en az bir kez benzer şekilde yaralanma geçirmişti. Yaralanmaların en çok evde (n=42, %35) meydana geldiği görüldü. Travmatik yaralanmaların en fazla 7, 8 ve 10 yaşlarında meydana geldiği, 12 yaş ve sonrasında da sayıca hep yüksek seyrettiği belirlendi. En sık yaralanan bölgelerin yaşa göre dağılımı şöyleydi: İlk altı yaşa kadar dirsek, 7-11 yaşlarında el bileği ve el, 12 yaş ve üzerinde el bileği. Hasta annelerinin çok büyük bir çoğunluğu ev kadını (%86.7) idi. Annenin ev dışında çalışıyor olması, annenin eğitim düzeyi ve kardeş sayısı tekrarlayan yaralanmalar ile ilişkili bulunmadı (p>0.05).

Çıkarımlar: Bu çalışma çocuk yaralanmalarının özellikleri konusunda yararlı bilgiler sağlamıştır. Özellikle çocuk yaralanmalarının arttığı okul döneminin başı (7 yaş) ve ergenlik çağının başında (12 yaş), hedef kitlelerin risk davranışları konusunda bilinçlendirilmesi ve yaralanmaların önlenmesini amaçlayan eğitim faaliyetlerinin yoğunlaştırılması, çocuk yaralanmalarının önlenmesinde en yüksek verimi sağlayacaktır.

Anahtar sözcükler: Düşme; kaza; çocuk; Türkiye/epidemiyoloji; yaralanma/epidemiyoloji/etyoloji.

Objectives: The purpose of this study was to evaluate social, economical, and cultural factors of childhood injuries and to assess preventive measures.

Methods: The study included 120 children (75 boys, 45 girls; mean age 8.3 years; range 0 to 14 years) who presented to the emergency department due to trauma from September to December 2007. Information was gathered from the patients or parents on the following: age, number of siblings; time, etiology, place, and type of trauma; type and time of transportation, educational and sociocultural level of the parents, and whether the patient had a similar injury before.

Results: About one-tenth (10.8%) of the patients were admitted and treated. Twenty patients (16.7%) had at least one similar injury previously. Most of the events were household injuries (n=42, 35%). The highest number of injuries occurred at the ages of 7, 8, and 10 years, and the number of injuries remained high from 12 to 14 years of age. The most frequent site of injury was the elbow during the first six years of age, the wrist and the hand at ages 7 to 11 years, and the wrist from 12 to 14 years of age. The great majority of the mothers were housewives (86.7%). Occupation and educational status of the mother, and the number of siblings were not related with recurrent childhood injuries (p>0.05).

Conclusion: This study provided helpful information on the characteristics of childhood trauma. Programs targeting to increase the awareness on pertinent risk behaviors and to promote educational efforts concerning the risks and preventive measures will be of great help in preventing childhood injuries, in particular at the beginning of school life (age 7) and adolescence (age 12), at which time child injuries show culmination.

Key words: Accidental falls; accidents; child; Turkey/epidemiology; wounds and injuries/epidemiology/etiology.

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Musculoskeletal injuries in children have a wide coverage in Orthopedics and Traumatology. New techniques are continuously being developed for the management of these injuries and their sequels in order to minimize the impact of the damage. Although many injuries are successfully managed by current treatment methods, negative effects of trauma and treatment on child's psychology cannot be denied. Persistent disabilities may also occur related to the injury itself. Therefore, as in other fields of medicine, prevention of traumatic injuries is both more effective and cost-saving for the healthy generations. Causes of childhood injuries in developed and developing countries have been discussed with a wide etiological perspective.[1-7] Based on this background, prevention programs such as Citizenship Safety Project (CSP) and Injury Minimization Programme for School (IMPS) have been implemented in some countries.[8] National registry system as well as research related to this subject is very limited in our country.[9]

In countries with a relatively young population as in our country, childhood injuries comprise a much greater field of practice among other injuries. The aim of this prospective, descriptive study was to investigate social, economical, cultural factors in childhood injuries in order to contribute to the creation of a national prevention program in the future. Our country's conditions were compared with those of other developed countries and measures to be taken for the prevention of childhood injuries have also been discussed.

Patients and methods

A total of 120 children aging 0 to 14 years (mean age 8.3) admitting to the emergency unit of Haydarpasa Numune Training and Research Hospital due to injury between September and December 2007 and whose parents provided informed consent to participate in this study were included. Of these patients, 75 were boys and 45 were girls. Patients were evaluated according to four age groups (infant and toddler, ≤2 years; play age, 3–6 years; primary school age, 7–11 years; and adolescence, 12–14 years). In addition to orthopedic musculoskeletal injuries alone, multiple injuries concerning other specialties, such as neurosurgery and general surgery, were also included.

A study-related questionnaire was completed by the physician during diagnostic work-up and treatment of the injured child at the emergency unit. Patients and their families were questioned for patient's age, number of siblings, time of injury, type of injury and setting, how and when they arrived at the hospital, education and sociocultural level of the family, previous history of similar injury. The relationship between interventions and conditions before patient's admission and educational and sociocultural level of the family were evaluated.

Statistical analysis of the data was performed through Fisher's exact test, and p values of less than 0.05 were considered statistically significant.

Results

While 13 of the 120 patients (10.83%) were treated at the Orthopedics and Traumatology in-patient clinic, 107 (89.17%) were treated at the emergency unit. Of the patients, 83 (69.17%) admitted to the hospital at the same day of injury, 32 (26.67%) admitted at the following day, 4 (3.33%) two days after injury, and 1 (0.83%) four days after injury. Twenty patients (16.67%) had at least one previous history of similar injury and admission to a healthcare institution.

Table 1. Initial intervention type and setting of those patients who were treated before admitting to the emergency unit

	Government healthcare institution/paramedics (n)	Private healthcare institution (n)	Patient/family intervention (n)	Bonesetter (n)	*Total (n)*
Dressing	4	1	1	–	6
Analgesic ointment	–	–	7	–	7
Temporary fixation	7	1	2	1	11
Ice application	–	–	14	–	14
Heat application	–	–	2	–	2
Bandaging	–	–	2	–	2
Total	11	2	28	1	42
%	9.2	1.7	23.3	0.8	35.0

Table 2. Distribution of patients (number, %) according to injury settings

	Number	%
Home	42	35.0
Playground	11	9.2
School	32	26.7
Street	28	23.3
Garden	5	4.2
Other	2	1.7
Total	120	

Before admission to our emergency unit, 42 patients (35%) had undergone prior intervention performed by another healthcare institution, paramedics or relatives of patients. Initial intervention was performed in our hospital in 78 patients (65%) (Table 1). From 120 patients, 101 (84.17%) arrived at our hospital by their private cars, 9 (7.50%) by ambulance, 8 by public transportation (6.67%), 1 by cab (0.83%), and 1 on foot (0.83%). Classifying cases according to the injury setting, it was detected that most injuries occurred at home (42 patients-35%) (Table 2).

Approximately two thirds (75 patients, 62.5%) of the patients were boys, and 64 had more than one sibling (Table 3). Distributing cases according to age, it was detected that the highest numbers of injured children were at seven, eight and ten years of age, remaining high at 12 years and over (Table 4). The most frequent anatomic locations of injury were the elbow region until up to 6 years, the hand and wrist region between 7 and 11 years, and wrist region at and over 12 years of age.

Table 3. Distribution of previous injuries of the patients according to number siblings

	Previous injury		
Siblings	Yes	No	Total
0	4	17	21
1	7	28	35
2	4	33	37
3	2	12	14
4	2	5	7
5	1	3	4
≥6	–	2	2

Evaluating injury-related fracture or dislocation complication rates, it was observed that all injuries at the femoral region resulted in femoral fractures, and that this rate was also high for forearm, elbow and ankle injuries (Table 5).

Patients' fathers had a rather wide spectrum of professions and approximately one third of them were primary school graduates. Distribution of their educational levels is shown in Table 6. Professions of patients' mothers demonstrated a lesser diversity. Mothers of 104 patients were housewives (86.67%), 5 were workers (4.17%), 3 were hairdressers (2.50%), 2 were cosmetic workers (1.67%), 3 were teachers

Table 4. Distribution of injury etiologies (number of patients) according to age (years)

	Age														
Etiology	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nursemaid's elbow	–	–	1	3	–	1	–	–	–	–	–	–	–	–	–
Fall in playground	–	–	–	–	–	–	2	–	–	–	–	–	3	1	–
Fall from bed or couch	1	1	1	1	1	–	–	–	–	–	–	–	–	1	–
Fight	–	–	–	–	–	–	–	–	1	–	–	–	–	1	1
Fall from a tree	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1
Dropped off by parent or caregiver	1	3	–	1	1	–	–	–	–	–	–	–	–	–	–
Fall on flat terrain	1	–	1	1	1	–	2	2	2	1	3	3	1	2	2
Joking/teasing	–	–	–	–	–	2	–	2	–	–	–	1	1	1	–
Fall while running	–	–	–	–	–	–	–	1	2	–	1	1	–	1	–
Sports injury	–	–	–	–	–	–	–	2	2	1	2	–	1	2	4
Home accident	–	–	2	–	2	2	1	–	1	1	1	1	3	–	2
Injury during play	–	–	–	1	–	–	1	1	2	1	1	1	–	–	1
Fall from stairs	–	–	–	1	–	–	–	–	1	–	2	1	2	2	1
Bicycle injury	–	–	–	–	–	–	–	–	1	1	1	1	–	–	–
Traffic accident	–	–	–	1	1	–	1	1	–	–	–	–	–	–	–

Table 5. Distribution of patients and complications according to injury site *

Injury site	Nubmer	fracture or dislocation	
		Number	%
Shoulder	4	1	25.0
Elbow	18	8	44.4
Forearm	10	6	60.0
Wirst	24	10	41.7
Hand	14	–	
Femur	8	8	100.0
Hip	2	–	
Knee	9	–	
Tibia	1	–	
Ankle	7	3	42.9
Foot	10	2	20.0
Head/face	15	–	
Thoracic cage	1	–	
Lumbar region	1	–	

*Four patients had injuries on multiple sites

(2.50%), 1 was a computer operator (0.83%), 1 was a lawyer (0.83%) and 1 was an insurer (0.83%).

In order to investigate whether the mother's employment constituted a risk factor for recurrent injury, patients with two or more injuries and those with first injury were compared with regard to whether their mothers were housewives or not. No significant differences were found ($p>0.05$). When patients were classified according to the educational levels of their mothers (no education or, at most, secondary school level versus high school or college level), no statistically significant difference was found regarding recurrent injuries ($p>0.05$). When patients with only 1 sibling and those with 2 or more siblings were compared, no statistically significant difference was found concerning recurrent injuries ($p>0.05$).

Discussion

Childhood injuries and prevention strategies are currently an important aspect in all societies of different socioeconomic and cultural background in the whole world. However, injury type (i.e. sports injuries, traffic accidents), setting (i.e. home accidents, playground accidents) and related preventive measures greatly vary among different societies.[1,2,5,6,9,10,11,12]. Currently, there is no sufficient knowledge to implement a program that will address this issue in our country. This study aims to make a contribution of knowledge in this field. Injury incidence in boys has been shown to be much higher than girls in many previous studies.[10, 7] We detected the boy to girl ratio to be approximately 2:1 in this study. An equal gender ratio was noted between 1 and 4 years of age. The most frequent causes of injury at this age group namely, fall from bed or couch, accidental drop by the parent, and home accidents can obviously be expected to affect both genders equally. While more girls were injured at 2 to 3 years and at 11 to 12 years old, more boys were injured in all other age groups. The most common causes of injury at those age groups in which more girls were affected were nursemaid's elbow, in the 3 year-old group, and home accidents, in the 12 year-old group. Although it is not possible to draw solid conclusions with this limited number of subjects, it can be suggested that a more elastic structure of the connective tissue in girls may be a predisposing factor for nursemaid's elbow. A higher occurrence of home accidents in 11 and 12 year-olds can be explained by the clumsiness associated with adolescence and puberty. Higher injury rates observed in boys of other age groups can be related to the activity level of boys in sports and their tendency to participate in more aggressive sports such as soccer.

Table 6. Distribution of educational status of parents

	Father		Mother	
	Number	%	Number	%
College-University	22	18.3	9	7.5
High school	34	28.3	25	20.8
Secondary school	22	18.3	23	19.2
Primary School	41	34.2	52	43.3
No education	1	0.8	11	9.2

There are no previous reports on patient transportation in the literature. Most of our patients arrived at the hospital by private cars (84.17%), and 7.5% arrived by ambulance. Some form of intervention had been performed in nearly one third (35%) of our patients before their admission to our hospital. Only one patient had previously consulted a bonesetter, who can be found practicing in specific rural areas of our country. Some common prior interventions were also efficient first-aid measures, particularly "temporary fixation" and "ice application" (Table 1). Execution of these interventions often by the patient or the family shows that the first-aid background of society is

not too low. Contrarily, only 69% of the patients were admitted to the hospital on the day of injury. This finding demonstrates that some of the injuries are not taken seriously at the beginning. The low number of ambulance use for transportation might also be due to late hospital admission.

In a study investigating injuries in pre-school children, Ramsay et al. found that the educational level of the persons responsible for taking care of the children were low.[2] In our series, most of the mothers were housewives (86.67%), 11% had no education, and 52% completed primary school. This rate is similar to that reported by Alptekin et al. of 82%, which comprises housewives among mothers of injured children at the Inner Anatolia region.[9] Due to the lack of a comparison group in our study, it is impossible to draw a definite conclusion regarding the effects of educational status on injuries. Nevertheless, when the mothers of the injured children were divided into two groups according to their education levels - as secondary school or less and high school or more -, no significant differences were found between children with only one injury and children with two or more injuries concerning mothers' educational status ($p>0.05$). When comparing children with initial and recurrent injuries according to their number of siblings in order to test if the time spent by the caregiver affected recurrent injuries in families with more than two children, no statistically significant difference was detected ($p>0.05$). Although the sample size was not big enough to provide undeniable proof about this aspect, we may suggest that maternal educational level and number of siblings do not have a direct effect on the likelihood of injury.

Bener et al. found that the most frequent cause of lethal injuries was traffic accidents.[12] Other authors have also reported traffic accidents as the main reason for injury-related hospital admissions, followed by falling from a height.[13, 11] In a similar series, Graham et al. identified falls as the most frequent cause of injury, especially falling from a bike.[5] Alptekin et al. investigated home accidents in all age groups and reported that the most frequent cause was falls (38.4%).[9] In our series, in which most of the cases were treated on an outpatient basis, the prominent source of injury was falling on flat terrain (Table 4). Unlike Haider's series, there were no "battered child" cases in our series. Parallel to previous literature, sports injuries demonstrated an increase after school age; however, no bicycle accidents were noted after the same age.[13] We suppose that this is related to the season and weather conditions at the time of the study. Approximately one tenth of the patients were injured at the playground. Howard et al. have suggested that meeting certain standards in playground equipment as well as ground and environment planning leads to a decrease in injuries.[4]

The chief injury site greatly varies according to age. Classifying according to age, as 0–2 years (infant and toddler), 3–6 years (play age), 7–11 years (primary school age), and 12–14 years (adolescence and puberty), revealed that the elbow was the main injury site in the first two age groups, in spite of variations. While painful pronation was more frequent in the first years of life, supracondylar humerus fractures became more numerous by the end of play age period. It can be observed that, parallel to growth and development, this injury evolves from a parent protection reflex (nurse maid elbow) to an initial injury resultant from individual activities. Rennie et al. have reported, in their study evaluating childhood injuries leading to fracture, that upper extremities are more frequently harmed.[7] We similarly found that the most common sites of injury were the wrist and the hand at school age, and the wrist in adolescence and puberty. Investigating the etiological causes in these age groups, it was detected that sports injuries were the main types, and that injuries acquired during play and home accidents were less frequent. These results are also in parallel with data reported by Belechri et al. [14]. These investigators also identified the hand and the arm as the prominent sport-related injury sites in 5 to 14 year-old children.[14] It is expected that injuries will have a parallel increase to play and sports activities in these age groups. Another frequent cause of injury in both school age and adolescence periods is fall from a flight of stairs. This injury type is not frequently reported in foreign literature. Our result might be associated to the vertical, and mostly not well-planned, nature of the constructions in the large city that our investigation was conducted at. Moreover, we believe that rapid and impatient motion characteristics as well as attention deficits specific for the childhood period might play a role in this injury type, which typically occurs by rapidly trying to climb up or down the steps at either school or home.

Prevention

Injury prevention is only possible by defining its causes. In his study conducted in pre-school children, Garzon classified the injuries as cause-related, environment-related and child-related. He has suggested that injury risk can be reduced by some modifications in the first two factors, but also emphasized that these modifications may be insufficient without the close supervision of the caregiver.[6] We evaluated the causes of injury from two different perspectives. The first was the injury setting, and the second was the activity related to the injury. Though the occurrence of some injuries in some settings was purely coincidental, some injuries were setting-specific. For instance, falling from a flight of stairs can occur in various settings, while falling from the bed can essentially occur only at home. Hence, we believe that it will provide more useful to evaluate the causes based on the event itself and to consider preventive strategies based on the setting and associated activity.

Out of 15 main groups of etiological factors, nursemaid's elbow is a play age injury and education of parents would be sufficient to minimize its risk. Falling at the playground is a frequent cause of injury during play age and adolescence, and can be minimized by proper design and use of safer materials for playground equipment (Figure 1). Determining safety standards for the city playgrounds and ensuring their implementation is required. Education and reminders about supervision to the parents or the individuals responsible for the child can be beneficial in minimizing playground injuries that are impossible to completely prevent owing to the characteristics of the childhood period. The value of placing protective bars in infant beds in order to prevent falls is rather obvious.

Figure 1. A playground with some safety issues. The timber walls placed around the playground at various heights poses risks for falling and tripping for children.

Fight, teasing, injury during play are amongst the injuries that are pretty impossible to predict beforehand. Falling from a tree, falling while running, falling from a flight of stairs are injuries that are closely associated to the high level of activity specific to the childhood period. These injuries can be prevented by assessment of causes based on the event (i.e. running in terrain not suitable for running, slipping over from faulty built stairs and falling). Injuries due to being dropped by the parent or caregiver can be eliminated by education (how to hold the infant, how to provide child-care). Furthermore, provision of professional child-care service for working mothers and widespread implementation of these services are other measures that can minimize these injuries. One of the frequent causes of injury, which was surprisingly observed in nearly all age groups in this series, was falling on flat terrain (18.33%). This injury might be related to the individual's lack of attention, surface irregularities of pedestrian walkways or road repairs that are performed without taking proper precautions. If excluding the individual-related causes of this injury, orderly arrangement of pedestrian areas and proper precautions during road repair would undeniably provide substantial injury reduction.

Sports injuries are the third main causes of injury (11.66%) and should be evaluated on its own. When sports injuries were assessed, it was observed that they mostly occurred following uncontrolled struggle with the opponent while playing soccer; the upper extremity injuries were more common. These findings are in accordance to those reported by Goldberg et al.[15] The frequent injuries of upper extremities during childhood can be explained by their increased predisposition to injury at this age group. These types of sports activities, which we suspect are performed on improper grounds, settings, and with inappropriate clothing during childhood may thus be predisposing to injury. Although it is difficult to state without a more detailed analysis the exact role these factors play on the mechanism of injury occurrence, negative effects of improper grounds, settings, and inappropriate clothing can easily be predicted. School lessons or public media programs on technical details of soccer, a very popular sport in our country, may decrease this

type of injury by allowing individuals to perform this sports activity consciously.

Bicycle injuries, which are essentially a type of sports injury, were evaluated separately in this study. Bicycle injuries were noted in a less than expected incidence (3.33%) and nearly all occurred at play age period. This low incidence may be due to two reasons. Firstly, since this study was conducted in Autumn and Winter months, when schools were open and the sun set at an early time, the frequency of performing this sport was low. Secondly, the geographic features of the city in which this study was conducted may not be very suitable for riding a bicycle. Incidence of this type of injury is expected to increase in the summer months. Further increase would be inevitable in such regions where there are no separate pathways assigned for bicycle traffic.

Home accidents were the second most frequent cause of injury in this study (13.33%) and were observed in all age groups beginning from play age. Since children spend most of their time at home, they are highly exposed to home injuries at this period of life. Additionally, more severe injuries may occur because their bodies are more fragile.[11] By investigating the occurrence of home accidents, 3 main groups became apparent. The first group consisted of injured girls through assisting their mothers in the kitchen; the second comprised injuries from hitting or rubbing against the furniture; and the third comprised injuries related to slipping over the wet bathroom floor. Graham et al. suggested that childhood injuries could be reduced by increased parental supervision.[5] While some of the injuries in this series could be prevented by taking simple measures against related causes (i.e. wet ground and furniture arrangement that may pose danger), those injuries caused by children's home activities carried out in secret or alone may not be completely eliminated. Nonetheless, consciousness-raising of the parents and close supervision of the children when carrying out home activities may be an effective attempt in preventing home accident-related injuries.

Traffic accidents are the leading cause of children deaths in developed countries.[3] Taking into account the high incidence of traffic accidents in our country, the associated injuries were found to be lower than expected in this study (3.33%). This might be explained by minimized traveling activities due to the seasonal timing of the study - schools were open, weather conditions were poor and daylight time was reduced. Preventive measures to reduce traffic accidents should be evaluated during city planning and constantly executed by educational activities and punishment systems against rule violations.

Some limitations of this study include restriction to only one region of a metropolitan, having a small sample size, and being conducted at a certain period of the year. Additionally, some patients with injuries that were not orthopedic (i.e. burns) may not have admitted to emergency orthopedics unit and, therefore, were automatically excluded from the study. However, it is important to note that this study provided valuable preliminary data that was previously unavailable.

The results obtained can be beneficial to characterize childhood injuries in our country. They have shown that mother's employment status or educational level and number of siblings are not associated with recurrent childhood injuries. Injury prevalence was found to increase at certain age periods. Generally speaking, these age groups are the beginning of school age (7 years old) and the beginning of puberty (12 years old). Education and raising consciousness are beneficial and effective methods for each etiological cause of injury.[2] Recognizing risk factors for each age group as well as providing educational activities on injury prevention to target populations at the initial periods of peak incidences would probably be most efficient. These educational activities can be planned to be performed at schools or in public transportation vehicles. Implementation of a national injury prevention program for childhood injuries could reduce both the incidence and the severity of these injuries. These programs can be categorized according to the most frequent injury settings, such as school-based, playground-based, street-based. Spreading educational activities about awareness and precaution from educational institutions to the whole society should be a matter of high priority in order to raise healthier future generations.

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