

**POSSIBILITIES FOR INJURY PREVENTION THRU  
ANALYSIS OF THREE COMMON TYPES OF  
CHILDHOOD INJURY**

Ph.D. Thesis

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2010

## 1. INTRODUCTION

Every year, millions of children all over the world die from preventable causes. Injuries and violence are an important contributor. Child injuries are a growing global public health problem. They are responsible for about 950 000 deaths in children and young people under the age of 18 years each year. Non-fatal injuries affect the lives of between 10 million and 30 million children each year. Unintentional injuries are one of the leading causes of death, hospitalization and disability across the world. Boys tend to have both more frequent and more severe injuries than girls, and there are 24% more injury deaths among boys than among girls under 15 years. Head injuries are the most common causes of deaths in children (in 80% of all cases).

In Hungary, more than 400 children die from unintentional injuries in the age group of 0-24 years, and 24 000 children need medical attention after injury each year. Approximately 2 500 children under 14 years of age are seriously injured and around 45 are killed due to road accidents in our country. The costs of medical treatment due to childhood injuries amounted to 2 milliard and 615 million Forint in 2004 in Hungary.

Worldwide, the most common cause of child injury deaths are road traffic collisions, followed by drowning, poisoning, falls and burns. Falls are the leading causes of non-fatal injury. However, the pattern and etiology of injuries and their outcome vary by age and substantially within populations and across countries. Children from poor families are disproportionately affected by injuries.

Injuries can be prevented or controlled. Data on injury and its determinants are essential for identifying priority issues and high-risk groups, and also for understanding the underlying causes of injury. The availability of good quality data and of trained people to analyze such data are therefore important in the search for effective prevention interventions. Reductions in child injury mortality and morbidity have been achieved in some developed countries as a result of the application of evidence-based programmes based on rigorous research. Unfortunately, such research is not widespread and is particularly limited in low-income and middle-income countries like Hungary.

Furthermore, prevention of child and adolescent injury can substantially reduce the cost burden on public health systems. The cost of many interventions is often much lower than the overall cost of the consequences of injury, which makes injury prevention a particularly cost-effective public health strategy.

## **2. AIMS OF THE STUDY**

We analyzed three common types of childhood injuries: horse-related injuries, dog bites and bicycle injuries. They are a serious medical and public health problem, in spite of this there is a lack of detailed investigations in these fields in Hungary.

**The following aims were set in our study:**

1. The first objective was to obtain a precise view of the affecting factors of horseback riding and horse care injuries in children.
2. We aimed to establish the pattern of incidence, mechanisms, and circumstances of accident and injury in a series of pediatric patients who sustained dog bites.
3. The purpose of our study was to analyze the cycling habits of Hungarian children, and to investigate the relationship between wearing bicycle helmet and severe head injuries among them.
4. Further objective was to investigate the characteristics and the outcome of bicycle accidents and injuries in Hungarian pediatric patients according to different age-groups and the living environment.
5. On the basis of the results we aimed to work out guidelines for the prevention of horse-related, dog bite, and bicycle injuries.

## **3. HORSE-RELATED INJURIES**

### **Introduction**

Horseback riding is an increasingly popular activity prevalent among girls. Injuries can occur during both riding and handling a horse. Horse-related injuries can result in severe spinal cord, head, and upper limb trauma as well as injury of the internal organs. One quarter of all lethal sport injuries in children are caused by horseback riding. Mortality rate of exposed population is stunningly high, reaching 0.2-2.5%. When using mean Injury Severity Score (ISS) per injury to compare horse-related injuries with other childhood injuries, equestrian-related injuries ranked second after auto-pedestrian injuries, and had a higher score than all terrain vehicle, bicycle, and passenger motor vehicle crash injuries.

## Patients and methods

In a retrospective study from the hospital registers, we reviewed 265 horse-related injuries in children under 18 treated at the Surgical Unit of the Department of Pediatrics at the University of Pécs, Hungary (77 children), and of the Department of Pediatric Surgery at the Medical University of Graz, Austria (188 children) between 1999 and 2003. Detailed information was gained from the clinical records and a questionnaire sent out to all of the injured children and their parents. We distinguished two groups of mechanisms of the injury: Group 1: trauma sustained during horse-riding, and Group 2: injury suffered while handling the horse. We investigated the relationship between factors like age, sex, mechanism and type of injury and the effect of these factors on the ISS, hospital stay and long term disabilities.

## Results

From the 265 injured children, 112 (42%) sent back the questionnaires filled in. These 112 patients were studied in detail (101 females (90.2%) and 11 males (9.8%)). The age distribution peaked at 9-14 years; the average age was 11 years.

Every third child had to be admitted to the hospital for more than one day. The injury happened on an average of 3 years after riding a horse for the first time. The number of injured children without any knowledge or experience with horses was significantly higher in Hungary when compared to Austria. There were seven principal mechanisms of injury (Table I).

Groups	Mechanisms of injury	N	%
Group 1.	1 Falls from horseback	79	70.5
	2 Falls with horse	7	6.3
Group 2.	3 Kicks	11	9.8
	4 Bites	5	4.5
	5 Collision	3	2.7
	6 Trampling	3	2.7
	7 Other	4	3.6
	Total	112	100.0

Table I: Mechanisms of injuries during riding a horse (Group 1) and due to handling a horse (Group 2)

Group 2-children were significantly younger (mean age: 9.1 years) than group 1-children (mean age: 12.5 years). The most common areas of injury were the upper extremities, followed by the head/neck region, and the trunk. Almost half (9%) of the trunk injuries (22%) in Group 1 were lesions of the vertebral column. There were no vertebral column injuries in Group 2.

Children injured on the upper extremities and the shoulder were significantly younger (mean age: 10.5 vs. 12.3 years), however patients who had an injury on the head/neck and the lower extremities were significantly older than those with other injury localization (mean age: 12.7 vs. 10.9 years).

88.4% of patients had an ISS value between 1 and 4. Patients in Group 1 had a median ISS of 3, while children in Group 2 had a median ISS of 2. The severity of injuries slightly increased with age, and it peaked at 16-18 years of age (median ISS 3). Almost one third of children had long-term physical (30.4%) and psychological (28.6%) disabilities after the injury.

Seventeen (40%) of the Hungarian and 51 (73%) of the Austrian children wore a helmet during the injury. Twenty-three children suffered a head injury, 20% of children in both Group 1 and Group 2; 9 of them wore a helmet at the time of the accident. The rate of children not wearing a helmet was significantly higher in Group 2 than in Group 1. Only four of the injured – all of whom were from Austria – used a safety vest at the time of injury.

Children who suffered an accident with their own or a familiar horse had an average hospital stay of 3 days. However, average length of hospital treatment was 7 days, when the injury originated from having ridden or contacted an unknown horse.

## **Discussion**

The rate of female injured reached a preponderance of 90.2% and age distribution peaked at 9-14 years of age in our study. We have noticed that the incident typically occurred at 3 years after the first horse-riding experience suggesting that in possession of some practice kids may take more risk and/or become less cautious and focused. About 80% of injuries occurred during riding causing - due to the height and speed - more severe injuries in comparison with those sustained while handling a horse. According to our study every third child required hospital admission. We could prove that having contact with an unknown horse significantly extended hospitalization.

Younger children (less than 10 years of age) were more often injured by kicks and bites from the horse, while those older than 10 years of age were more likely to suffer injuries when riding.

Adequate parental or teacher supervision is a prerequisite for injury prevention when children are on or near a horse. According to our results children without experience or those who have contact with an unknown horse need particularly meticulous adult supervision.

Compared to Hungarian kids, children in Austria wore protection devices at a higher rate at the time of the injury. As the present study also demonstrated that children were not likely to wear a helmet when handling horses - since the probability of a head injury in this group is quite as high as in Group 1. We found, that the wearing rate of safety vest was minimal, however torso trauma constituted 22-24% of all injuries.

Teaching and supervision along with the use of protective equipments such as helmet and vest can prevent major injuries. These measures are very important among Hungarian children, and equally important while handling horses as well as during riding.

## **4. DOG BITES**

### **Introduction**

Dog bites are a serious and often underestimated public health problem. In the United States, an overall incidence of 1.3:1000 for dog bites that require medical treatment is reported. Children tend to underestimate the danger arising from dogs because they are more careless than adults in their interaction with dogs. Children are more likely than adults to sustain canine bite wounds, with the highest incidence being among 5- to 9-year-old boys (6:1000). The likelihood of a child's sustaining a dog bite in their lifetime is 50%. The aesthetic and psychosociological consequences of trauma caused by a dog bite reportedly burden the quality of life of the affected child and his or her family.

### **Patients and methods**

Our retrospective survey included all children who sought medical attention after a dog bite between 1994 and 2003 in the Department of Pediatric Surgery at the Medical University of Graz under 17 years of age. The analysis was performed on hospital database, furthermore we analyzed the questionnaires sent to all of the affected families. The dog breed was taken from the veterinarian report. To gain information about the local distribution of dog breeds, we analyzed 5873 files from the community dog registers that contained the data of the attacking dogs. For analysis, the 18 most popular breeds, accounting for 90% of all dogs, were considered. For calculation of the risk index, the representation of a dog breed among the total dog population was divided by the representation of this breed among all registered dog bites. All children were followed up until wound healing and revisited 3 to 4 weeks after that. Late follow-up was performed in 317 (93%) children 2 to 11 years after the dog attack.

## Results

In this study, 341 children (174 boys, 167 girls) who were aged between 8 days and 16 years (mean age: 5.9 years) were included. The highest incidence was found in 1-year-old children, with the incidence decreasing thereafter with age. The vast majority (73%) of the dogs was familiar to the children. In 75% of all known circumstances that led to the injury, the child interfered with the dog (Table II).

Circumstance	%
Playing with/near dog	28
Passing the dog (walking)	14
Cuddling the dog	10
Feeding the dog	8
Passing the dog (cycling)	4
Disturbance of dog while eating	4
Surprising the dog	2
Pulling the dog's tail	2
Interfering during dog fight	2
Unknown	26

Table II: External circumstances of dog bites

Of 357 injuries, the face, head, and neck region was the leading body part affected (50%), followed by upper (28%) and lower extremities (18%). Injuries to the trunk/chest were less common (4%). A total of 290 (85%) children sustained deep wounds. Children with injuries to the head and neck were significantly younger compared with the total study population (mean age: 4.1 year). According to the local veterinary guidelines, 198 (58%) of the biting dogs were classified as large. In 305 (89%) of 341 dog attacks, the exact breed of the dog could be determined (Table III). The relative risk for a dog attack by a German shepherd or a Doberman was the highest. Children who were younger than 5 years sustained significantly more attacks by small dogs compared with older children.

Inpatient treatment was required for 93 (27%) patients. The mean hospital stay of these children was 4.9 days. Surgical procedures in general anesthesia for wound adaptation were performed in 89 (26%) of 341 children. Complications occurred in 40 (12%) children. Five children complained of nightmares after the dog attack; fear of dogs remained with another 34 children.

Dog Breed	Dog Bites	Dog Bites %	Dog Population %	Risk Index
German shepherd	105	34	12	2.83
Doberman	8	3	1.1	2.71
Spitz	5	2	1.1	1.81
Pekingese	10	3	1.9	1.56
Dachshund	22	7	5.2	1.35
Schnauzer	5	2	1.5	1.33
Collie	10	3	2.3	1.30
Hound dog	15	5	3.9	1.29
Poodle	10	3	3.1	0.98
Rottweiler	3	1	1.1	0.92
Beagle	3	1	1.2	0.80
Terrier	15	5	8.1	0.61
Bernese dog	3	1	1.7	0.58
Labrador/Retriever	11	4	8.2	0.49
Cross-breed	39	13	28	0.46
Spaniel	5	2	6.5	0.31
Shi Tzu	1	0.3	1.2	0.26
Maltese	0	0.0	1.1	0.00

Table III: Incidence of dog attacks according to breed in a total study population of 341 children

## Discussion

There is an annual incidence of 1:1000 children who sustain dog bites. In the present report the incidence was the highest in 1-year-old children. Despite significant morbidity only a small number of fatal dog attacks on children have been reported previously. In agreement with previous publications, our data showed that the most common area targeted by dogs was above the shoulders, reflecting the closer proximity of the child's head to the attacking dog.

Injuries to the face, head, and neck area occur more frequently in younger children. Scarring is a common consequence related to dog bites, and the resulting emotional distress should not be underestimated, particularly for face wounds. Eleven percent of the children in our series reported prolonged emotional distress; therefore, treatment strategies should include early psychological support as well.

We propose that the individual behavior of the attacking dog or the dog breed may be directly related to the severity of injuries. On the basis of the dog population in our catchment area (Graz), German shepherds and Dobermans were the most aggressive breeds. We did not identify any of the „fighting dog breeds” to be likely to attack more frequently than average.

Small dogs attacked small children significantly more frequently than older children, presumably because small dogs are more likely to feel superior to little children. A majority (73%) of the attacking dogs in the present report were familiar to the children. Furthermore, the children interfered with the dog in a majority of the cases.

Parents should postpone purchase of a dog until children are of school age. School-aged children can be trained successfully in precautionary behavior when approaching a dog.

However it still seems to be more reasonable to teach the dog owners and parents to pay attention when children are close to dogs than to place the blame/ responsibility for a dog attack on the children. Proper education of dog owners and behavioral training of dogs are required, and legislation should regulate training of all dogs and dog owners and leashing of dogs when using public areas.

## 5. BICYCLE INJURIES

### Introduction

Annually approximately 400 children are seriously injured or killed due to bicycle accidents in Hungary (Table IV). According to a research performed in 2003, the number of bicycle fatalities is extremely high in Hungary compared to several other countries.

		Pedestrians	Vehicle					Total
			car	bus	motor	other	bicycle	
2000	killed	22	13	1	1	2	<b>5</b>	22
	injured	752	775	34	46	57	<b>572</b>	1484
2003	killed	9	16	0	1	1	<b>6</b>	24
	injured	678	1102	23	52	96	<b>453</b>	1726
2004	killed	14	22	0	1	0	<b>2</b>	25
	injured	691	1137	30	54	57	<b>486</b>	1764
2008	killed	10	15	0	0	0	<b>0</b>	15
	injured	522	1025	28	63	67	<b>387</b>	1585

Table IV: Number of children injured or killed in road traffic injuries in the age group of 0-14 years (KSH)

The peak incidence of bicycle injuries and fatalities is in the nine- to fifteen-year-old group with a male-to-female ratio of 2 to 3:1. Collisions with motor vehicles account for 36% of bicycle injuries. They are responsible for most serious injuries, and fatalities in 90%. Head injury is the most common (70%) cause of bicycle death. Important risk factors for bicycle-related injuries include the lack of helmet use, collision with motor vehicles, unsafe riding environment, male sex, alcohol and substance abuse and bad mechanical condition of the bicycle.

The most common mechanisms of injury are falls; however, various components of the bicycle itself can cause injuries, for example spokes when ridden improperly, handlebars, saddle and seat post.

A number of factors can decrease the risk of injury (Table V). Bicycle helmets offer a substantial protective effect by reducing the risk for bicycle-related deaths by 75%, injuries to the head by 74 to 85 % and to the nose and upper face by approximately 65%.

<b>Protective equipment</b>	<b>Mechanical</b>
Helmets	Correct fit of bicycle
Gloves	Regular safety checks
Eye protection	Effective breaks
Padded shorts	Fenders
Shoes	Spoke guards
Reflecting and bright clothing	Child carrier seats
Lights, strobes	Suspension
	Handlebar padding
	Reflectors - front, rear, pedal, wheels
<b>Education</b>	<b>Environmental</b>
Helmet use campaigns	Proper road design and maintenance
Media campaigns about safe cycling	Separate bicycle lands/cycle paths
Rodeos teaching skills	

Table V: Prevention of bicycle injuries

## Patients and methods

**School analysis:** From an average population of 767 children, aged 7 to 14 years in primary schools, filled in a questionnaire about the use of helmet, the occurrence of head injuries, their attitudes towards the use of bicycle helmet and cycling habits in the streets. The answers were analyzed according to age and gender. We compared our results with similar evaluations performed in Austria.

**Hospital database:** This is a retrospective review of 1,803 bicycle related injuries treated at the Surgical Unit of the Department of Pediatrics at the University of Pécs, Hungary (1,010 children) between 2000 and 2006, and at the Department of Pediatric Surgery at the Heim Pal Hospital Budapest, Hungary (793 children) between 2004 and 2006. The analysis was performed on hospital database; furthermore we analyzed questionnaires sent to all of the families. Included were both children injured during riding as well as those injured by transportation. We investigated the circumstances and characteristics of injuries according to the environment-type (village, town, large town (Budapest)) and the age of the injured in four age groups.

## Results

**School analysis:** By analyzing the 767 questionnaires we found, that 53% of children in Hungary are bicycling at least once per week. An average of 8% of children wear safety helmet regularly during bicycling. The helmet wearing rate was 17% among 7-8-year-old

children and only 3% among 14-years-olds. Only 41% of the children participating in this study found that it is important or very essential to wear the helmet. They found helmet foolish, uncomfortable, and for a superfluity.

Hundred and sixty-six children (21.6%) were medically treated because of previous bicycle injury. The most common areas of injury were the upper extremities in 34%, followed by the lower extremities in 28%, head/neck region in 26%, and the trunk in 12%. Sixty-four percent of children suffered a serious head injury (concussion, contusion, fracture of the skull, open wounds of eyes and ears), 36% of them slight head injuries (superficial abrasions, contusions). Only 8% of the injured wore a helmet at the time of the injury.

**Whole hospital database:** Among the 1,803 injured children 492 (27.3%) were females and 1311 (72.7%) males. The age distribution peaked at 11-12 years. Fall from the bicycle was the most frequent mechanism in all age groups. Spoke-injuries were characteristics in the age group of 1-5 years; however the rate of this injury mechanism was 10% of children between 6 and 9 years of age. Road traffic injuries (collision with motor vehicles) were most frequent among 6-14 year-old children.

The incidence of spoke-injuries was significantly high in villages (13%), compared to midsize towns (4.6%) and the large town (9.9%). Collision with motor vehicles occurred around 3% in all types of environment.

The most common areas of injury were the upper extremities, followed by the head/neck region, and the lower extremities. Injuries of lower extremities and head were significantly high in the age group of 1-5 years. Head-injuries were more common in villages, while in midsize towns and the large town arm injuries proved to be significant. Besides the significantly high rate of concussions, 68% (n=13) of the severe head injuries ensued in villages.

We found the most severe injuries among 2-year-old (median ISS 4) and 14-16-year-old children (ISS 2-4), the median of ISS was 1 in the other age groups. ISS was extremely high (more than 13) in five cases; the age of these five injured children was between 12 and 16 years. In three of these cases the injury mechanism was collision with motor vehicles.

We found that median ISS was prominently high in cases of collisions with motor vehicles (median ISS 5) and collisions against standing objects (median ISS 4) in villages compared to midsize towns and the large town.

**Hospital database - analysis of the questionnaires:** Three hundred and seventy-eight families sent back the questionnaires filled in properly. We found, that 71% of the 6-9-year-old, 89% of the 10-14-year-old, and 91% of the 15-18-year-old children was bicycling alone

or in the company of another child at the time of the injury. The most frequently mentioned cause of injury was poor road quality in villages. Injuries which occurred on the roadway were especially characteristic for this environment type. No injuries were mentioned to have occurred on cycling roads.

Almost one third of children (31.8%) had long-term physical (pain, disturbing scars) and every sixth child (15.9%) had psychological disabilities (fear of cycling, periodic unpleasant recollection of the injury) after the injury. The most long-term disabilities were found in children between 10 and 18 years of age. The average length of hospital stay was 1.27 day, however we found that children injured by collision with motor vehicles were treated a mean of 7 days in hospital.

About 90% of the children did not wear any safety equipments at the time of the injury. The helmet wearing rate was only 8% (31 children). Children between 10 and 18 years of age were more likely (24 children, 10.9%) to wear a helmet at the time of the injury than younger ones (6 children, 3.7%). In villages, 5% of children injured wore a helmet; it was significantly lower, than the wearing rate in towns (9%) and in the large town (9.1%).

Thirty-eight of the respondents (26 in villages) suffered an injury as a passenger on the bicycle, 29 of them were injured by spokes. Five of them were sitting in a safety seat applied unsuitably.

School-education regarding teaching of road safety was less typical in villages than in midsize towns, and the large town among the injured. Furthermore parents in villages found price of safety devices rather high compared with the other two groups.

## **Discussion**

Prevention of bicycle injuries in children is one of the most common discussed and researched fields of injury prevention worldwide. Unfortunately, such research about the characteristics of bicycle accidents and injuries are limited in Hungary. However the number of bicycle fatalities is high compared to other countries.

Adequate parental or teacher supervision is a prerequisite for injury prevention among both younger as well as older children – especially by bicycling in road traffic. We found, that the majority of children (except of the 1-5-year-old age group) were bicycling alone or with another child at the time of the injury. Injuries were most severe among 2-year-old and 14-16-year-old Hungarian children, suggesting that in possession of some practice older kids may take more risk and/or become less cautious and focused. The most frequent long term

disabilities were found among 10-18-year-old children. The incidence of road traffic injuries was the highest in the age group of 6-14 years.

None of the children suffered an injury on bicycle roads. However, the number of collisions with motor vehicles was around 3% in all types of environment. Injuries were the most severe in villages in cases of collisions with motor vehicles and of collisions with standing objects, compared with midsize towns and the large town.

Wearing of safety devices was less characteristic of children in Hungary, helmet wearing rate was only 8% among both school as well as injured children. We found that the rate of helmet use was significantly lower in villages (5%) compared to that in midsize towns (9%) and the large town (9.1%). Therefore it may not be surprising that the number of head injuries, in particular, concussions and severe head injuries was significantly higher in these cases. Compared our results with data of Austrian investigations we found, that the helmet wearing rate of children in Austria is much higher (42%) than in Hungary (8%), therefore serious head injuries (32%) occur in a significantly lower rate than in our country (64%).

Spoke-injuries were especially characteristic for village children, and had the highest incidence in the age group of 1-5 years. Children injured by spokes were transported without a protective wheel cover and safety seat (80%), or in a safety seat applied improperly (20%).

We suppose that the worse financial status of families in villages could be responsible for the aforementioned differences. Therefore with special attention paid to this population, there is an urgent need for orientation of parents and children alike. Village children and families are the ones to be the primary targets of education about the importance of using safety devices, especially helmet and safety child seat. Further, there is a clear need for helping village families to come at safety equipments.

As poor road quality played an important role in the injuries, and overwhelming majority of the injuries occurred on roadways in villages, the quality of road infrastructure should be improved substantially, particularly in this group.

## **6. SUMMARY OF NOVEL FINDINGS**

1. **Horse related injuries.** To prevent horse-related injuries, it is recommended to wear safety equipments such as helmet and vest. Children in Hungary are not likely to wear them compared to children in Austria; therefore these devises should receive more publicity in our country. Using of proper helmets and vests are equally important during riding as well as near a horse. Adequate parental or teacher supervision is the other

prerequisite for injury prevention when children are on (especially among children over than 10 years of age) or near a horse (especially by children under 10 years of age). According to our results children without experience or those who have contact with an unknown horse need particularly meticulous adult supervision. We could prove that the mechanism as well as the localization of injury displayed a close association with age. We have also noticed that the incident typically occurred at three years after the first horse-riding experience.

2. **Dog bites.** On the basis of the dog population in our catchment area (Graz), German shepherds and Dobermans were the most aggressive breeds. A majority (73%) of the attacking dogs in the present report was familiar to the children, and the children interfered with the dog in most of the cases. The most common area targeted by dogs was above the shoulders. In the present report the incidence of dog bites was the highest in 1-year-old children. Therefore parents should postpone purchase of a dog until children are of school age. School-aged children can be trained successfully in precautionary behavior when approaching a dog. However it still seems to be more reasonable to teach the dog owners and parents to pay attention when children are close to dogs. Proper education of dog owners and behavioral training of dogs are required, and legislation should regulate training of all dogs and dog owners and leashing of dogs when using public areas.
  
3. **Bicycle injuries.** The number of bicycle fatalities in Hungary is extremely high compared to other countries. In our study injuries had the highest incidence among 9-14-year-old Hungarian children. Adequate parental or teacher supervision is a prerequisite for injury prevention when children travel on the road, as most of the children (75%) got injured alone, or in company of other children. The most common mechanism of injury was fall from the bicycle, followed by spoke-injuries especially in the 1-5-year-old age group. Collisions with motor vehicles had the highest incidence in the age group of 5-14 years. As injury mechanisms showed different characteristics in the analyzed age groups, we also found differences in body parts affected by the injury. The most common areas of injury were head and lower extremities among 1-5-year-old children.  
The extremely low rate of helmet use (8%) and child safety seat, the high rate of serious head injuries, and spoke injuries underline the mandatory to popularize these safety devices amongst children and families in Hungary.

We found that the rate of helmet use was significantly lower in villages compared to that in midsize towns and the large town, therefore the number of concussions and severe head injuries was more common in these cases. Furthermore the occurrence of spoke-injuries was the highest in villages, village-children suffered the most severe injuries in cases of collisions with motor vehicles and standing objects, and poor road quality played an important role in the injuries. According to these findings, we think, that village children and families are the ones to be the primary targets of education about the importance of using safety devices (helmet, child seat), and of helping them to come at safety equipments. The quality of road infrastructure should be improved substantially, particularly in this group.

## LIST OF PUBLICATIONS

### Publications related to the thesis

1. Schalamon J, Ainoedhofer H, Singer G, Petnehazy Th, Mayr J, **Kiss K**, Höllwarth ME. Analysis of dog bites in children who are younger than 17 years. *Pediatrics*, 2006, 117:374-9. **IF: 5.012**
2. **Kiss K**, Spitzer P, Höllwarth ME, Pintér A. Védősisak viselés és a kerékpáros fejsérülések összefüggése gyermekkorban. (Relationship between bicycle injuries and wearing of safety helmets among children in Hungary.) *Magyar Traumatológia, Ortopédia, Kézsebészet, Plasztikai Sebészet*, 2006, 49: 309-14.
3. **Kiss K**, Swatek P, Lénárt I, Mayr J, Schmidt B, Pintér A, Höllwarth ME. Analysis of horse-related injuries in children. *Pediatr Surg Int*, 2008, 24:1165-9. **IF: 0.964**
4. **Kiss K**, Pintér A. Szükséges-e bukósisak viselése gyermekkorban kerékpározás során? Érvek és ellenérvek. (Are bicycle helmets necessary for children? Pros and cons.) *Orv Hetil*, 2009, 150:1129-33.
5. **Kiss K**, Pótó Zs, Sárközy S, Pintér A. Kerékpáros gyermekbalesetek életkori jellegzetességei Magyarországon. (Age-related characteristics of bicycle injuries among children in Hungary.) *Gyermekgyógyászat*, 2010, 61:115-118.
6. **Kiss K**, Pótó Zs, Sárközy S, Pintér A. Bicycle injuries in children: an analysis based on demographic density. *Accid Anal Prev*, 2010, 42:1566-1569. **IF: 1.963**

### Papers presented in the topic of the thesis

1. Schalamon J, Ainoedhofer H, Singer G, Petnehazy Th, Mayr J, **Kiss K**, Höllwarth ME. Analysis of dog bites in children who are younger than 17 years. 6th European Congress of Paediatric Surgery, Maastricht, Netherlands, 2005.
2. **Kiss K**, Spitzer P, Höllwarth ME, Pintér A. Relationship between bicycle injuries and wearing of safety helmets among children in Hungary. 13th Congress of Hungarian Association of Paediatric Surgeons with International Participation, Miskolc-Lillafüred, 2005.
3. **Kiss K**, Spitzer P, Höllwarth ME, Pintér A. Védősisak viselés és a kerékpáros fejsérülések összefüggése gyermekkorban. (Relationship between bicycle injuries and

- wearing of safety helmets among children in Hungary.) XII. Gyermektraumatológiai Vándorgyűlés, Debrecen-Hortobágy, 2005.
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**Cummulative impact factor: 7.939**

## **ACKNOWLEDGEMENTS**

I would like to thank Prof. Sümegi Balázs for letting me be part of his doctoral program.

My most sincere thanks and gratitude to Prof. Pintér András for pushing me and supporting me continuously during my research.

I want to express my gratefulness to all my colleagues of the Department of Pediatric Surgery at the Medical University of Graz, Austria and of the nonprofit organization Safe Kids Austria (Grosse Schützen Kleine) for their professional and financial support and for the friendly atmosphere that surrounded me during my research in Graz.

I would also like to thank all the coworkers at the Surgical Unit of the Department of Pediatrics at the University of Pécs, who helped my work, and all colleagues at the Department of Pediatric Surgery at the Heim Pal Hospital Budapest for allowing me to collect data in their database.

I thank to Pótó Zsuzsanna and Lénárt Imre for their help in statistical analysis of my research.

Finally, I would like to thank my family for their patience, and support, without which this work would not have been possible.