Paper I

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Child injuries in Bergen, Norway

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Abstract

We undertook a prospective collection of data on all children below the age of 16 presenting with a history of trauma to the Accident and Emergency Department and at Haukeland University Hospital in the city of Bergen, Norway, during 1998. Our study included 7.041 new injuries, giving an annual injury incidence of 9% for preschool children, and 13% for children aged 6 to 15. Boys were injured more often than girls, and they hurt themselves equally at all age groups. Girls, however, had the lowest incidence of injury at 4–6 years of age, and two peaks at 2 and at 10–12 years of age. In the youngest children there was a predominance of head injury (51%) while in school children upper extremity injury was the commonest (46%). Most of the younger children sustained their injuries at home, while older children were injured both at home and school. Sixty percent of all medically treated patients with injuries associated with roller blade, skateboard or snowboard activities sustained a fracture. These newer sports create a new injury pattern, but soccer and bicycle injuries still predominate. On comparing our data with previous studies performed a decade ago, we found a significant decline in bicycle injuries ($p = 0.019$), but burns are still as common ($p = 0.35$), which suggests a need to focus more on burns prevention.

1. Background

Relatively minor injuries in children are common and accepted as a "normal phenomenon" in physically active and exploring young individuals, but serious or lethal injuries are obviously unacceptable. There will always be a conflict between protecting our children against accidents and allowing the useful trying and failing in learning new skills. In 1995, 56 children under the age of 15 years died in Norway as a result of accidents, violence or suicide [1]. Compared with the other Nordic countries, Norway has the highest incidence of lethal accidents in this age group; Norwegian children below 15 years of age had 37% higher accident mortality than children in Sweden in 1986–88 [2].

Accidental injuries are the leading cause of deaths among children in the western world [3]. The World Health Organisation (WHO) has therefore emphasized the importance of injury control. The project called "Safe Community" has been initiated to stimulate communities to use local injury data as a basis for targeting injury prevention. Post intervention registration showing a fall in injury rates should encourage continuous and systematic work to prevent injuries, as seen in Sweden [4] and in the northern Norwegian city of Harstad [5].

Since 1990 the Norwegian National Injury Surveillance System (NISS) at the National Institute of Public Health has registered injuries in a defined population in four Norwegian cities (Harstad, Trondheim, Drammen and Stavanger) representing 7.3% of the Norwegian population [2]. Bergen has no general registry of accidents. All burn injuries were registered in Bergen in 1989 [6], and in 1990–91 a registration of all bicycle accidents was performed [7]. Both concluded with preventive measures against the studied accidents.

The aim of this project is to make a survey of the medically treated accidents and injuries in children below the age of 16 in Bergen in 1998. By analysing the details of the circumstances of the injury and compar-

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ing current with earlier data, we hope to pinpoint areas in need of further intervention for injury prevention.

2. Patients and methods

2.1. Study area and population

Bergen is the second largest city in Norway after Oslo. It is located on the western coast and has a relatively mild and humid climate. One Accident and Emergency Department (AED) is located in the central part of the town and treats most of the minor injuries. About 95,000 patients are treated here each year. Haukeland University Hospital is the regional hospital receiving all major injuries and multiply injured patients. It is also the National Burns Centre, receiving patients from all over the country. Bergen had 227,250 inhabitants in 1998, and the child population consisted of 19,400 below the age of 6 (group 1) and 28,350 between 6 and 15 years old (group 2). Norway introduced compulsory school start for all children aged 6 years in 1997, so we used this age as a limit between the groups.

2.2. Study design

We included all children below the age of 16 years who received medical treatment at the AED, and those admitted to the hospital. Data were recorded prospectively over a 12-month period from 1 January, 1998 to 31 December, 1998. Minor injuries treated by the general practitioners in Bergen were not included in this study.

All patients or their parents received a standard questionnaire about the current accident, earlier accidents, and whether they thought the injury could have been prevented by the use of safety devices or other means. The child or its parents were also asked whether the injury was caused by accident, kicks or pushes during sport or playing activity, by fighting and other intentional violence, or intentionally by the child him/herself. The treating doctor answered some additional questions about the severity of the injuries and whether they suspected child abuse. All data were registered directly into each patient's own computerised medical record on a separate screen page. The Infodoc patient data system has been in use at Bergen AED since 1992. Data from the screen data page with the year of birth and the community number, otherwise anonymised, was transmitted to the Epi Info statistical program distributed by the WHO [8]. Information from Haukeland University Hospital was collected manually on anonymous written sheets only containing the patient's age and sex.

3. Results

We registered a total of 7041 new injuries on children below the age of 16 in 1998. Of these, 5468 were inhabitants of the city of Bergen, the remainder came from neighbouring municipalities and some from other regions of Norway. During the same period, 732 injuries were registered at Haukeland University Hospital. There were 329 patients sent from the AED and they were accordingly not registered twice. The large majority of accidents were categorized as mild or moderate. However, four children died, two were critically injured, but survived, and ten were very seriously injured. Injuries in need of medical treatment at the AED or the hospital in the city of Bergen had a yearly incidence of 9% in group 1 (children under the age of 6 years), and 13% in group 2 (children aged 6 to 15 years).

3.1. Sex and age distribution

Of patients attending the AED, 3.747 were boys (57%) and 2.865 were girls (43%) giving a male:female ratio of 1.3:1. This ratio was 1.5:1, (59.5% boys and 40.5% girls) among those hospitalised. While boys hurt themselves with almost equal frequency at the different ages, injuries in girls were less frequent at all ages, but especially at 4–6 years. Girls had two peaks in incidence of injury: at 2 and at 10–12 years of age (Fig. 1).

3.2. Injuries

In group 1 the children had injuries to their head/face in 51% of the cases, while in group 2 injuries to the upper extremity were most common (46%) (Fig. 2).

The commonest diagnosis in patients admitted to hospital was concussion (commotio cerebri) and involved 160 children. Of the 146 children attending the AED with concussion, 36% were referred to hospital for observation. There were 140 patients diagnosed as "head injury without fracture" and 5% of them where hospitalised. Eleven children had skull fractures; six

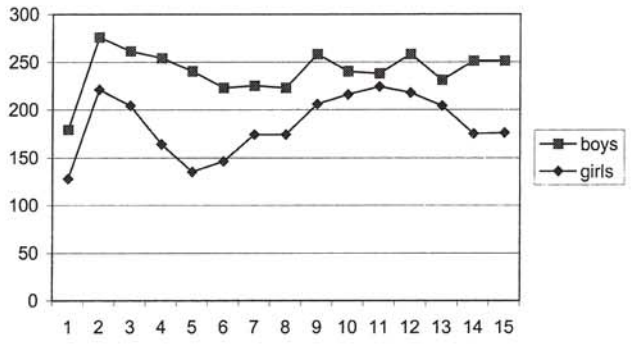

Fig. 1. Number of child injuries by age and sex.

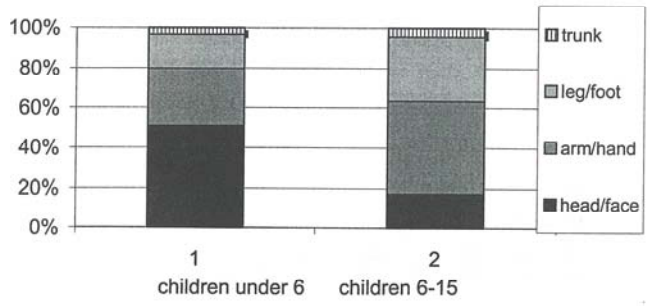

Fig. 2. Percentage of injuries to different parts of the body in each child age group.

had additional intracranial injuries and two died (Fig. 3). Of the children with concussion attending the AED, 14% were injured in bicycle accidents and approximately 50% of these had not been wearing a helmet. Of the younger children with head injuries, 50% had a history of a fall from height (Fig. 4).

Children in the preschool group had fractures in 9.2% of all injuries, with an annual incidence of 9.2 per 1000 children. Children in group 2 had fractures in 27% of all injuries, giving an incidence of 40 per 1000 children a year. A total of 1742 fractures was registered, 70% of which involved the upper extremity. Distal radial fractures were seen in 27% of all fractures (Fig. 5), while 16% of all fractures needed treatment with reduction or operation.

In 1998, 136 children attended the AED with burns, and in about 50% it was thought that the injury could have been prevented. Thirty percent had scalds from tea, coffee or soups, 15% burnt their hands on the cooker and 16% were burned on various kinds of ovens. Three percent had firework injuries (Fig. 6). The National Burn Centre received 15 children from the community of Bergen with major burns in 1998. Of these 33% were girls of foreign ethnic origin.

Pet bites, mainly from dogs, injured 106 children. Of these 61% were girls, and the majority were 7–12 years old. Their arms were bitten in 50% of the cases, their

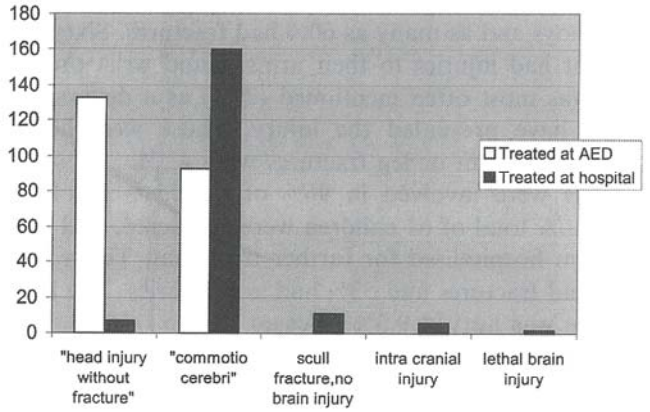

Fig. 3. Number of children with different categories of head injuries.

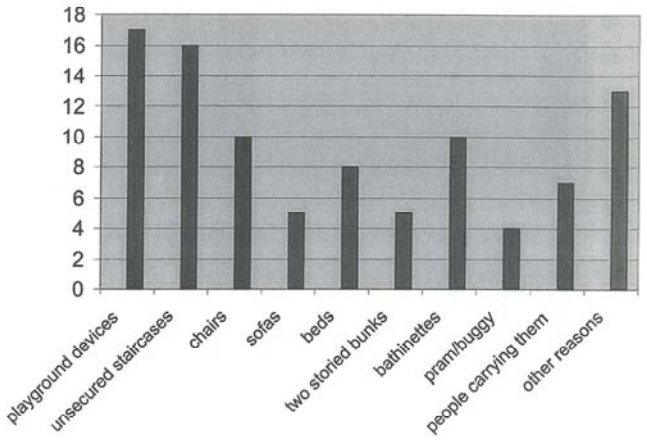

Fig. 4. Number of children < 6 years old with head injuries and what they fell from.

head or face in 32% and their legs in 13%. There were 21 children who had been bitten by other children.

Of the children attending the AED with new injuries, 20% stated that they had had previous fractures. In our study we also found that 12% of the children had more than four previous injuries that needed medical treatment, while about 1% had more than 10 such previous injuries.

3.3. Place of injury

Of the total number of injured children, 63% of the injuries happened outdoors. Accidents involving the younger children (group 1) occurred indoors in 56% of cases, compared with 30% for the older children (group 2). Group 1 were mainly injured at home or near home (62%), and only 13% in kindergarten (Fig. 7). Group 2 hurt themselves almost equally at home (37%) and at school (29%). Injuries at school mostly happened outside in the school breaks (37%) while 25% occurred in

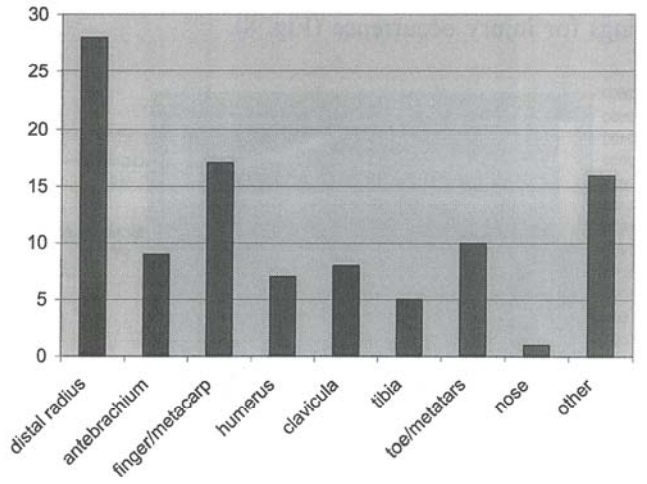

Fig. 5. Distribution of different types of fractures by percentage of all child fractures.

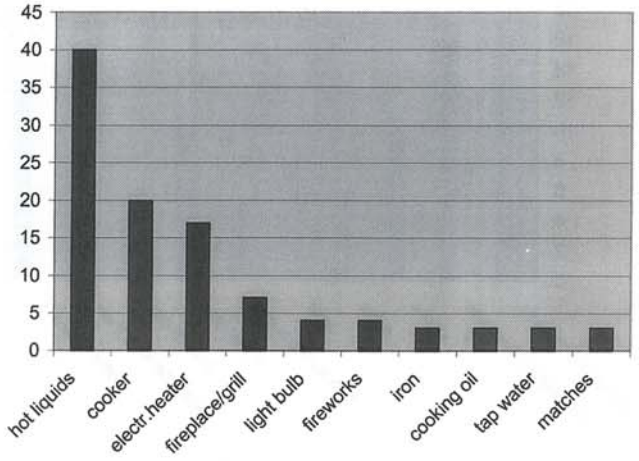

Fig. 6. Distribution of different causes of burns by percentage of all burns.

school gymnastics. Organised sport accidents were involved in 10% of all injuries among the oldest children, and 4.7% of all children were hurt on playgrounds. Traffic accidents caused the most serious injuries, and occurred in 0.9% and 1.8%, respectively, in the younger and older age groups. A total of 126 children were involved in traffic accidents, 29% were hospitalised, and two of them died (1.6%). While 50% of the traffic accidents caused injuries to the head, face or neck, 14% were fractures and 15% were soft tissue injuries. Bicycles were involved in 38% of traffic accidents. The incidence of traffic injuries in 1998 was 2.2 per 1000 children under 16 years of age.

Two of the four lethal injuries were suffocations, and one of these was due to drowning. Another child almost died from drowning but survived with sequelae.

3.4. Situations and circumstances

Soccer and bicycle accidents were the dominant settings for injury occurrence (Fig. 8).

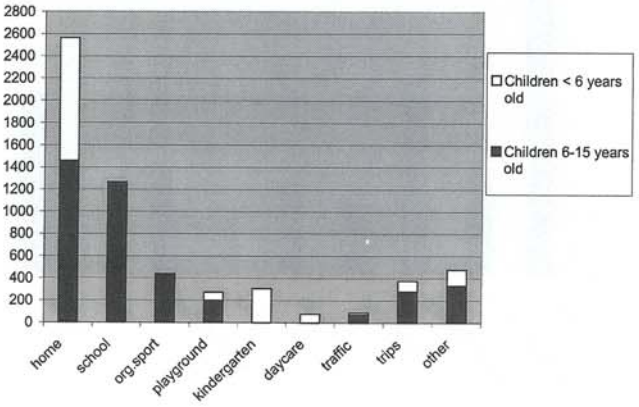

Fig. 7. Number of children in different age groups injured in different places.

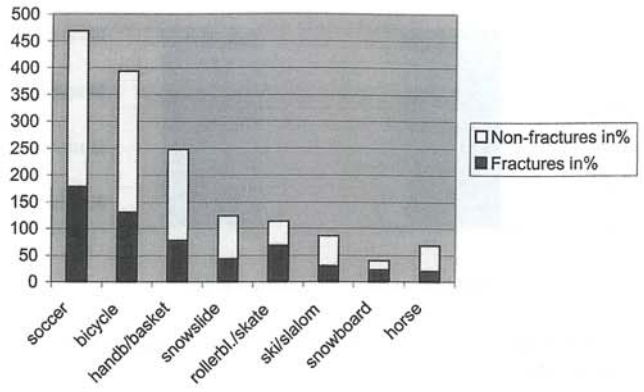

Fig. 8. Number of injuries associated with different activities. Percentage of fractures in each activity is marked.

Soccer accidents had an annual incidence of 11 per 1000 children below the age of 16. This incidence increased to 16 per 1000 in children aged 6 or more. Boys were injured three times as often as girls, but they were also clearly more numerous on soccer pitches. Thirty-eight percent of soccer accidents were fractures, and paradoxically these accidents more often involved the arms than the legs. Fall was the commonest injury mechanism, but injuries were also caused by hard kicks from other players and hard blows from ball shots against the goalkeeper's hands.

A total of 445 children had been involved in bicycle accidents, and 13% were hospitalised. Out of these 62% were boys, 50% had arm injuries, and 28% had injuries to their head or face. Four had skull fractures and two of them had intracranial injury with bleeding. Nine percent of all patients involved in bicycle accidents thought the injury could have been prevented by the use of helmet. While 33% had fractures, 33% had soft tissue injuries. Ten children were hospitalised because of injuries to their faces, and 50% had fractures of the mandible or maxilla. Dental injuries were not included in our study.

Roller blade and skateboard accidents were registered in 112 cases, giving an annual incidence of 2.7 per 1000 children below the age of 16. Of the injured, 74% were boys and as many as 60% had fractures. Sixty five percent had injuries to their arms. Hand wrist protection was most often mentioned (29%) as a device that could have prevented the injury. Those were hospitalised with arm or leg fractures were 4.5%.

Girls were involved in 96% of accidents involving horses. A total of 61 children were registered, and 15% of them hospitalised for further treatment. Thirty percent had fractures and 53% had arm injuries. The head or face was hurt in 9.3% of cases.

Alpine sports injuries in 1998 included 48 downhill skiing (slalom) accidents and 38 snowboard accidents. Of these 35% of slalom injuries and 58% of snowboard accidents were fractures. Boys aged 13–15 were most

often injured in snowboard accidents (80%), and 66% of these injuries were located in the forearm or wrist. Slalom accidents involved the lower extremities in most cases (54%), and ski bindings failing to release in the fall were mentioned as a cause.

Downhill sledging caused more than 50% of all injuries to children attending the AED in the first weeks in the early winter season. In 1998, 124 accidents were reported and 35% were fractures. The legs were involved in 39% of the cases, arms in 29% and head in 23%. In 20% it was felt that securing the sledging area would have prevented accidents as many children had collided with fences or rocks, or had slid over precipices. Some thought that helmets should have been used in this activity.

3.5. Injury reason

Of all injuries, 85.7% were recorded as accidents, 12.4% occurred during sport or play, 1.2% were caused by intentional violence from others while only 0.2% were self-inflicted. Children being injured due to violence included 69 children and 73% were boys. Seventy-one percent were more than 10 years old. While 57% of these violent injuries happened at school and, then mostly, during the school breaks ($>50\%$), 20% happened near or at home. Heads and arms were injured in 80% of the cases. While 19% had fractures, 28% had soft tissue injuries and 3% were admitted to hospital for treatment.

Child abuse or neglect accounted for 7 verified and 16 suspected cases in our material (0.33% of the injuries), giving an incidence of 0.48 per 1000 children. Fifty-two percent had injuries to their head or face. All age groups were represented. Unrecognised cases were probably present, but at least some of these victims were identified. In all of these cases the police, the Children's Officer or child health visitors were notified.

4. Discussion

The accident and injury spectrum will naturally reflect the physical activity in which children are involved. Injuries associated with soccer and bicycle riding are, therefore, most common [9]. Some activities still seem to involve a greater risk of injury than others. Injuries related to roller blade, skateboard or snowboard have a high percentage of fractures (58–60%), and involved a total of 89 children in 1998. In spite of this, 177 children sustained fractures while playing soccer, and 119 while riding bicycles. Roller blades, skateboard and snowboard activities are, however, growing in popularity and will probably result in an increasing number of fractures in the coming years, as has been seen in other countries [10].

The location and severity of the injury related to each physical activity gives an important guide to possible preventive measures. Roller blades and skateboard injuries mostly involve fractures of the carpus, wrist and forearm. Elite sportsmen and women in these new sports practice without using the recommended protective devices. They are important role models for the youngsters. Even soccer accidents seem to cause mostly forearm injuries. This has also been shown in other studies [11], but wrist and forearm protective devices were rarely used. Head injuries were seen in 28% of bicycle injuries. Helmets could have prevented many of these [7]. Iceland introduced compulsory use of bicycle helmets for children under the age of 15 years in 1997.

Compared with a registration of medically treated bicycle injuries in Bergen in 1990–91 [7], we found a significant fall in incidence from 9.3 per 1000 children under the age of 16 to less than 8 per 1000 ($p = 0.019$), which might indicate that helmets were used more often. New cycle tracks might have prevented injuries from happening. It is also possible that fewer children are bicycling; perhaps roller blade running has taken over as preferred activity.

A prospective study of all burns in the city of Bergen was performed in 1989 [6] and included 131 patients below the age of 15. In order to compare studies we eliminated the children over 15 years in our material, which resulted in a total of 145 patients. The incidence of burn injuries in 1989 was 3.2 per 1000 children, while the incidence in 1998 was 3.0 per 1000 children ($p = 0.35$). Thus, there was no significant fall in the incidence of burns among children in Bergen over the last decade. In Harstad there was a 53% decline in the number of burns in children aged 0–4 years in the period 1985–1994 due to systematic and practical information to parents about burn prevention at home. Information was given from the nurses at the maternal and child health care centres [5]. Burns preventive information seems to have failed to reach the parents in Bergen. In our study we found an overrepresentation of girls from ethnic minorities among the children with severe burns. It seems important to intensify the burns preventive information to families from ethnic minorities.

In 1997 Norway introduced compulsory school start for all 6-year-old children. Great efforts from both school authorities and the police have been made since then to prevent accidents from happening on the way to school. Free reflective waistcoats were handed out, and the police patrolled the pedestrian crossings near schools. Fortunately our register in 1998 showed few combined school and traffic accidents.

Injuries caused by violence from other children usually occurred during school breaks, as did most school injuries in general. This corresponds with other studies [12]. The importance of having adults present in the

school breaks seems obvious. Playground accidents were seen in about 5% of all injuries in our register. Some additional accidents happened on playgrounds at school, but were registered as school injuries. Many opinions about possible over-protection of children have been expressed in the Norwegian media due to new safety demands for playground devices. These regulations were initiated in 1996, and by the year 2000 all dangerous devices should be replaced.

Our register shows a relatively low rate of accidents among the youngest schoolgirls while the youngest schoolboys hurt themselves just as much as boys of other ages. This has also been demonstrated in other studies [13]. Why girls aged 4–6 hurt themselves less may have many explanations. Behavioural studies have shown that girls at this age are more interested in and have better fine motor skills than boys at the same age [14]. Girls have their pubertal peak height growth velocity around the age of 12 and might, thus, be clumsier and more prone to injuries. Some children are prone to frequent injury. Research on the relationship between children's behavioural characteristics and injury rates is interesting. If it were possible to identify children with elevated risk for injuries, better and more individualized parent focused intervention could be initiated. Special injury behavioural checklists have been developed and used in studies to identify these children [15].

Injury registration is an important tool for initiating the right preventive action both locally and more generally, but registration is time consuming for doctors and other medical staff. Many practical problems have to be overcome in order to continue injury registrations. The computerised reminders used in our registration helped the staff to remember to hand out the questionnaire to the patients. This also encouraged the doctors to remember to fill in the medical evaluation form associated with the injury. This might also have increased doctors' awareness of possible child abuse or neglect as a reason for injury [16]. Patients or their parents are usually willing and interested to answer questionnaires about the accident, but with more serious injuries it can be difficult to give priority to answering these questionnaires. Hospital registrations may therefore be more difficult to make, and it is sometimes better for the forms to be completed retrospectively every day or week by one responsible medical staff member [17]. Police records can also be useful in this respect. It is very important not to lose the information about the circumstances of these more serious injuries.

We hope to continue our injury data collection, both at the AED and the hospital in Bergen, as a basis for selection of targets for injury prevention. Our study indicates a need to intensify burns prevention, especially hot liquid burns. The number of head injuries due to falls from playground devices supports the authorities' efforts to secure these devices better. Increased safety in the home for the smallest children is similarly important. With new sports equipment such as roller blades, skateboard and snowboard becoming popular, we have seen a new injury pattern with a high percentage of fractures. Hand wrist protective devices could probably have prevented most of these fractures.

Continuous efforts to prevent traffic accidents on the way to school seem important, and these have till now proven successful. The decline in bicycle accidents must not make us forget to encourage children to use helmets.

Acknowledgements

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