A Community Based Study of Sport and Recreation-Related Injuries Treated in Hospital Emergency Department in Finland

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Abstract: *Objectives*: The aim of this study was to determine the incidence and characteristics of sport and recreation (SR)-related injuries treated in an emergency department (ED). This paper is the first community based study on SR-related injuries in Finland in a defined geographic region.

Material and Methodology: Prospective observational study based on injury information recorded in the injury data base in ED. From June 1, 2004 to May 31, 2006 of a total of 4 844 unintentional injuries (in 4 407 patients) leading to treatment in ED), 414 (in 404 patients, 9%) were SR-related.

Results: In SR-related injury patients the median age of females was 25 years (SD 21) and that of males 25 years (SD 13) (range: 5 to 88 years). Patients aged 10 to 19 years had the highest injury rates. Most of the injuries were fractures (35%), sprains (28%) and wounds or contusions (27%). 38% of all injuries were located in the upper and 40% in the lower extremity. 14.5% of the patients were hospitalized. Patients with SR-related injuries had relatively more fractures and dislocations than those with other unintentional injuries ($\chi^2 = 31.67$; d.f. = 10, p = 0.0005). The annual rate of SR-related injuries attended to hospital ED was 251 per 100 000 persons.

Conclusion: In order to prevent SR-related injuries, the knowledge of preventive methods should be improved among residents and athletes.

Keywords: Sport injury, active recreation injury, emergency department presentation, community level.

INTRODUCTION

Sport and recreation (SR) - related injuries are an important cause of morbidity. These injuries account for nearly one third of all injuries in a rural population in United States [1] and over 20% in a Dutch trauma centre study [2]. Because of the high incidence the need for hospital treatment as out-patient or in-patient resources is considerable [3-5].

Information about the regional population distribution of SR-related injury rates is important for preventive methods. In the late 70s at the main casualty department of the University hospital in Helsinki, Finland the frequency of sport injuries was 9% and the incidence of patients with sport injuries who needed further treatment as in-patients was 6% [6]. However, since the 80s, in Finland there are no exact data on SR- related injuries treated in ED. Previous Finnish studies report mostly sport injuries requiring hospital care [6] or both in-patient and out-patient treatment [7-9]. Furthermore, there are data on trends in SR-related injuries among young people (15-25 years) where the subjects were interviewed by Statistics Finland in 1988, 1993, 1997, and 2003 and asked to report the injuries in which they had been involved during the previous 12 months [10]. Since the 90s most of the Finnish research on sport injury has focused on limited numbers of sports and often only on elite sports like soccer, ice hockey, volleyball, basketball, judo, karate, skiing, and downhill skiing [11-14].

According to statistics from the USA, the overall incidence of non-fatal SR-related injuries treated during one year in hospital EDs was 15.4 per 1 000 [15]. The frequency was highest in persons aged 10-14 years and lowest in persons aged over 44 years [15]. SR-related injuries covered 16% of all unintentional injury related ED visits [15]. During 1997 and 1998 a national sample of 496 US hospital EDs showed that the rate of sport-related injuries was 11% of all injury visits [16]. SR-related injuries are the leading cause of paediatric ED visits in US [17]. Recently, in a Dutch study the rate of sport-related injuries in a trauma centre was 21% of all ED visits, and 8% of the injured patients were admitted to hospital [2]. SR- related injuries included cases occurring both in organized and in non-organized activities.

In Finland (5.3 million population) SR-related injuries are treated in acute hospitals, in primary health care, in private clinics and praxis, or in occupational health services. In 2006, there were a total of 1.3 visits per inhabitants in Fin-

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nish emergency departments or in out-patient clinics, and 4.7 visits per inhabitants to physicians in primary health care. In 2006, 13% of all ambulatory visits to the EDs and out-patient clinics were due to surgery, orthopaedics or traumatology. There are no data on trauma visits in the Finnish occupational health services. In 2006, this system covered a total of 1.76 million workers. In the Finnish private system there were about 4 million visits in 2006, of which no separate data on trauma visits are available [18].

The aim of this prospective study was to describe the epidemiology and characteristics of SR- related injuries treated in emergency department of Kuusankoski Regional Hospital during a period of two years. This is the first prospective community based study of SR-related injuries covering a defined geographic region in Finland. This hospital is a national pilot hospital of injury registration in our country.

MATERIAL AND METHODS

From June 1, 2004 to May 31, 2006, we registered prospectively all consecutive first visits due to an acute injury in the ED of Kuusankoski Regional Hospital in south-eastern Finland. "Injury" was defined according to WHO as an unintentional injury (accidental) and an intentional injury (physical abuse and self-harm). The acute hospital is responsible for an area of about 100 000 inhabitants in seven municipalities.

The International Classification for Diseases, 10th Revision (ICD-10- Finnish Modification FM) for public hospital discharges in Finland was used [19]. In the primary injury data all the missing ICD-10 codes (12%) as regards the external cause of injury and the type of injury were checked in patient records and the data were complemented. After this procedure, the accuracy of the total two-year hospital injury data, (including unintentional and intentional injuries) (n = 5 553) was controlled with a 10-percent random sample by comparing the injury data with the medical records of the patients [20]. The accuracy of the total injury register data (n = 5 553) was good. We found a high accuracy regarding the external type of accident (89% in the first year and 91% in the second year), the type of accident (92% in both years), and the diagnosis (92% in both years) [20].

The SR-related injuries were identified according to the type of accident (code Y94.2 in ICD-10 FM). In addition, the following data were gathered: age, sex, date and time of accident, external cause of accident (ICD-10) representing following external causes: V10-V19, V28-V29, W00-W01, W17, W19, W22, W44-W45, W52, W55, X50, X57-X59), trauma diagnoses (ICD-10, a maximum of 3 diagnoses), type of sports (32 different subtypes), treatment of injury, admittance to the hospital or, further, to central hospital, or treatment as out-patient. For the present study, all the data on the SR-related injuries were manually checked in patient records.

In the present study the frequency calculations are based on the number of unintentional injuries and the íntentional injuries were excluded.

Measures of Severity

The severity of the injuries was scored in three different ways. First, sprains, strains, contusions, and wounds were classified into mild injuries, whereas dislocations, fractures or concussions were severe injuries. Second, severe sport injuries were analyzed using the Sports Severe Index (SSI): per type of sport, the quotient of the number of admissions and the number of injuries treated [2].

Third, the anatomical severity of individual injuries was assessed with the use of the Abbreviated Injury Scale (AIS) [21]. Mortality was defined as dying at the hospital due to the injury.

Non-Organized *vs* Organized Sports Definition

Non-organized sports include "unstructured" competition or physical activities, such as playing soccer with friends or jogging with friends or alone. Organized sports activities include all "structured" competition or practice sessions.

Statistical analyses were performed using the STATA statistical software package (version 9.3 for Windows). In statistical analyses, Wilcoxon-Mann-Whitney-rank-sum test, χ^2-test and Fisher´s exact test were used. The injury rate was calculated per 100 000 population-years. Age and sex specific incidence rates were estimated by using age and sex specific population data from the 2005 Finland census.

Ethics approval was obtained from the ethics committee of Kymenlaakso Health Care District.

RESULTS

Incidence, Age and Gender

During the 24- month- period, a total of 5 553 injuries took place of which 4 844 were unintentional. 8.5% of the unintentional injuries were SR-related in 404 patients (404/4 407; 9.2%) (Table **1**). 74% (n = 299) of the patients with SR-related injuries were males. Among the 404 patients, there were a total of 443 diagnoses. 26 patients had two and four patients had three different trauma diagnoses. 98% of all patients with a SR-related injury had only one ED-visit during the study period and 10 patients (9 men and one woman) had two visits. 14.5% (60/414) of all SR-related injuries needed treatment as in-patients. During the two-year-period the annual rate of SR-related injuries treated in ED was 251 per 100 000 persons.

Table 1. Total Injury Data According to the Number of Injuries and Patients

Type of Injury	No. of Injuries	No. of Patients
Unintentional and intentional injuries	5 553	5 021
Unintentional injuries	4 844	4 407
SR-related	414	404

The median age of all patients with an unintentional injury (excluding SR-related injuries) was 52 years (SD 26) in women and 39 years (SD 20) in men (range 3 months to 100 years). Among the patients with SR-related injuries the median age of females was 25 years (SD 21) and that of males 25 years (SD 13) (range: 5 to 88 years). Women with SR-related injuries were significantly younger than women with other unintentional injuries (z = -7.59; p = 0.000). There was a similar result among men (z = -11.77; p = 0.000). In

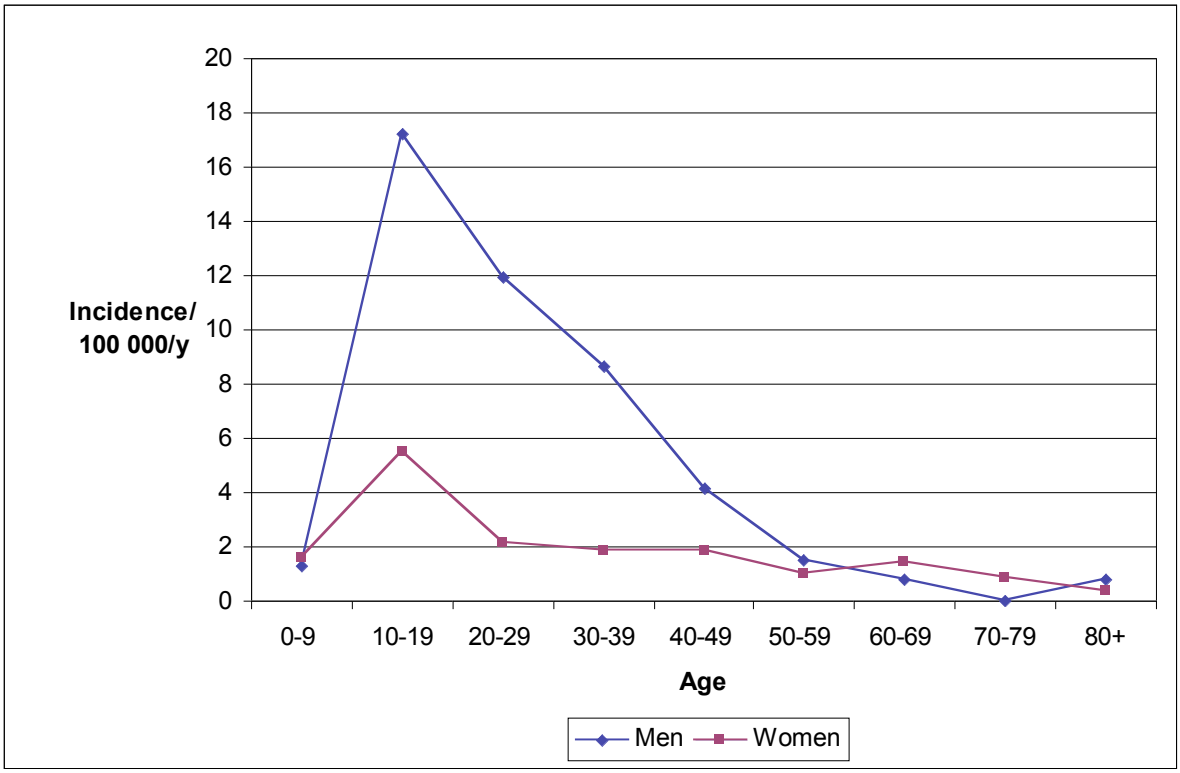

Fig. (1). Yearly age-adjusted incidence in hospital treated (ED) SR-related injuries by gender.

both genders those aged 10 to 19 years had the highest injury rates and incidences tapered gradually for successively older age groups (Fig. **1**).

Sport Subtypes

The injured patients represented 32 different sport types. All the types were analyzed separately. 40% of all SR-related injuries occurred in team sport activities such as soccer, ice hockey, volleyball, and floorball. Soccer and ice hockey accounted for 31% of all the cases. 36% of the injuries took place in single activities such as snow boarding, downhill skiing, cross country skiing, skating, bicycling, horse riding, and aerobics/gymnastics (Table **2**).

Location of Injuries

The predominant injuries were fractures (35%), sprains (28%) and wounds or contusions (27%) and two-thirds to three-fourths of all different injury types were seen in men (Table **3**). In the total SR-related injury material, 38% of all injuries were located in the upper and 40% in the lower extremity (Table **4**). Males had a significantly higher ED visit rate than females in SR-related injuries (75% *vs* 25%, respectively). Wrist and knee injuries were the most frequent injuries among women; among men, correspondingly, ankle, head, face, neck, and knee injuries (Table **4**). Men sustained more ankle injuries than women compared to all other injuries of the lower extremity (Fisher´s exact test p = 0.008). Men also had more head, face or neck injuries than women (Fisher`s exact test p = 0.005). No differences were found between the genders in the anatomical location (upper or lower extremity or other location) of SR-related injuries (χ^2 = 2.42; d.f. = 2, p = 0.299).

Severity of Injuries

Patients with SR-related injuries had more fractures (χ^2 = 9.1376; d.f. = 1, p = 0.003) and dislocations (χ^2 = 7.3932; d.f. = 1, p = 0.007) than patients with other unintentional injuries. There were no significant differences in the severity of the SR-related injuries between the genders (sprains, strains, contusions, wounds *vs* fractures and concussions) (Fisher`s exact test, p = 0.064). However, more serious SR-related injuries were found in children younger than 14 years and in patients over 44 years of age than in patients 14 to 44 years of age (χ^2 = 31.67; d.f. = 10, p = 0.0005). Children under 14 also had more SR- related injuries in the upper extremity than those older than 14 (χ^2 = 26.24; d.f. = 5, p = 0.003). The Abbreviated Injury Scale (AIS) scores were mostly 1 (55%) or 2 (43%). There were no differences between the genders in this respect (Fisher's exact test, p = 0.08) (Table **5**).

When hospital admission was used as a severity criterion, 14.5% (n = 60) of SR-related injuries were classified as severe. SR-related injuries with SSI ≥ 25 (n = 31) were consequences of long jump (100%), badminton (57%), parachute jump (50%), running, pole walking or walking (43%), swimming or diving (33%), bicycling (28%), horse riding (27%), volleyball (27%), and cross country skiing (25%) (Table **2**). However, due to the small figures, these data should be interpreted with care. One patient (0.2%) died due to an intracranial injury as a result of falling during cross country skiing.

Organized and Non-Organized Sports

71% of injured patients participated in organized sports and 29% in non-organized sports. Non-organized SR-related

Table 2. Rate of Admission in Different Types of Sport Injuries (n = 414)

Type of Sport	Cases[1]		Admission		SSI[2]	Mortality
	n	%	n	%	%	n
Long jump	1	0	1	2	100	-
Badminton	7	2	4	7	57	-
Parachute jump	2	0	1	2	50	-
Running, pole walking, walking	7	2	3	5	43	-
Swimming, diving	3	1	1	2	33	-
Pedal cycling	25	6	7	12	28	-
Horse riding	22	5	6	10	27	-
Volleyball	15	4	4	7	27	-
Cross country skiing	16	4	4	7	25	1
Motor sports	15	4	3	5	20	-
Tramboline	5	1	1	2	20	-
Soccer	80	19	13	22	16	-
Downhill skiing	18	4	2	3	11	-
Snowboarding	31	8	3	5	10	-
Wrestling	11	3	1	2	9	-
Gymnastics, aerobics	22	5	2	3	9	-
Ice-skating	16	4	1	2	6	-
Floorball	23	6	1	2	4	-
Ice hockey	48	12	2	3	4	-
Roller skating	11	3	0	0	0	-
Golf	1	0	0	0	0	-
Self-defence event	14	3	0	0	0	-
American football	2	0	0	0	0	-
Finnish baseball	6	1	0	0	0	-
Basketball	6	1.	0	0	0	-
Other	7	2	0	0	0	-
Total	**414**	**100**	**60**	**100**	**-**	**1**

[1]Number and percentage of injuries per type of sport treated in ED.
[2]SSI = Sports Severity Index: per type of sport; the quotient of the number of admissions and the number of injures treated.

activities led to significantly more fractures than did organized activities ($\chi^2 = 20.76$; d.f. = 4, p = 0.000). On the other hand, 39% of all shoulder injuries were seen in horse riding, ice-hockey and soccer. Knee injuries occurred most frequently in soccer (21%) and floorball (18%), ankle injuries in soccer (37%), volleyball (11%), badminton (9%) and floorball (9%). Most of the head injuries were due to ice-hockey (34%).

DISCUSSION

This is the first Finnish study at community level to report the incidences of SR-related injuries. It provides information about the external causes, natures and demographic patterns of SR-related injuries in a defined area in south-eastern Finland. This catchment area (100 000 inhabitants) is a typical Finnish area with urban and rural municipalities. In the study region there are 204 sports clubs representing 50 different types of sports with a total of 30 000 members. These figures represent a normal average situation in the non-governmental Finnish Sports Federation. The Federation has 125 member organizations in Finland (with a population

Table 3. Type of Injury by Gender (n = 443)

Diagnosis	Women		Men		Total	
	n	%	n	%	n	%
Sprain	23	18	102	82	125	28
Dislocation	4	15	23	85	27	6
Concussion	6	33	12	67	18	4
Fracture	49	32	105	68	154	35
Wound, contusion	31	26	88	74	119	27
Total	**113**	**26**	**330**	**74**	**443**	**100**

Table 4. Anatomical Location of Injuries by Gender (n = 443)

Location	Women		Men		Total	
	n	%	n	%	n	%
Upper extremity	**49**	**29**	**120**	**71**	**169**	**38**
Clavicle	0	0	4	100	4	
Shoulder	10	23	31	77	41	
Upper arm	0	0	1	100	1	
Elbow	1	8	16	92	17	
Forearm	4	45	5	55	9	
Wrist	23	43	29	57	52	
Hand	11	23	34	77	45	
Lower extremity	**39**	**22**	**140**	**78**	**179**	**40**
Hip	3	33	5	67	8	
Thigh	1	11	8	89	9	
Knee	20	33	43	67	63	
Leg	1	11	10	89	11	
Ankle	9	14	58	86	67	
Foot	5	26	16	74	21	
Other location	**25**	**26**	**70**	**74**	**95**	**22**
Head, face, neck	12	17	55	83	67	
Thorax	3	33	5	67	8	
Abdomen	2	33	3	67	5	
Pelvis	7	58	5	42	12	
Spine	1	33	2	67	3	
Total	**113**	**25**	**330**	**75**	**443**	**100**

of 5. 3 million) and the total national membership is 1.1 million Finns [22].

Table 5. The Abbreviated Injury Scale (AIS) Scores Among 414 Injuries by Gender

AIS-Score	Women (%)	Men (%)	Total (%)
1	52 (49.1)	177 (57.5)	229 (55.3)
2	53 (50)	126 (40.9)	179 (43.2)
3	1 (0.9)	4 (1.3)	5 (1.2)
4	-	-	-
5	-	1 (0.3)	1 (0.2)
6	-	-	-
Total	106 (100)	308 (100)	414 (100)

Sport injuries are the leading cause of trauma in Finland [23]. In 2006, a cohort of 8,290 persons was randomly selected from the over 14-year-old Finnish population (4.38 million) [23]. The results were calculated by weighting the sample findings to correspond the entire population. 6.4% of the Finnish population aged over 14 years experienced sport injuries, followed by home injuries (6%) and leisure injuries (2%) [23]. In Germany 3.1% of adults (aged 18-79) sustained a sport injury within one year and sport injuries represent the second most common type of accidents after home accidents (3.7%) together with occupational accidents (3.1%) [24]. In a study from Switzerland, sport injuries accounted for 55-60% of all self-reported injuries [25].

Since the 80s [6] the present study is the first in Finland to examine all medically attended injuries from different sport activities among all age groups in an ED. In the present study 9.2% of the patients with an unintentional injury had SR-related injuries and 14.5% of these patients needed inpatient treatment. In a study from Norway the corresponding figures were 17% and 6% [26]. In other studies the hospitalization rate has been 2% to 11% [2, 27- 30].

Registration of SR-Related Injuries

In the present study the first visits due to an acute SR-related injury to a regional hospital during two years were analyzed. This study is a part of a more comprehensive study project. The hospital is a national pilot hospital of injury registration and the injury data collected in the hospital are a reference data for the whole country [20].

The International Classification of Diseases (10^{th} revision of ICD-10) [19] is generally used to classify hospital admissions. However, information as regards the type of sports is not available in the ICD-10 Finnish Modification. We used a special coding system gathering all sport types that were common in the catchment area of Kuusankoski Regional Hospital. In health region interventions sport injury prevention may be improved by using local epidemiological data. High quality epidemiological data are essential for planning, developing and evaluating efforts to prevent injuries.

Sport Subtypes and Risk of Injury

There has been an increase in participation in regular physical activity among Finnish children (aged 3 -18 years) and adults (aged 19 - 65 years) [31, 32]. According to the National Exercise Survey, 91% of the 13-18-year-olds were active in sport or exercise, of them 42% were members of sport clubs. The most popular types of sports in this age group were, in order of frequency, soccer, bicycling, skiing, swimming and jogging [31]. 72% of the 19 - 65-year-old, correspondingly were participating in some kind of sport activities at an organized or non-organized level at least 3 times per week. The most important sports were walking, bicycling, skiing, swimming and fitness club training [32]. According to both of the surveys [31, 32] sport activity was similar in the whole country.

According to this study team sports like badminton and volleyball showed the highest admission rate (SSI scores) as has been stated in a Dutch study as well [2]. Furthermore, in this study individual sports with the highest injury risk were bicycling, horse riding, cross country skiing, running, pole walking or walking. Other studies have shown, similarly, that bicycling [16, 33], and horse riding [29, 34] led to serious injuries. But then again, in a recent Finnish one-year follow-up study (n = 3 363) where the subjects (15- to 74-year-old Finns) reported their frequency and average time spent in each activities, and all acute injuries, the individual injury risk per exposure time was relative low in walking, swimming, and rowing. The risk was higher in squash, orienteering, and contact and team sports [35].

When analyzing the injury severity of SR-related injuries, the best scoring system is the AIS-coding, originally developed for traffic accident victims [21]. Each injury is assigned an abbreviated injury scale (AIS) score and is allocated to one of six body regions (head, face, chest, abdomen, extremities (including pelvis), and external). Some papers already have used this scoring system [36-41]. According to the present study about 99% of all injuries were scored to AIS-class 1 and 2, and there were no statistically significant differences in the severity between the genders. Also in other studies nearly all injuries belonged to AIS-class 1 or 2 [38, 39, 41].

Age, Gender and Type of Injury

Most studies on SR-related injuries have focused on children or adolescents because these injuries mostly occur among younger persons [16, 17, 30, 42]. Fewer studies deal with persons of all ages [2, 4, 6, 33, 43]. The age and sex of the patients and the anatomical localisation pattern in our study is in agreement with the data from Sweden [41], Australia [33], Canada [44], and Germany [24].

Among younger children, boys (aged 5-24) have shown to have approximately twice the rate of sport- injury related visits to ED than girls [6, 30]. The result is similar in self-reported sport injuries [42, 43]. In this study, a threefold rate was seen among boys aged 10-19. In a recent study from Canada sport- related injuries (organized and non-organized sports) among boys (aged 0-19 years) accounted for 69% of all sport-related injuries [4].

Similarly to prior studies [4, 16, 17, 24], in the present study the leading ED diagnoses among children and in the total material were fractures and sprains and wounds. Non-organized sports are associated with more serious injuries and greater rates of admission to hospital than organized sports [4]. In the present study, correspondingly, there were

significantly more fractures in non-organized than in organized sport activities.

Compared with non SR-related injury visits, our study shows that there are relatively more SR-related visits with fractures and dislocation. A similar result on SR-related fractures has been stated in Canada [16].

The large number of shoulder injuries in horse riding, ice-hockey and soccer and the large number of knee and ankle injuries in soccer suggest the need for further study. Aside from protective equipment, appropriate clothing, and training, other safety measures should be considered when preparing to ride [34]. In ice-hockey most shoulder injuries occur during games due to checking or collisions with players [14]. Prevention programmes can reduce soccer injuries [45].

Limitations

There are limitations in our study. Our data are based on the hospital records gathered on the special database which do not include the variable as regards the time spent in sport activities. In fact, this kind of information is impossible to gather in ED circumstances. Thus we could not take into account the exposure time in different forms of sport activities. Furthermore, our data only include the patients with SR-related injuries who were attended to hospital ED for treatment and therefore do not cover all the patients with SR-related injuries in the region. This should be kept in mind when interpreting the results. This limitation exists in other studies on this subject as well (17, 28, 33, 34).

Calculated rates are likely to be underestimated for two reasons. In our hospital catching area there are a few teams playing soccer, basketball and volleyball on the highest national level, and ice-hockey on the second highest level. All these teams have team physicians and in many cases they contact private hospitals in treating their players. Some of these injury cases may be missed in our data. Secondly, persons who had been treated in other health service facilities like local health care centres, private clinics, physical therapists` offices, etc. are not included in these data. It is unknown to what extent SR related injuries are treated in these facilities. In general, more injury patients are treated in the study region in primary health care than in acute hospitals [46]. According to a recent study of primary health care in the same region, the proportion of SR-related injuries of all unintentional injuries was 12% [46], whereas the corresponding percentage in the present study in hospital ED was 9%. However, we are convinced that most of the serious injuries have been treated in Kuusankoski Regional Hospital because it is the only acute hospital in this region.

CONCLUSION

This study provides a profile of typical patients at community level who were treated in ED for SR-related injuries. They are likely to be 10-30 year-old, which reflects the sport or recreation participation rates in these age groups. Three fourths of the patients are males. Almost 15% of the patients need treatment as in-patient. Most of the injuries are located in the upper or lower extremity (38 *vs* 40%), and the most common injury is a fracture (35%). Although SR-related injuries are mostly minor, the possibility of long lasting consequences should be kept in mind [47]. High quality epidemiological data are necessary to enable us to follow the future trends in the profile of SR-related injuries. The knowledge of preventive methods should be improved among residents and athletes. According to a recent Finnish national study, sport injuries have significantly increased from 1988 to 2003 [6]. This trend will continue if we cannot translate the research results into sporting practice. This requires intervention and evaluation studies.

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CONFLICT OF INTEREST STATEMENT

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