School-related fractures

BACKGROUND Introduction of daily PE classes has been proposed as a measure to reduce childhood obesity. At the same time, the prevalence of activity-related fractures among children is increasing. Previously, we have found that the fracture rate per 10 000 hours of activity amounted to 1.9 for snowboarding, 0.79 for handball, 0.44 for football and 0.35 for trampolining. The purpose of the study is to describe the prevalence of school-related fractures, as well to investigate whether PE exposes schoolchildren aged 6–16 to a heightened risk of fractures when compared to other activities.

MATERIAL AND METHOD Fractures in children aged 6–16 resident in the catchment area of Akershus University Hospital were recorded over a 12-month period. Information on fractures sustained at school, defined as fractures that occurred during school hours, during supervised after-school activities (SFO) or on the way to or from school, was retrieved from the records. The fractures were classified according to activity, time of the school day when the injuries occurred and their anatomical location.

RESULTS Of a total of 1 144 fractures registered among children aged 6–16, altogether 422 (37 %) were school-related, equivalent to 8.5 per 1000 children. Of these, 257 (61 %) were in boys. Altogether 276 (65.4 %) fractures occurred outdoors, 135 (32 %) occurred during breaks and 94 (22.3 %) during PE classes. The fracture rate for PE amounted to 0.29 fractures per 10 000 hours (95 % CI: 0.22–0.33).

INTERPRETATION The fracture rate for PE classes is lower than for a number of other common leisure activities. As a measure to increase children's physical activity, the introduction of daily PE classes will be a beneficial alternative with a view to the risk of injury.

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MAIN MESSAGE

Two in five fractures sustained by children aged 6–16 years occurred in a school setting.

One in three school-related fractures occurred during breaks.

Unsupervised play was the activity that was most frequently associated with fractures.

The fracture rate during PE classes was lower than the fracture rate for trampolining, handball, football, snowboarding and alpine skiing.

Fractures are not uncommon among children. For example, Swedish figures show that their prevalence in children under 16 years doubled from 1950 to 1980 (1). Annual incidence in Norway amounts to 180–245 fractures per 10 000 children under 16 years, and up to 40 % of these injuries occur during sports and leisure activities (2, 3). In Sweden, an increase in sports-related fractures has also been registered among school-age children and adolescents (4).

At the same time, obesity in children is an increasing problem in the Western world, including in Norway (5). The proportion of children above the 97.5 weight percentile doubled during the period 1973–2003 (6), and today every sixth eight-year-old is overweight (7). Overweight during childhood increases the risk of lifestyle diseases (diabetes and cardiac disease) later in life (8), as well as mental disorders (9). The Directorate of Health and international guidelines recommend that children engage in daily physical activity for at least one hour (10, 11), although it appears that only half of all Norwegian fifteen-year-olds are as physically active as indicated by these recommendations (12).

School is a natural arena for implementation of preventive measures, because all children will be reached irrespective of their socioeconomic or cultural background. There is thus a broad consensus that the best intervention to combat inactivity and overweight is to increase physical activity in the school setting (10, 13–15). More PE classes can improve children's health and help increase their level of activity outside school hours and into adulthood (13, 16). It has also been proven that more physical activity at school results in better academic performance (17, 18). Activity can thus help prevent the high rates of attrition from upper secondary school. Daily PE classes at school have been a health-policy goal for the Norwegian Medical Association since 2001 (19). The proposal has been widely endorsed, for example by the Norwegian Cancer Society, the Norwegian Confederation of Sports and the Norwegian Directorate of Health (10).

This notwithstanding, a balance will have to be struck between attempts to increase the level of activity, and prevention of unnecessary injuries among children. In this study we describe the prevalence and characteristics of school-related fractures. We have also attempted to quantify the risk of fractures associated with PE classes.

Material and method

All fractures sustained by school-age children (6–16 years) resident in the catchment area of Akershus University Hospital were registered over a 12-month period (16 March 2010–15 March 2011). Akershus University Hospital is responsible for operating three A&E departments that have shared patient records (at Lillestrøm, Stensby and Ski).

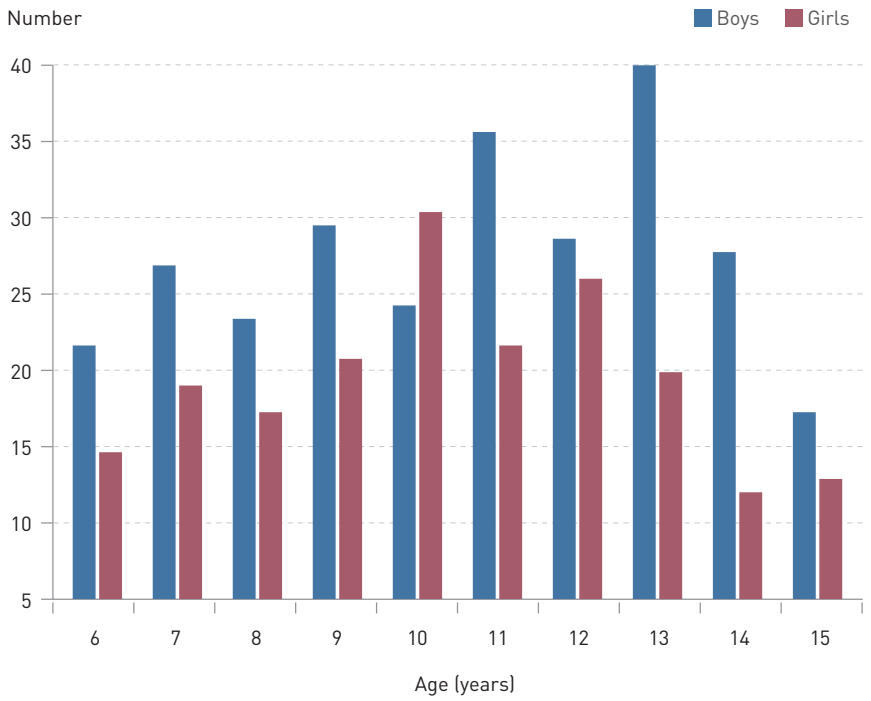

Figure 1 *422 school-related fractures in Akershus county by age and gender*

Patients were included by the A&E doctors, and patient lists were checked on a weekly basis to capture those who had not been invited to participate in the study. Children resident in other catchment areas but who were treated in our hospital were excluded from the register. Other hospitals in the region were contacted to identify children who belonged to our catchment area but had been treated in other A&E departments or hospitals, and these children were included. We therefore assume that we have a virtually complete register of fractures in the child population in the institution's catchment area for the period in question.

All fractures were classified in accordance with the International Classification of Diseases and related health problems, tenth edition (ICD-10). The diagnosis and treatment were registered by the doctor responsible. The patient's guardians completed a questionnaire on the mechanism of injury and activity at the time of injury. Main findings from the register of fractures among children have been published in a previous article (3).

For this study we retrieved information on all school-related fractures from the register. School-related fractures were defined as a fracture that occurred during school hours, during supervised after-school activities (SFO) or on the way to or from school.

We estimated the prevalence of school-related fractures occurring in school-age children over a period of one year. To be able to compare the risks of sustaining a fracture inherent in different activities, we estimated a fracture rate. The fracture rate was defined as the number of fractures that occurred per hour of activity, and is reported per 10 000 hours.

Incidences and fracture rates were estimated on the basis of population figures as of 1 January 2011 (at the mid-point of the period) retrieved from Statistics Norway (20). At that time, a total of 49 400 children aged 6–16 were registered as resident within the hospital's catchment area.

All exposure time at school was calculated in full hours (60 min.), not in teaching hours (45 min.), in order to permit comparisons with other studies. Figures for the annual number of PE classes in Akershus county are based on information from the Norwegian Directorate of Education and Training, which reports 70.6 full hours per year as an average for primary and lower secondary school (20, 21). The number of hours of breaks per day varies between schools to a greater extent than the number of teaching hours. The duration was therefore determined on a discretionary basis to amount to 60 minutes, which corresponds to what has been used by others in similar studies (22).

Table 1 Overview of 422 school-related fractures by activity and school setting at the time of injury

	Break		Other/ various		PE class		Supervised after-school activity		To or from school		**Total**	(%)
Unsupervised play	41		37		40		18		2		**138**	(32.7)
Football	20		16		14		4		0		**54**	(12.8)
Playground equipment	20		7		1		10		0		**38**	(9.0)
Tobogganing	15		11		1		6		0		**33**	(7.8)
Handball or basketball	3		6		24		0		0		**33**	(7.8)
Bicycle	0		6		2		0		15		**23**	(5.4)
Other[1]	36		39		12		10		6		**103**	(24.4)
Total (%)	**135**	(32,0)	**122**	(28,9)	**94**	(22,3)	**48**	(11,4)	**23**	(5,5)	**422**	

[1] Includes skateboard/scooter (n = 13), skiing (n = 11) and skating (n= 4) etc.

Statistics

Descriptive analyses were used to describe the prevalence and distribution of fractures. To compare the distribution of continuous data between groups, we used a two-tailed Mann-Whitney test, since the data were not normally distributed.

Categorical data were analysed with the aid of the chi-square test. The significance level was set at 5 %. The estimation of a 95 % confidence interval for the fracture rate during PE classes and breaks was performed under the assumption that the prevalence of fractures follows the Poisson distribution.

Ethics

The study was approved by the regional committee on health research ethics, and the

data were processed in de-identified form after having been collected. The study was also approved by the hospital's data protection officer. For all included patients, all guardians as well as children older than 12 years provided written and oral consent to participation in the study.

Results

In the register of fractures sustained by children, we identified 1 144 fractures in children of school age (6–16 years). Of these, 422 (36.9 %) were school-related. The risk that a child will sustain a school-related fracture was estimated to 8.5 per 1 000 children per year. Altogether 257 of these fractures (60.9 %) were sustained by boys, whose median age at the time of injury was 11.2 years (Figure 1). There was no significant difference in median age between the genders (11.5 years for boys, versus 10.8 years for girls, p = 0.2).

An overview of the number of fractures distributed by type of activity and school setting at the time of injury can be found in Table 1 and e-Table 2. Altogether 276 fractures (65.4 %) occurred outdoors. A total of 135 fractures (32 %) occurred during breaks; the fracture rate for breaks amounted to 0.14 per 10 000 hours (95 % CI: 0.12–0.17). Unsupervised play was the most common type of activity at the time of injury (138 fractures, 32.7 %), followed by football (54 fractures, 12.8 %). Altogether 23 fractures occurred on the road to or from school, and 15 of these were caused by falls from a bicycle.

Table 3 and e-Table 4 provide an overview of the anatomical location of the fractures, distributed by type of activity at the time of injury. Fractures of the wrist accounted for the largest proportion of the school-related fractures (32 %).

Fractures sustained during PE classes

Altogether 94 fractures (22.3 %) occurred during PE classes. Of these, 55 were sustained by boys. The fracture rate for PE classes amounted to 0.29 per 10 000 hours (95 % CI: 0.22–0.33). Of all the fractures that occurred indoors, 69 (47.3 %) were related to PE classes. The proportion of fractures occurring during PE classes increased with age.

Among pupils aged 6–11, altogether 40 of 257 (15.6 %) school-related fractures occurred during PE classes, against 54 of 165 (32.7 %) fractures sustained by pupils aged 12–16 (p < 0.001). There was no difference between the genders in the proportion of fractures sustained during PE classes (21.4 % in boys and 20 % in girls, p = 0.6).

Table 3 422 school-related fractures by anatomical location and activity at the time of injury.

	Wrist	Hand	Foot	Elbow	Col-larbone	Lower arm	Other
Unsupervised play	47	27	22	13	6	8	15
Football	19	14	9	3	1	3	5
Playground equipment	16	3	5	7	0	3	4
Handball or basketball	3	19	6	0	1	2	2
Tobogganing	12	4	2	1	6	0	8
Bicycle	10	5	0	1	2	1	4
Other[1]	28	28	17	12	3	2	13
Total (%)	**135** (32)	**100** (23.7)	**61** (14.5)	**37** (8.8)	**19** **(4.5)**	**19** **(4.5)**	**51** (12)

[1] Includes skateboard/scooter (n = 13), skiing (n = 11) and skating (n= 4) etc.

Discussion

We found that more than one-third of the fractures sustained by children aged 6–16 were school-related. Very few studies of school-related fractures have been published in Norway. A study undertaken by the Personal Injury Registry in four Norwegian cities in 1995–97 found that 20 % of the fractures sustained by children of school age occurred at school (22). Methodological differences may partly explain why we found a higher proportion (36.9 %). For example, the data collection procedure for the Personal Injury Registry differed significantly from our clinical registration.

The design of our study is more similar to one that was used in a study in Bergen in 1998. That study found that 30 % of the fractures sustained by school-age children occurred at school (2). This result is in better accordance with our findings. This notwithstanding, our results may indicate that the proportion of school-related fractures has increased. Activity at school has been a political objective throughout the decade that has passed since the Bergen study, and the proportion of school-related fractures may have come about because children engage in physical activity more frequently now than previously, in PE classes as well as in other settings.

We estimated a fracture risk of 8.5 fractures per 1 000 children per year. In a study from New Zealand, the authors found 118 school-related fractures among 25 000 pupils in the course of one year (23). In comparison, this represents a fracture rate of 4.7 fractures per 1 000 children. The difference is most likely due to the fact that the New Zealand study included only pupils in primary school, whereas our study includes children up to the age of 16, and in our study the prevalence increased with age.

We found that on average, 22 % of the school-related fractures occurred during PE classes. Both the prevalence and the proportion of fractures sustained during PE classes were higher among the oldest children. As children grow older and their motor abilities improve, they engage in more advanced physical activity, such as ball games, cycling, trampolining and snowboarding. They develop more muscle mass, run faster and jump higher. This increased mobility may help explain why the risk of sustaining a fracture during PE classes increases with age. This concurs with the study made by Schuller and Kopjar, who found that 34 % of the injuries in children aged 7–12 had occurred in association with sports, compared to 60 % of the injuries among those aged 13–15 (22).

Even though our study shows that most of the school-related fractures occur during breaks, the fracture rate for breaks is very low (0.14/10 000 h.). The same applies also to unsupervised play. This concurs with figures from Canada and the Netherlands, showing that most school-related fractures occur in association with unorganised activities and unsupervised play (24, 25). In New Zealand as well, most fractures occurred outdoors during unsupervised play, and only 12 of 118 fractures (10.1 %) had occurred during organised sports activities (23). A Canadian study found that most of the

sports-related injuries that occurred during school hours were sustained during organised sports activities and other physical activities pursued outside of PE classes (26).

We found that falls from a bicycle were the most common cause of fractures on the road to and from school. Kopjar and Wickizer investigated the prevalence of bicycle-related injuries in children aged 10–15 in Stavanger in the period 1990–93 (27). Of a total of 77 bicycle-related fractures, altogether 18 (23 %) had occurred on the road to and from school, i.e. an annual prevalence of 0.6 per 1 000 children. The authors called for measures that could prevent these injuries. In our study, we found 15 bicycle-related fractures that had occurred on the road to and from school in a population of 49 400 children, i.e. an annual prevalence of 0.3 fractures per 1 000 children. It is conceivable that better cycle lanes, cycle training at school and more attention to traffic safety may have reduced the number of bicycle-related fractures on the road to and from school.

The effect of introduction of daily PE classes on fracture risk has been investigated in a large Swedish intervention study. The prevalence of fractures in 2 395 children was monitored for five years (28). The intervention group (808 children aged 6–9) had 40 minutes of PE each day, while the control group (1 587 children) had 60 minutes of PE per week. There was no difference in the prevalence of fractures in the two groups.

The fracture rate for PE classes of 0.29 per 10 000 hours (95 % CI: 0.22–0.33) in this study is lower than the fracture rates for other common activities that children tend to pursue (3). On the basis of the same population in Akershus county we have previously estimated that the fracture rate per 10 000 hours of activity amounted to 1.9 for snowboarding, 0.79 for handball and 0.35 for trampolining (3). This indicates that PE is a safe framework for children's physical activity. PE is undertaken in familiar surroundings under qualified supervision. Provided that high-risk activities are not excessively introduced in this subject or that the degree of supervision is not reduced, increasing the number of PE classes therefore seems to be a good and safe alternative for increasing physical activity among children.

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