

Fractures in New Zealand Elementary School Settings

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ABSTRACT

BACKGROUND: There is a need for greater international understanding of student safety in schools. This New Zealand study investigated the causes and school location of fractures sustained by students attending elementary school, with special emphasis on the types of fractures sustained following falls from playground equipment of various heights.

METHODS: Over a 1-year period, 76 participating schools (with a combined roll of over 25,000 students) completed a questionnaire about the nature and circumstances of student fractures sustained during regular school hours.

RESULTS: Some 118 students sustained a total of 131 fractures. Injuries from playground equipment were no more frequent than those from general activities at school, and most were sustained in falls from heights less than 59 inches. Most fractures were to the upper limbs. Fractures were found to vary by gender and school size.

CONCLUSIONS: The results are discussed in terms of the conditions and policies present in local schools, and the tension that exists in maintaining safety while offering appropriate challenges to students. Improvements in school safety may be more likely to result from a greater focus on the way that students interact at school, rather than on modifications to playground equipment.

Keywords: fractures; elementary school; playground equipment.

Citation: Rubie-Davies CM, Townsend MAR. Fractures in New Zealand elementary school settings. *J Sch Health*. 2007; 77: 36-40.

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Common injuries to students involving fractures have been the focus of much international research, especially in relation to incidence, cause, and prevention,¹⁻³ but little of that research has been directed at fractures sustained at school. A number of studies have examined injuries associated with school playground equipment, including the type and frequency of injury,^{4,5} the nature of the playground equipment,^{6,7} the types of fall materials below the equipment,^{8,9} and the methods for determining the risk of injury from playground equipment.¹⁰ However, these playground studies were not specifically focused on fractures sustained during school hours or with an examination of the location of fracture as a function of the height fallen. These issues are addressed in the current study.

Furthermore, concern with the safety of playground equipment in schools has resulted in the introduction of guidelines or standards in the United States and other countries,¹¹⁻¹⁵ regulating both the height of such equipment and the fall materials below the equipment in order to lessen the degree of injury that students sustain when they fall. But it is possible that an emphasis on the safety of playground equipment may divert attention away from safety in other aspects of the school environment. The rates at which fractures occur from playground equipment as compared with fractures in other locations within school grounds would provide an interesting contrast in examining the relative safety of playground equipment. The current study also addressed this issue.

In brief, this New Zealand study examined the circumstances surrounding fractures that occurred within school grounds during official school hours over 1 academic year (February-December).

METHODS

The sample included 76 elementary schools (grades 1-6), selected using public information available from the Ministry of Education, to be representative of the range of New Zealand schools in size, type, and location and of the ethnicity and socioeconomic status of families. Participating schools were in the upper part of the North Island of New Zealand, an area covering about 15% (or 15,000 square miles) of the land mass and containing more than one third of the population of 4 million. Hence, the participating schools provided a representative sample of New Zealand schools in that they included a majority of both large and small urban schools (63%), schools from provincial towns (16%), and rural schools (21%), which incorporated the full range of socioeconomic levels. A representative number of private schools (11%) were also included. Based on the rolls of the schools, this meant the potential inclusion of 25,782 students.

Following contact by the researchers, the trained first aid person in each school (all schools in New Zealand are required to designate a member of staff with a current First Aid Certificate, usually the school secretary, as the first point of call in emergencies) agreed to complete a questionnaire each time a student in the school sustained a fracture and forward the completed questionnaire (in prepaid envelopes) to the researchers. Details about the student (age and gender) and of which bones were fractured were entered into the questionnaire after a medical diagnosis had been completed at the hospital to which the injured student was taken. This information is required by the Ministry of Education; thus, these questionnaires were completed alongside the school records. However, the questionnaire also asked where the incident occurred and the circumstances surrounding the resulting fracture. When students fell from playground equipment, the questionnaire required a description of the equipment and a measure of the vertical height of the fall from the last point of contact with equipment to the ground using a standard measuring tape.

Schools that had not sent back any questionnaires (representing no fractures) by December were asked to confirm in writing that their schools had not had any fractures during the school year. Three schools did not respond in writing but provided verbal confirmation of no fractures when contacted by phone. The study was conducted with the approval of the University of Auckland Human Participants Ethics Committee.

SURVEY FINDINGS

Some students sustained more than 1 fracture. Hence, the initial part of the following section reports the numbers of fractures that occurred over the year of the study and which bones were fractured. The following sections describe the number of incidents of fractures, the locations where these incidents occurred, and the circumstances surrounding the fractures, while the final section focuses on injuries sustained in falls from playground equipment.

Numbers and Types of Fractures

During the academic year, 118 students sustained fractures. This represented an average of 1.55 students in each participating school during the academic year of the study and a ratio of 1 in every 218 students across the schools.

In 10 instances, students fractured more than 1 bone or the same bone in more than 1 place. There was 1 instance, where a student sustained 3 fractures of his tibia when tackled by another student during an organized rugby game. In a similar free-play incident, a boy suffered 4 fractures to his metacarpals

when he reached to pick up a ball just as another boy attempted to kick the ball. In all other cases of multiple fractures, victims sustained 2 fractures. All 10 instances occurred while students were engaged in an outdoor activity, and 6 of them were related to falls from playground equipment.

Students fractured a variety of bones. Table 1 shows which fractures occurred by which location within the school. Injuries sustained outside were separated into those resulting from playground equipment, those from organized, teacher-supervised sport (such as rugby and athletics), and "other" such as those sustained while playing student-organized games (such as chasing or hopscotch) or sports during free intervals, or simply while moving outside from 1 location to another. Indoor activities, on the other hand, refer to fractures that occurred, for example, while students were indoors during a gym session or inside during interval. It should be noted that this table includes the total number of fractures that occurred (131) rather than the number of students sustaining fractures (118).

Overwhelmingly, the majority (122/131; 93%) of the fractures were sustained by the limbs (Table 1). Of injuries to limbs, more were to the upper limbs (100/122; 82%) than the lower limbs (22/122; 18%). Upper limb fractures were somewhat more likely to occur in falls from playground equipment (52%) than from other outdoor activities including organized sport (41%), with indoor activities accounting for the remainder (7%). Conversely, lower limb fractures were less likely to occur in falls from playground equipment (9/22; 41%) than from other outdoor activities including supervised sport (12/22; 55%), with only 1 fracture to the lower limbs occurring

Table 1. Total Number and Percentages of Fractures to Various Body Parts by Location Within Schools

	Playground Equipment	Organized Sport	Other		Total
			Outdoor Activity	Indoor Activity	
Upper limbs					
Fingers/metacarpal	0	1	10	2	13
Carpal	15	0	7	2	24
Radius/ulna	25	2	17	3	47
Humerus	12	4	0	0	16
Total	52	7	34	7	100
Lower limbs					
Toes/metatarsus	0	2	1	1	4
Ankle	2	0	3	0	5
Tibia/fibula	7	4	2	0	13
Total	9	6	6	1	22
Other					
Clavicle	1	0	5	0	6
Scapula	1	0	0	0	1
Mandible	0	1	1	0	2
Total	2	1	6	0	9
Overall total	63	14	46	8	131

indoors. Other fractures (to the torso and head) were relatively rare (only 9/131; 7%) and all occurred outside, most during organized sport and other outdoor activities (7/9; 78%) rather than from the use of playground equipment (2/9; 22%).

Circumstances Surrounding Fractures

As noted earlier, a total of 118 students received fractures, and the remaining results focus on the numbers of students sustaining fractures rather than the total number of fractures. The numbers of students with fractures varied across schools; for example, there were 31 schools where no students had fractures, while there was 1 school where 9 students sustained fractures. Fractures were more common in larger schools and among boys (67) rather than girls (51). The mean age of students with fractures (7.5 years) was similar to the average expected age of students in elementary school.

Analysis of the circumstances surrounding the fractures recorded in the questionnaires revealed that there was a range of ways and places in which fractures occurred. These are shown in Table 2 where there were 3 categories of unforeseen or accidental injuries. "Trip" was used where a student was running or walking and tripped over another person or object but also included times when the student slipped over, overbalanced, or just fell over on the ground or floor. "Collision" was used where a student accidentally collided with another student or an object or when the student was hit with a ball or some other object. "Fall" was defined as all unaided falls from a height that resulted in a fracture. Injuries that resulted from deliberate intervention by another student, whether legitimate (such as a tackle made during rugby) or not (such as when a student deliberately pushed another) were classified as "Accomplice." Finally, "Other" referred to causes that did not readily fall into the above categories, for example, when a student fell off a scooter. As may be seen from Table 2, those students injured on playground equipment all involved falls, mostly unaided although 5 involved being pushed or bumped by another student prior to the fall. Most other outdoor injuries resulted from tripping, as was the case

Table 2. Circumstances in Which Fractures Occurred at School

	Playground Equipment	Organized Sport	Other		Total
			Outdoor Activity	Indoor Activity	
Trip	0	3	21	5	29
Collision	0	5	9	0	14
Fall	52	1	5	1	59
Accomplice	5	3	4	0	12
Other circumstances	0	0	2	2	4
Total	57	12	41	8	118

for indoor injuries. Only about 10% of injuries were sustained during organized sport, mostly through collisions.

Fractures From Playground Equipment

A little under half (57) of all students injured sustained fractures as a result of falls from playground equipment. A large proportion of these injuries (37%) resulted from falls from overhead ladders, while other falls were from track rides (where the student hangs suspended from a wheel moving along a rope or wire⁷) (16%), platforms (12%), sliding poles (9%), vertical ladders (7%), and climbing frames (5%). Interestingly, both the overhead ladders and track rides (accounting for more than half of all falls from playground equipment) were activities that required students to support all or a good part of their body weight by their arms. Both are designed to improve upper body strength. All remaining fractures resulted from falls from swings, swing bridges, slides, tires in the ground, and climbing walls.

Finally, the study investigated the height of the fall from playground equipment which resulted in a student sustaining a fracture. Of the 57 incidents, most students (58%) received fractures after falling from heights of 59 inches or less (including 10 students who fell from heights less than 39 inches). One third of fractures resulted from heights of between 60 and 79 inches, while 9% were from falls in excess of 79 inches. Fractures to the radius/ulna were the most frequent (42%), and these appeared similarly likely to occur at heights below 59 inches (54%) as above that height (46%). Interestingly, all 6 students who sustained fractures to the tibia or fibula fell from a height of less than 59 inches (4 of them from less than 39 inches). Given that the occurrence of fractures is not linearly related to the height of the fall and that many fractures result from falls from relatively low heights, greater attention needs to be directed at moderating student behavior on and around such equipment and in developing greater personal safety awareness.

DISCUSSION

The results of the current study suggest that the incidence of fractures in schools is relatively low in New Zealand at less than 1% of the school population surveyed. Wilkins, an internationally recognized researcher of childhood fractures, notes that approximately 2% of children sustain a fracture from any location (including school) within each year.³ This result might be seen as surprising in a country noted for its moderate climate that allows outdoor activities all year and for its emphasis on participation in sports. It might also seem surprising in view of the relatively large amount of time available for free

play in schools (approximately 1 hour each day) and the relatively large areas available for play and sport (making close supervision difficult). However, most school play areas are grassed rather than concreted, there is adult playground supervision of all activities, every school must comply with strictly monitored national standards governing safety in schools, and all schools have programs that promote safe use of playground equipment. These health services features likely contribute to reduced rates of accidents and injuries when compared with injury rates for students playing relatively unsupervised in public and neighborhood recreation areas.

Fractures were also found to vary by gender and school size. The greater injury rate for boys is consistent with other research¹⁻³ and is likely to have roots in social factors such as the greater encouragement of risk taking in boys and the greater participation in contact sports. Interestingly, in this regard, for more than a decade, elementary schools in New Zealand have encouraged greater participation of females in traditionally male contact sports such as rugby, largely by replacing tackles with a "touch" rule to make the player release the ball. In parallel with this change, national educational guidelines have encouraged greater emphasis on sport for enjoyment and health rather than on competition and winning. Although not yet documented that these changes have contributed to reduced injuries for students, some national sport administrators have publicly claimed that the changes have reduced the competitive spirit (often perceived as the willingness to endure pain and to risk injury) in the current generation. It may be that increasing the physical safety of students at school may come at some loss of desirable features of mental health, such as the desire for autonomy and challenge.

The greater incidence of fractures in larger schools may simply be a function of larger student bodies—all schools at which 5 or more fractures were recorded were large urban schools (of varying socioeconomic status). However, decreased personal space for students, more students on the playground equipment at any given time (interval times are at the same time for all students in elementary schools in New Zealand), and an increased ratio of students to adult supervisors remain as factors with implications for the application of health services interventions. In this regard, the interpretation of school injuries in studies such as this would be enhanced by information on playground use. Is there an empirically reliable "safe" number of students in the playground or using specific equipment at any 1 time?

The finding that about half of all fractures sustained outside did not involve playground equipment suggests that greater attention be given to factors other than playground equipment, height limits, and landing surfaces. Indeed, it has been

argued that further increments in safety in these aspects may both be uneconomic and compromise the mental and physical health benefits of challenging activities.² At the same time, however, it must be recognized that attempts to increase safety in sports activities, free play, and regular movements about the school may also compromise other health-related goals, such as the reduction of obesity and the promotion of a physically active lifestyle. This dilemma is a challenge to those working to reduce playground injuries, especially where society accepts that some injury from play is an inevitable part of growing up.

CONCLUSION

The results here offer a response to MacKay's call for cross-country comparisons of playground safety.⁶ In a context where playground safety is promoted at a national policy level and supported by health and safety initiatives in schools, incidents involving fractures can be maintained at a relatively low level—even in a country with an outdoor lifestyle, a tradition of sports involvement for everyone at school, and an international image as a tourist adventure destination. Improvements in school safety may be more likely to result from a greater focus on the way that students interact at school rather than on the modifications to playground equipment. A tension remains between keeping students safe and providing a developmentally enriching educational environment.

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