

# A descriptive analysis of children's playground injuries in the United States 1990–4

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## Abstract

**Objectives**—To review playground injury statistics over a five year period in order to develop an awareness of how and where children in the United States are being injured.

**Methods**—All data are based on the United States Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS) for playground related injuries during 1990–4. The surveillance data includes injuries recorded in more than 90 hospital emergency departments located throughout the United States.

**Results**—Each year there are roughly 211 000 preschool or elementary school-children in the United States who receive emergency department care for injuries associated with playground equipment. On average, 17 of these cases result in death. 70% of all injuries occur on public playgrounds, with nearly one third classified as severe. Swings, climbers, and slides are the pieces of playground equipment associated with 88% of all NEISS reported injuries. Falls to the surface are responsible for 70%.

**Conclusions**—NEISS playground injury statistics contribute to our understanding of playground injuries. By identifying where and how children are injured, suggestions can be made in an attempt to make playgrounds safer.

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**Keywords:** contributing factors; playground; playground injuries.

Each year thousands of children receive emergency department care for playground equipment related injuries. In New Zealand, approximately 7400 children require emergency department care with over 1100 being hospitalized, for incidence rates of 930 and 137 respectively, per 100 000 children.<sup>1,2</sup> In the United States there are over 200 000 children treated in emergency departments, for an incidence rate of 398 for children ages 0–4 and 533 for children 5–15 per 100 000.<sup>3–5</sup> Playground injuries are the leading cause of injuries to students in the school environment. The total cost of these injuries in the United States was estimated to be \$1 billion in 1992.<sup>4</sup> An Arizona Department of Health study found that only 72% of students with reportable injuries were actually taken to the emergency room or to a doctor.<sup>6</sup> Thus, the number of playground injuries is actually much higher.

Studies of playgrounds in day care centers have reported injury rates per 100 000 child hours ranging from 0.25 to 2.18, with the majority being above 1.5.<sup>7–10</sup> Most child care injuries are relatively minor, the most important risk factor being the height of the tallest piece of climbing equipment.<sup>7,8</sup> Climbing equipment 6 feet or taller had over twice the rate of fall injuries as climbing equipment less than 6 feet.<sup>11</sup> In another study, the risk of injury from falls of heights greater than 1.5 meters was four times that of falls from 1.5 meters or less.<sup>1</sup> Thus, researchers have suggested that lowering the height of playground equipment may reduce the number of children who receive emergency department care.<sup>1,7,8</sup> This is supported by additional research indicating that falls to the surface account for 58% to 70% of all playground injuries.<sup>12,13</sup>

These findings clearly point to needed changes. Therefore, the purpose of this paper is to review playground injury statistics in the United States over a five year period in an attempt to provide a broader, more complete picture of how children are injured on playgrounds.

## Methods

All statistics are based on data obtained from the United States Consumer Product Safety Commission's (CPSC) National Electronic Injury Surveillance System (NEISS) for the years 1990–4. NEISS collects data on playground product related injuries from a sample of more than 90 hospital emergency departments. Thus, only emergency room injury statistics are recorded and national statistics are estimates. The estimated number of cases is based on a probability sample. The basic factor used to inflate each case is the inverse of the probability of selection of the hospital that treats the case.<sup>5</sup> The actual surveillance data include a number of elements (that is, treatment date, patient's age, sex, diagnosis, accident locale, and remarks comments).

For the purpose of this analysis, playgrounds are defined as designated areas where stationary or manipulative equipment is located to facilitate a child's physical, emotional, social and intellectual development. Public playgrounds include all play areas open to the general public, including schools, parks, apartment complexes, child care centers, and restaurants. Similar to previous studies based on NEISS data, injuries are classified according to the specific type of play device involved (that is, swing, slide, merry-go-round, etc). Other components did not generally appear to contribute to the incident.<sup>12,14</sup>

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From April through December 1988, the CPSC conducted an in-depth investigation on a systematically selected sample of NEISS playground incidents.<sup>14</sup> This follow up investigation found that about 15% of the verified cases were 'out of scope', that is, the injuries did not involve playground equipment. Thus, the projected national estimates in this study are adjusted to reflect this finding.

Information on playground equipment related fatalities was obtained from data reported to the CPSC for the years 1991 through 1995. These data were obtained from a review of NEISS and the CPSC's files of death certificates, consumer complaints, and newspaper clippings. Therefore, the deaths do not represent a complete count of all playground related deaths but are useful as broad indicators of some of the factors involved in these deaths.

**Results**

The number of playground injuries remained fairly constant over the five year period. Each year, there are approximately 211 150 preschool and elementary schoolchildren in the United States who receive emergency department care for injuries involving playground equipment (see table 1). Nearly 70% of these occur on public playgrounds.

Boys are involved in a slightly higher percentage of NEISS reported playground injuries (53.5%) than are girls (46.5%). These differences are slightly more pronounced for preschool aged children—boys, 56.1%. May, June, and September (14.4%, 12.0%, and 12.0% respectively) are the months with the highest percentage of injuries, while January, December, and February (2.5%, 2.6%, and 3.6%) have the lowest.

On average, there are 17 playground related deaths each year in the United States, 67% of which occur on home playgrounds. Strangulation from ropes, clothing, or strings on clothing, account for 49% of these deaths. Falls to

the surface were reported in another 24%, while 11% involved equipment falling on the individual. Entrapment (3.5%) or being struck by a swing (3.5%) were also contributing factors in a number of incidents. All other reported deaths were isolated occurrences, such as being struck by rotating playground equipment, face buried in the sand, and hitting the swing set; 62% of the deaths involved boys, 38% girls.

**SEVERITY AND TYPES OF INJURIES**

The head and face area was involved in the majority of injuries to children 0-4, while the most commonly injured area was the arm and hand for the 5-14 age group. Approximately 35% of the injuries were classified as severe (that is, concussions, dislocations, fractures, internal injuries, amputations, and crushings). Seventeen per cent were moderately severe (that is, ingestions, foreign body, hematoma, dental injuries, punctures, strains, sprains, hemorrhage, avulsion, dermatitis, conjunctivitis) and 48% were relatively minor (that is lacerations, contusions, and abrasions). However, it should be noted that all injuries were severe enough to prompt a visit to an emergency room and about 3% required hospitalization.

The most common types of injuries have remained relatively constant over this period. The most common diagnosis was fractures, followed by lacerations, contusions, and strains. Internal injuries comprised the fifth most prevalent diagnosis.

Further analysis reveals that the most common diagnosis varies from one piece of equipment to another. Fractures were predominant for climbers each year, whereas injuries associated with slides tended to vary between fractures and lacerations. Conversely, the most prevalent injury associated with swings was lacerations, followed by fractures, and the most common seesaw injuries were lacerations.

**EQUIPMENT TYPE**

The NEISS information identifies several types of playground equipment on which injuries occurred: swings, climbing equipment (referred to as climbers), slides, seesaws, merry-go-rounds, 'other' equipment, and 'equipment not specified'. Other equipment includes items such as sliding poles, sandboxes, spring rockers, tunnels, bridges, and ropes. Equipment not specified includes injuries which did not identify a particular piece of equipment.

As illustrated, swings, climbers, and slides are associated with the majority of injuries,

Table 1 Estimated playground injuries in the United States, 1990-4 by body part and type

	Ages 0-4	Ages 5-14	Total
Mean No/year	64180	146970	211150
Body part (%)			
Head/face	60	30	39
Arm/hand	21	43	36
Leg/foot	12	15	14
Other	7	12	11
Nature of injury (%)			
Fracture	21	35	29
Laceration	38	17	24
Contusions/abrasions	21	23	23
Strain/sprain	6	14	12
Internal injury	6	3	4

Table 2 Distribution of injuries by type of equipment and age, 1990-4

Equipment	Ages 0-14			Ages 0-4		Ages 5-14	
	Mean	Rate	95% CI	Mean	Rate	Mean	Rate
Swing	75375	138	129 to 146	24025	128	51350	143
Climber	54755	120	109 to 132	12005	64	53750	150
Slide	42920	78	74 to 83	19865	106	23055	64
Seesaw	8175	15	13 to 17	2850	15	5325	15
Merry-go-round	4000	7	6 to 8	980	5	3020	8
Not specified	8885	16	13 to 19	2355	13	6530	18
Other equipment	6995	13	11 to 14	2120	11	4875	14

CI=confidence interval.

nearly 88% (see table 2). Seesaws and merry-go-rounds are the other two major pieces of equipment involved but they account for less than 6%. For young children, swings have the highest incidence rates per 100 000 (based on United States census figures for 1990) whereas climbing equipment has the highest incidence rates for school age children.

The percentages of severe, moderately severe, and minor injuries also vary according to the type of equipment involved (see table 3). Minor injuries were the most common classification for the majority of the equipment including seesaws, swings, and slides. The sole exception is climbers, where the most common classification was severe. Due to the lack of definitive data in this area, merry-go-rounds were included in other equipment.

**CONTRIBUTING FACTORS**

Remarks and comments describing each injury were also analyzed to ascertain factors contributing to the incident. Because of the limited information contained in each NEISS remark, contributing factors were restricted to: (1) falls to the surface; (2) falls to the equipment; (3) hit by the equipment; (4) ran into the equipment; and (5) others. For example, the classification of falls to the surface was based on phrases such as 'fell from (equipment)', 'fell onto (surface)', 'fell off (equipment)', and 'landed on (surface)'. It should be noted that 3% of the NEISS comments had unknown contributing factors and were not included in the analysis. Because the various pieces of playground equipment have differing contributing factors, not all classifications are used in each analysis (see table 4).

As illustrated, falls to the surface were the leading contributing factor. When all pieces of equipment are combined such falls were a contributing factor in 70%. This percentage is the result of the major pieces of equipment—swings, climbers, and slides, which account for 88% of all injuries. The large percentage for climbing equipment is noteworthy because slightly over 85% of these injuries involve a fall to the surface. However, while the end result was a fall to the surface, it is often

unclear what actually caused the fall. It could be lack of maintenance, inadequate supervision, or inappropriate age design.

Another major contributing factor for many pieces of equipment appears to be falls onto equipment (9%) such as slides, seesaws, other equipment, and merry-go-rounds.

A third factor is being hit by the equipment. This is especially consequential for swings and seesaws. Nearly 21% of all swing injuries involve either being hit by the swing or by someone sitting in the swing, and about 26% of the seesaw injuries listed being hit by the seesaw or running into it.

The final substantial factor is the 'others' classification which includes protrusions and projections. Due to the emphasis in the CPSC's *Handbook for Public Playground Safety* places on these hazards, the number of injuries related to protrusions and projections was examined separately.<sup>15</sup> Results indicated that these were contributing factors in 1.3%. Thus, while factors such as protrusions are a hazard that can and should be remedied, they are only involved in a small percentage of injuries.

**Discussion**

While no playground will ever be 'injury proof', steps can be made to ensure that playing on the playground is a safer, fun filled, learning experience. One of the first steps in this endeavor is to develop an awareness of how and where children are injured.

NEISS provides the most comprehensive statistics currently available in the United States. However, the system is not without its shortcomings. First, while based on a systematic probability sample, the national numbers are only estimates. Second, the estimates include only injuries reported to emergency departments. Thus, the actual number of these injuries is much higher.<sup>6</sup> Finally, NEISS surveillance data are often limited and fairly general in nature. While the individual's sex, age, diagnosis, and treatment date are almost always given, the remarks or comments describing the incident are typically vague. For example, rarely is much information provided about the playground, such as 'was pushed off a 6 foot slide onto pea gravel landing of shoulder'. More common are comments like 'Mom said she fell off the swings at school'. Thus, we are unable to obtain vital information that would more accurately describe other contributing factors such as unacceptable surface materials, lack of maintenance, or inadequate supervision.

Overall, the results are consistent with previous NEISS based studies.<sup>12 14</sup> For example,

Table 3 Severity of injuries by type of equipment; values are %

Equipment	Severe	Moderately severe	Minor
Swing	32	16	52
Climber	43	17	40
Slide	32	19	49
Seesaw	27	14	59
Not specified	28	22	50
Other equipment	20	23	57

Table 4 Contributing factors by type of equipment; values are %

Contributing factors	No of cases in NEISS	Swings	Climbers	Slides	Seesaws	Merry-go-rounds	Not specified	Other equipment
Falls to surface	19082	62.9	85.2	68.3	53.8	57.8	60.9	29.2
Hit by equipment	2068	20.8	N/A	N/A	23.9	N/A	N/A	N/A
Falls to equipment	2454	2.9	8.8	17.6	15.3	18.5	21.3	22.4
Ran into equipment	486	N/A	2.5	N/A	N/A	N/A	5.0	35.9
Others	3096	13.4	3.5	14.1	7.0	23.7	12.8	12.5

N/A=not applicable (was either not appropriate or was included in the 'others' because of the limited number of cases).

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ple, injury patterns were not significantly different for boys and girls. Younger children were more likely to suffer injuries to the head and face, while the most commonly injured body part for older children was the arm and hand. Children under age 5 were most frequently injured on swings, and schoolchildren were most often injured on climbing equipment. It is also interesting to note that the percentage of injuries per month increases in September, which is the traditional start of school in most parts of the United States.

### Implications for prevention

An in-depth analysis of the factors involved in playground related injuries for specific pieces of equipment revealed that the majority of injuries involve a fall to the surface. Thus, attention to the proper depth and type of surfacing located under and around equipment should be a top playground management priority. This is especially pertinent for climbing equipment, which tends to be taller and poses a greater risk of injury.<sup>11</sup>

According to the United States CPSC guidelines, acceptable playground surfacing materials include wood chips, rounded gravel, sand, shredded rubber, or a variety of synthetic surfaces.<sup>15</sup> Hard materials, like asphalt and concrete, are unsuitable surface materials. Likewise, earth surfaces such as dirt, turf, and grass, are unacceptable because their shock absorbing properties vary depending on wear and climatic conditions. Specific surface material depths should be proportionate to the height of the equipment. However, a 12 inch depth of loose fill materials is a good guideline for equipment up to 8 feet in height. In general, the surfaced area under and around playground equipment should extend a minimum of 6 feet in all directions from the edge of stationary equipment.<sup>15</sup> Slides and swings require different fall zone areas because of the child's momentum. Fall zones for slides should be 4 feet taller than the slide, with a minimum of 6 feet. Fall zones for swings are twice the height of the pivot in front and in back of the swing. Once adequate surfacing is installed, it must be regularly inspected and maintained.

Nearly one fourth of the swing injuries involve being hit by the moving swing. Therefore, it appears that swing safety should include supervision and education so that the number of children who play too close to moving swings can be reduced. Similarly, 36% of the 'other' equipment injuries involve a child running into the equipment. Perhaps by providing additional education and supervision, some of these injuries could also be prevented.

Two key elements of supervision are foresight and control (SD Hudson, D Thompson,

MG Mack, unpublished paper). It is the duty of the supervisor to protect children from the foreseeable risk of unreasonable harm.<sup>16</sup> As such, supervisors must visually survey the area before each play period looking for foreign objects, broken equipment, and inadequate surfacing. Secondly, supervisors must actively control the environment. According to a noted safety expert, Richard Borkowski, 'Supervision is first, last, and always a matter of being there—being in and around the area of activity. It's being close enough to watch, to control, and to offer the safest environment possible.'<sup>17</sup>

Playing on playgrounds should be a fun filled learning experience for all children. Thus, steps must be taken to provide play environments where children are able to take safe challenges and risks which push their minds and bodies to new limits.

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