

## **Special Study: Injuries and Deaths Involving Children Under Age 2 Associated with Playground Equipment**



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## **Executive Summary**

This special study was conducted by the U.S. Consumer Product Safety Commission's Directorate for Epidemiology staff to address an inquiry from ASTM International on playground equipment-related injury and death scenarios involving children under the age of 2. The injury data is based on a study of playground-related injuries treated in U.S. hospital emergency rooms from October 2000 to September 2001. Playground-related fatalities reported to CPSC from January 1990 to August 2002 were also reviewed.

- During the special study period, there were an estimated 8,250 children (95 percent confidence interval: 6,390-10,110) under the age of 2 treated in U.S. hospital emergency rooms for injuries associated with playground equipment.
- Ninety-five percent of the injured were 12-23 months of age. Five percent of the injured were 11 months or younger. The youngest child in the sample was 3 months and the oldest was 23 months.
- Lacerations, contusions and abrasions were the most commonly reported injuries (52 percent). Seventy-eight percent of those relatively minor injuries were to the head or facial region. Fractures, sprains and strains were the second most often reported injuries, accounting for 30 percent of the total.
- The head and facial region of the body was involved in 53 percent of all the injuries. The types of injuries incurred were mainly contusions, abrasions and lacerations. Nineteen percent of the head/facial injuries were of a more severe nature such as fractures, concussions or internal injuries. The leg/foot was the second most often reported region of the body injured with 34 percent of the injuries. Sixty-five percent of the leg/foot injuries were fractures, sprains or strains.
- Forty-one percent (3,390) of the estimated injuries involved public playground equipment and 33 percent (2,730) involved home use equipment. Additionally, 26 percent (2,120) of the injuries involved equipment that was not specified as either public or home playground equipment. None of the estimated injuries specified that homemade equipment was involved.
- Sixty percent of the injuries that were related to public playground equipment occurred in a public park. Sixty-three percent of those injuries were related to slides.
- Three percent of the injuries that occurred with home use equipment were in the yard of a residential daycare facility. Of the injuries that occurred with home equipment, 38 percent involved slides.
- The most common injury scenario was a fall, accounting for 50 percent of the total injuries. The lowest height from which a child fell in the study sample group was 1 inch and the maximum height was 10 feet.

- The second most common injury scenario was impact (colliding with or being struck by playground equipment) with 22 percent of the injuries.
- The third most common injury scenario involved children getting a leg or foot twisted while going down a slide. The resulting injuries were often fractures or sprains. This scenario resulted in 1,090 or 13 percent of the estimated injuries.
- Entrapments were involved in 270 estimated injuries and pinching was involved in 20 estimated injuries. None of the entrapments were head or neck-related.
- Protective surfacing on playgrounds is recommended for reducing the risk of serious head injuries. In this study the most common type of protective surfacing was wood chips, associated with 12 percent of the injuries. The most prevalent surfacing overall was grass (a non-protective surface), which was associated with 17 percent of the injuries.
- From January 1990 to August 2002, CPSC received 6 reports of children under 2 dying in an incident involving playground equipment. The latest death of a child under the age of 2 that was reported to CPSC occurred in April of 1995.
- Safety efforts involving the under-2 population of playground equipment users should take into account the nature of the incidents in which these children are involved. Overall, slides were responsible for about half the playground equipment-related injuries to children under 2, regardless of hazard pattern.

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## I. BACKGROUND

Each year, over 200,000 people are treated in U.S. hospital emergency rooms for playground equipment-related injuries. A majority of these injuries involve children under age 15. The youngest victims of playground equipment-related injuries are under 2 years old. Over a recent five-year period (1997 to 2001) an estimated average of 9,920 children under 2 years old were treated annually in hospital emergency rooms for injuries associated with playground equipment. A previous analysis<sup>1</sup> of fatality data by CPSC staff showed that reports of deaths in this age group involving playground equipment are rare.

The impetus for this special study was a request from an ASTM International<sup>2</sup> subcommittee that is currently working on a safety standard for public playground equipment for children under 2 (ASTM F144). The subcommittee asked CPSC to determine the heights from which children under 2 fall from playground equipment. There was a particular interest in the types of injuries incurred from heights of less than 12 inches and whether serious injuries can occur from falls from those heights.

CPSC staff concluded that a special study was the best way to obtain information on fall heights since specific questions could be posed during a telephone interview with regard to the cases in the survey sample. Additionally, staff considered it worthwhile to expand the scope of the study to all playground-related injury scenarios involving children under 2 for comparison purposes.

There are a number of issues with the under-2 age group related to playground equipment that are currently of concern. Fall height under 12 inches is one issue and more specifically, how it relates to injury severity. Many questions have arisen regarding the equipment itself versus its location and the type of surfacing in place. This is of particular interest for portable equipment. There is also an additional issue as to what hazards exist with equipment installed indoors versus outdoor equipment.

This study is not limited to public playground equipment. Staff also analyzed data associated with injuries and deaths with home use equipment to present the broader scope of playground-related incidents involving children under 2. It should be noted that portable equipment is found in both home and public locations. The following describes most of the general categories of playground equipment in use today:

- **Public Playground Equipment** is usually located in schoolyards, public parks, amusement parks, commercial/institutional day care, apartment complexes and other public recreation areas. Increasingly, at these locations multi-use structures are becoming the norm. ASTM F1487 is the voluntary standard for public equipment.
- **Preschool or Toddler Playground Equipment** is generally public equipment that is intended for children 2 to 5 years of age. It is usually located at commercial/institutional day

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<sup>1</sup> That analysis was Special Study: Injuries and Deaths Associated with Children's Playground Equipment from April of 2001. The 2001 study was a NEISS-based study, providing information on injuries and deaths to children 0-14 years of age that involved playground equipment.

<sup>2</sup> ASTM International, formerly known as the American Society for Testing and Materials, provides standards used in research, development, product testing, quality systems and commercial transactions worldwide.

care facilities, preschools or at public playgrounds in areas separated from standard size equipment. This equipment can also include multi-use structures. ASTM F1487 is the voluntary standard for public equipment encompassing users as young as a 5<sup>th</sup> percentile 2 year old.

- **Home Playground Equipment** is usually found outdoors at private residences. This category would also include the equipment installed at residential daycare. Usually, this equipment is of lighter construction than public equipment, but once again, heavier multi-use structures are being seen in home settings. ASTM F1148 is the voluntary standard for this type of equipment.
- **Portable Playground Equipment** is unique in that by its very nature it can be used indoors or outdoors. It is generally constructed of lighter weight molded plastic and the most likely users are children from just under 1 year of age to age 3. Portables are seen not only at private residences, but also at commercial and residential day care facilities and preschools. Currently, there are no voluntary or mandatory standards that specifically address this type of equipment.
- **Soft-Contained Playground Equipment** is generally located in fast food restaurants, “pay-for-play” facilities, shopping malls and amusement parks. Typical construction uses plastic crawl tubes and slides, climbing nets, ball pits and other padded climbing apparatus. Usually, the entire structure is surrounded by netting to minimize falls. ASTM F1918 is the voluntary standard for this type of equipment.

## **II. METHODOLOGY**

### **Injuries**

The injury incidents included in this special study were collected through the National Electronic Injury Surveillance System (NEISS). NEISS is a statistically selected sample of about 100 hospital emergency rooms throughout the United States that report product-related injuries to CPSC. These hospitals are stratified by size and type (such as large, small, children's, etc.) and are assigned statistical weights that CPSC uses to create national estimates of product-related injuries.

From October 1, 2000 through September 30, 2001 every playground equipment-related injury reported through NEISS that involved a child under 2 was assigned for a telephone investigation to obtain additional information about the circumstances, injury and equipment involved. The telephone investigations were conducted by persons under contract to CPSC, using a questionnaire developed by CPSC staff. Open-ended and multiple choice questions were posed to the respondent to determine the details surrounding the hazard scenario that resulted in the injury.

A total of 374 investigations<sup>3</sup> were assigned for this study, of which 306 cases were in scope.<sup>4</sup> Those 306 cases are the basis of this study. Generally, a case was considered to be out-of-scope if the victim's age was more than 23 months or the incident was not playground equipment-related.

### **Deaths**

CPSC obtains reports of fatalities from a number of sources, including death certificates, medical examiner and coroner reports, correspondence from the public, newspaper clippings and emergency room records. These reports are often assigned by CPSC staff for investigation to obtain additional details about the hazard scenario and the product(s) involved.

A search was conducted of the In-depth Investigation file (INDP), the Injury and Potential Injury Incident file (IPII), the Death Certificate file (DTHS) and the National Electronic Injury Surveillance System (NEISS) for playground-related deaths involving children under 2 reported to CPSC from January 1, 1990 to August 15, 2002. The resulting data were reviewed for inclusion in this study.

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<sup>3</sup> There were 269 telephone investigations completed by the contractor (of which 219 were in scope). The completed cases represent a response rate of 72% for this study.

<sup>4</sup> Included among the in-scope cases were cases where no contact was made or the respondent refused to participate. However, if there was information in the original case narrative and coding submitted by the NEISS hospital, describing the scenario, injury, etc., staff used the information in the study.

### III. DATA ANALYSIS

#### A. General Discussion of Injury Data<sup>5</sup>

During the study period, there were an estimated 8,250<sup>6</sup> injuries treated in U.S. hospital emergency rooms associated with playground equipment involving children under age 2. Ninety-eight percent of the injured victims were treated and released from the hospital. One percent of the injured were hospitalized, about 0.2 percent left the emergency room without seeing a physician and about 0.9 percent were treated and transferred to another hospital.

The victims in this special study were children under 24 months of age. Ninety-five percent of the estimated total injuries treated in hospital emergency rooms were to children 12 to 23 months old, and five percent were to children 11 months old or younger. The age range of victims in the study sample was 3 to 23 months. Fifty-eight percent of the injured victims were male.

Table 1 gives a breakdown of the estimated injuries by type of equipment (public, home, homemade or unknown).<sup>7</sup>

**Table 1: Estimates of Emergency Room Treated Injuries Involving Children Under Age 2 by Type of Playground Equipment**

Equipment Type	Percentage of Injuries Based on Estimate	Estimated Injuries
Total	100%	8,250
Public Equipment	41%	3,390
Home Equipment	33%	2,730
Homemade	---	0
Unknown	26%	2,120

Source: National Electronic Injury Surveillance System (NEISS), Special Study  
10/1/00- 9/30/01

Estimates may not add to the totals due to rounding.

In 26 percent of the injuries it was unknown whether the equipment involved was public or home use equipment, even if the location was specified. Hence, the estimates for public and home equipment are minimum numbers.

<sup>5</sup> In this report, injury estimates derived from NEISS are rounded to the nearest 10 injuries, but percentages are based on unrounded estimates.

<sup>6</sup> The coefficient of variation for this estimate is 11.5 percent. There is a 95% confidence interval associated with the estimate (6,390-10,110).

<sup>7</sup> A number of different analyses are presented in this report for different variables of interest (such as type of equipment or location of the incident). Some of the estimates are based on small sample sizes with relatively large amounts of associated variability. Interpretation of these estimates should be made with caution.

<sup>8</sup> There were no injuries involving homemade equipment that fell within the scope of the study.

This study showed that 25 percent of the injuries happened in public parks followed by 24 percent of the injuries in the yard of a home. Table 2 shows a breakdown of the injuries by age of the victim and the specific location of the incident.

**Table 2: Estimates of Playground Equipment-Related Injuries Involving Children Under Age 2 for Age of Victim by Location of Accident**

Age of Victim	Location of the Incident							
	Total	Public Park	Yard of Home	Apt. Complex	Day Care	Fast Food Rest.	Other <sup>9</sup>	Unknown
<b>Total</b>	<b>8,250</b>	<b>2,040</b>	<b>1,950</b>	<b>280</b>	<b>620</b>	<b>200</b>	<b>1,150</b>	<b>2000</b>
12-23 months	7,860	2,000	1,870	280	620	70	1,080	1,940
0-11 months	390	40	70	0	0	140	70	70

Source: National Electronic Injury Surveillance System (NEISS), 10/1/00 through 9/30/01, Special Study  
Estimates may not add to the totals due to rounding.

Table 3 (on the following page) provides estimates of playground equipment-related injury diagnoses for the under-2 age group by the region of the body that was injured.

Overall, injuries to the head and facial region were most common (53 percent or 4,400 of the total injuries). Seventy-five percent of the total head and facial region injuries were lacerations, contusions and abrasions. Nineteen percent of the head/face injuries were of a potentially more serious nature (fracture, concussion, or internal injury<sup>10</sup>).

Leg/foot region injuries were the second most common injury incurred by children under 2 with 34 percent of the total injuries (2,800). Fractures, sprains and strains accounted for over half (65 percent) of the total leg and foot region injuries. Contusions and abrasions were associated with 19 percent of these leg/foot region injuries.

Injuries to the arm and hand were the third most common with 9 percent of the total injuries. Eighty-five percent of those arm/hand injuries were of a more serious nature with the child suffering a dislocation, fracture or sprain/strain. Almost half of the arm/hand injuries were fractures (48 percent).

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<sup>9</sup> The *Other* category for this table includes the following locations: schoolyards, commercial settings not otherwise specified, and various other locations.

<sup>10</sup> The diagnosis of internal head injury is sometimes given for an injury as minor as a bump to the head, but this diagnosis can represent a severe injury.

**Table 3: Estimates of Playground Equipment-Related Injuries Involving Children Under Age 2  
Diagnosis by Body Part**

<b>Diagnosis</b>	<b>Area of the Body Injured</b>				
	<b>Total</b>	<b>Head &amp; Face</b>	<b>Leg &amp; Foot</b>	<b>Arm &amp; Hand</b>	<b>Other &amp; Unk<sup>11</sup></b>
<b>Total</b>	<b>8,250</b>	<b>4,400</b>	<b>2,800</b>	<b>710</b>	<b>350</b>
Laceration	2,330	2,230	80	20	0
Contus/Abras	1,930	1,090	530	70	240
Fracture	1,360	90	890	340	40
Strain/Sprain	1,090	0	940	140	10
Internal Injury	510	510	0	0	0
Concussion	230	230	0	0	0
Dislocation	190	0	70	120	10
Other or Unk <sup>12</sup>	620	250	300	10	60

Source: National Electronic Injury Surveillance System (NEISS), 10/1/00-9/30/01 Special Study

Estimates may not add to the totals due to rounding.

Table 4 (on the following page) presents estimates for injury diagnosis by region of the body injured for children 0-11 months and 12-23 months to determine if there were any differences in the types of injuries incurred between the two age groups. Children 12-23 months were involved in an estimated 95 percent (7,860) of the total playground equipment-related injuries to children under age 2. However, it is important to note that, the older age group is more mobile with more developed motor skills and probably is exposed to playground equipment more frequently than the younger group. Also, the estimates for the younger children are highly variable due to a small sample size.

<sup>11</sup> The *Other and Unknown* category for the area of the body that was injured includes: neck, shoulder, upper trunk, lower trunk, pubic region, 25%-50% of the body suffering the injury, all parts of the body suffering the injury, and unspecified part of the body.

<sup>12</sup> The category of *Other and Unknown* for diagnosis includes those diagnoses that are not commonly associated with or occur infrequently with playground injuries, such as, anoxia, aspirated foreign object, burns of all types, electric shock, poisoning, nerve damage, submersion, crushing, puncture, etc.

**Table 4: Estimates of Playground Equipment-Related Injuries Involving Children Under Age 2**  
**Diagnosis and Body Part by Age**

Diagnosis	Age of the Victim									
	0-11 Months Area of the Body Injured					12-23 Months Area of the Body Injured				
	Total	Head & Face	Leg & Foot	Arm & Hand	Other	Total	Head & Face	Leg & Foot	Arm & Hand	Other
Total	<b>390</b>	<b>140</b>	<b>260</b>	<b>0</b>	<b>0</b>	<b>7,860</b>	<b>4,260</b>	<b>2,540</b>	<b>710</b>	<b>350</b>
Laceration	<b>10</b>	10	0	0	0	<b>2,310</b>	2,210	80	20	0
Contus/Abras	<b>140</b>	70	70	0	0	<b>1,790</b>	1,020	460	70	240
Fracture	<b>150</b>	0	150	0	0	<b>1,210</b>	90	740	340	40
Strain/Sprain	<b>20</b>	0	20	0	0	<b>1,080</b>	0	920	140	10
Internal Injury	<b>40</b>	40	0	0	0	<b>470</b>	470	0	0	0
Concussion	<b>0</b>	0	0	0	0	<b>230</b>	230	0	0	0
Dislocation	<b>0</b>	0	0	0	0	<b>190</b>	0	70	120	10
Other or Unk	<b>40</b>	10	30	0	0	<b>580</b>	240	270	10	60

Source: National Electronic Injury Surveillance System (NEISS), Special Study, 10/1/00 through 9/30/01  
Estimates may not add to the totals due to rounding.

### Hazard Scenarios

Falls, impact, twisted leg/foot injuries with slides, entrapments or getting pinched by equipment can occur with public or home equipment, depending on the specific type of equipment. Table 5 (on the following page) presents the hazard scenarios by the general type of equipment (public, home or unknown) involved in the injuries.

**Table 5: Estimates of Playground Related Injuries to Children Under Age 2  
Hazard Scenario by General Type of Equipment<sup>13</sup>**

Hazard Scenario	General Type of Equipment			
	Total	Public	Home	Unknown
<b>Total</b>	<b>8,250</b>	<b>3,390</b>	<b>2,730</b>	<b>2,120</b>
Falls	4,090	1500	1,450	1,140
Hit or Struck by Equipment	1,830	510	780	540
Twisted Leg/Foot Injuries with Slides	1,090	910	70	110
Entrapment	270	20	210	40
Pinched or Caught by Equipment	20	20	0	10
Other Hazards	290	90	200	10
Unknown	660	350	20	290

Source: National Injury Surveillance System (NEISS), Special Study, 10/1/2000- 9/30/2001  
Estimates may not add to the totals due to rounding.

The most common hazard pattern was falls, associated with 50 percent of the injuries. The occurrence of fall-related injuries was almost equal between public and home equipment. The second most common hazard pattern related to the injuries (22 percent) was incidents where the child collided with the equipment or was struck by it (impact).

The third most common hazard pattern related to 13 percent of the injuries involved leg/foot injuries where children slid down a slide and got their leg twisted. The specific mechanisms of these particular injuries are discussed in the next section titled *Slide-Related Leg Injuries*.

Entrapments accounted for 3 percent of the injuries and most occurred with home equipment. The entrapments that occurred with these children involved legs and feet. There were no head or neck entrapments. Injuries where the child got a finger (or other body part) pinched in the equipment were rare. Three percent of the injuries were related to various other hazard patterns. In 8 percent of the estimated injuries there was not enough information to determine the specific hazard pattern involved.

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<sup>13</sup> Table 5 does not present numbers for homemade equipment, because there were no in-scope injury cases in the study sample that occurred with homemade playground equipment.

Table 6 presents an overview of the injuries for the specific types of equipment by the hazard pattern involved regardless of the general type of equipment (public, home or unknown).

**Table 6: Estimates of Playground-Related Injuries Involving Children Under Age 2 by Specific Type of Equipment and Hazard Pattern**

Specific Type of Equipment	Hazard Pattern							
	Total	Fall	Hit or Struck	Twisted Leg/Foot with Slides	Entrap	Pinch	Other	Unk
<b>Total</b>	<b>8,250</b>	<b>4,090</b>	<b>1,830</b>	<b>1,090</b>	<b>270</b>	<b>20</b>	<b>290</b>	<b>660</b>
Slides	<b>4,160</b>	2,140	340	990	120	0	80	490
Swings	<b>1,970</b>	760	1,040	0	70	0	100	10
Climbers	<b>390</b>	380	0	0	10	0	10	0
Play Gyms	<b>240</b>	170	70	0	0	0	0	0
Sandboxes	<b>180</b>	0	70	0	0	0	100	0
Gliders	<b>160</b>	0	160	0	0	10	0	0
Tubes or Tunnels	<b>140</b>	0	0	0	70	0	0	70
Tube Slides	<b>110</b>	0	0	100	0	0	0	10
See Saws/Teeter Totters	<b>100</b>	70	20	0	0	0	0	0
Merry-Go-Rounds	<b>80</b>	70	0	0	0	20	0	0
Swing Set Structures	<b>10</b>	10	0	0	0	0	0	0
Ball Pits	<b>10</b>	0	0	0	0	0	0	10
Other	<b>390</b>	320	70	0	0	0	0	0
Unknown	<b>320</b>	170	70	0	0	0	0	80

Source: National Electronic Injury Surveillance System (NEISS), Special Study, 10/1/00–9/30/01  
Estimates may not add to the totals due to rounding.

Overall, slides were associated with more injuries than any other type of equipment (52 percent of the injuries, including tube slides). Falls accounted for the greatest number of injuries (50 percent) associated with slides. Twenty-four percent of the injuries involved swings. The most common injury (53 percent) that occurred with a swing was colliding with or being struck by a swing (82 percent or about 850 of these injuries occurred when the swing struck the child).

In the sections of this document titled *Public Equipment-Related Injuries* and *Home Equipment-Related Injuries* there is more information on the hazard patterns associated with specific equipment.

### Slide-Related Leg Injuries

Of the total estimated slide-related injuries (4,270), 52 percent (2,230) resulted in an injury to the leg or foot. There were several scenarios that appeared in the data involving a child's foot or leg becoming twisted on a slide. One hazard scenario involved a child's shoe (often a sneaker) contacting the slide's surface or sidewall, causing the child's foot to become "stuck" or "caught" on the surface or sidewall. The child's

leg/foot often became bent in the process. Resulting injuries in the study's sample cases were primarily fractures and sprains.

There was another scenario related to the previous one, where a child went down a slide with an older person and the child's leg/foot ended up under that person or was trapped between that person and the side of the slide. Theoretically, this may also be the result of the child's shoe contacting the slide's surface (deck) or sidewall, causing a braking action in the child's forward motion.

The slide injury scenarios described above resulted in an estimated 1,090 injuries with public, home or unknown type of equipment, which was 26 percent of the total slide-related leg/foot injuries<sup>14</sup> and 13 percent of all playground equipment-related injuries suffered by children under 2. An analysis was done by Human Factors staff to determine how and why these types of incidents are occurring with this particular age group (Appendix B).

#### Human Factors Analysis

In a memorandum titled *Children's Leg Injuries on Slides*, Human Factors staff presents a behavioral analysis of the general injury mechanism associated with the slide injuries that involve the twisting of legs or feet. Human Factors staff notes that although it would seem that a ride down a slide takes no skill, it requires balance, a slight backwards lean of the child's torso, anticipation of momentum, stiffened legs to lift the heel off the slide deck and advance preparation for the dismount.

Many of the slide incident reports in this study described shoes (and, in at least one instance, bare feet) grabbing or catching on the slide surface, twisting the leg backwards. These incidents appear to occur, because rubber soled shoes (sneakers, for instance) and even bare skin can grip a slide surface (the deck or sidewall of the slide's chute) and because smaller feet can contact the sidewall of the slide with the full width of the foot. A larger foot would be more likely to hit the rim of the sidewall and glance over it instead of grabbing securely like a smaller foot. In addition, a small child's shorter legs are given ample room by most slides to freely bend backwards.<sup>15</sup>

Younger children who don't have much experience sliding and may not anticipate the downward plunge that occurs once they are on the slide. Older children who have experience on a slide will use the skills necessary to successfully slide down. In addition, if a child is on another person's lap they may be more relaxed and let their legs drag loosely. The downward momentum, when on a larger person's lap, is enough to twist a child's leg into a potentially injurious position.

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<sup>14</sup> Two of these incidents were hip injuries, but they are included here, because the mechanism involved was virtually the same, involving the leg or foot. In one incident the child was on his father's lap and his sneaker "caught" on the slide, dislocating the child's hip joint. In the other incident the child was pushed down the slide by his cousin and got his leg bent behind him, causing a slight hip fracture.

<sup>15</sup> The voluntary standard for public playground equipment has a requirement that the deck of the slide (slidebed surface) be at least 12 inches wide when intended for use by 2-5 year olds and at least 16 inches wide when intended for 5-12 year olds.

## Other Topics of Interest

The following discussion addresses some of the issues that have surfaced with regard to playground-related injuries involving children under 2.

### Falls

Fall height from equipment has been a specific interest of the ASTM subcommittee members with regard to the specified age group, especially in the types of injuries incurred from falls under 12 inches in height. In this study sample, children fell from a wide range of playground equipment and its components, such as slides, platforms, ladders, swings and climbers.

The lowest height<sup>16</sup> from which a child in the study sample group fell was 1 inch (described below) and the maximum height was 10 feet.<sup>17</sup> Of the 175 fall-related cases in the study sample, 8 were reported to have involved a fall that was from a height of less than 12 inches. These cases, ranging from a 1-inch fall to an 8-inch fall, were:

- An 18-month-old male fell **1 inch** at the end of a slide onto gravel outside at an apartment complex after being bumped by another child. He received scratches to his head.
- A 23-month-old female was on a swing set swing in the yard of a home and let go of the chains as she swung, falling backwards **6 inches**. She hit her head on the ground (dirt and grass), lacerating it.
- A 15-month-old female was on a slide inside her home and fell backwards **8 inches** from the first step, hitting her head on the carpeted floor. She had the wind knocked out of her, but no head injury.
- A 15-month-old male was on the first step of a combination structure's platform outside at school and fell **6 inches** onto shredded tires as he went off the step, twisting his foot. He fractured his tibia.
- A 21-month-old female was in the yard of a home, walking down a slide of a combination structure. When she got to the bottom she fell off the slide **6 inches** to the grass, contusing her foot.
- A 22-month-old female was swinging on a swing set outside at home. She was swinging on her stomach and fell forward over the swing **2 inches** to the dirt. She cut her gum and loosened a tooth.
- A 20-month-old male was standing on a merry-go-round platform at a city park and let go of the bar, slipping off the equipment. He fell **8 inches**, landing on the gravel surface below. He lacerated his forehead.

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<sup>16</sup> The fall heights are based on information the telephone interviewer obtained from the person interviewed concerning the incident. It is possible that some of the heights may not be exact since the respondents may be basing their answers on memory and not a specific measurement.

<sup>17</sup> The latter incident involved a 21-month-old male who fell from a platform of multi-use structure (consisting of a fort with a slide, swings and rope). He tried to reach a rope to slide down and missed, losing his balance. The victim suffered a contusion to his head as a result of the 10-foot fall to the dirt surface.

- A 19-month-old female was on a toddler slide in her backyard, going down too fast. She hit her face on the concrete sidewalk at the bottom, falling **6 inches**. Her face was bruised.

Three of the 8 cases mentioned the presence of protective surfacing (2 cases involved gravel and 1 involved shredded tires). In the remaining cases, the children fell onto dirt, grass, carpeted flooring or concrete. In the two cases involving concrete and the carpeted floor, it appears from the information provided that the equipment may be portable play equipment.

### Portable Playground Equipment

Also of particular interest has been portable playground equipment that can be used indoors or outdoors and in a public or home location. The surfacing on which portable equipment is placed is of concern since this type of play equipment can be used on a non-protective surface by virtue of the fact it can be moved from place to place. This type of equipment is popular in home and daycare locations.

Portable playground equipment is not easily identified in the data without the manufacturer's identification and/or pictures. Since this study did not use on-site investigations for the analysis there were no pictures available for examination. However, there were some descriptive indicators that helped in identifying these products for analysis.<sup>18</sup>

Out of the study sample there were 36 cases that appeared to involve portable playground equipment. The children involved in these incidents ranged in age from 12 to 23 months and more than half of the incidents (23) involved females. Over half of these incidents (22) occurred indoors and all but 2 of the incidents involved a fall from equipment. The fall height ranged from 6 inches to 4 feet. The 2 injury incidents that were not fall-related involved a child getting her leg caught in a tunnel of a play set and a child who was struck when a plastic jungle gym tipped over.

Many of the fall-related injury incidents (20) mentioned a carpeted floor (11) or grass (9) as the surface the child fell to. Other surfaces mentioned in the fall-related incidents were a slate patio, a foam mat, floors, wood chips and concrete (outside).

Among the types of injuries that were received in these cases were concussions and a closed head injury,<sup>19</sup> dislocations, fractures, sprains, contusions, abrasions and lacerations. Appendix A provides additional details on each of the 36 incidents.

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<sup>18</sup> These cases were identified by the known characteristics of portable equipment such as, type of materials used in the manufacturing process, size, location of use, or the specified manufacturer of the product.

<sup>19</sup> There were 3 incidents that resulted in concussions (two of them described as mild). They all involved children falling from portable slides. Two of these incidents occurred indoors with one child falling onto carpeted floor and the other falling to an unknown type of surface. The third incident occurred outdoors and the child fell to a slate patio. The closed head injury occurred inside and the child fell to a tile floor from a plastic slide.

### Indoor versus Outdoor Location of Injury Incidents

As stated in the *Background* section of this study, there is interest in the injuries that have occurred in an indoor versus outdoor location. Sixty-six percent (5,410) of the total injuries occurred outdoors with 2,040 occurring in a public park and 1,950 in the yard of a home. Ten percent (800) of the injuries occurred indoors and twenty-five percent (2,040) occurred at an unknown location. Of the injuries occurring indoors, 23 percent occurred in various types of commercial settings, including daycare. Falls were a common hazard scenario no matter where the equipment was located. Table 7 presents a breakdown of the injuries according to specific location and whether the injury occurred indoors or outdoors.

**Table 7: Estimates of Playground Equipment-Related Injuries to Children Under 2 by Specific Location of the Incident and Whether an Indoor or Outdoor Occurrence**

Location of Injury Incident	Total	Outside	Inside	Unknown
<b>Total</b>	<b>8,250</b>	<b>5,410</b>	<b>800</b>	<b>2,040</b>
Public Park	2,040	2,040	0	0
Yard of Home	1,950	1,950	0	0
Institutional/Commercial Daycare	530	370	150	10
Apartment Complex	280	280	0	0
Schoolyard	260	260	0	0
Fast Food Restaurant	200	20	20	160
Yard of Daycare Setting	100	100	0	0
Other Commercial Setting <sup>20</sup>	20	10	10	0
Other <sup>21</sup>	870	200	600	80
Unknown Location	2,000	200	10	1,790

Source: National Electronic Injury Surveillance System, Special Study, 10/1/00-9/30/01  
Estimates may not add to the totals due to rounding.

Examples of the types of equipment used indoors in the study sample cases were slides, play sets, combination structures, a teeter-totter, and a climbing gym (many of which were plastic). Most of those were in homes and the surfacing was often flooring (carpeted or tile). A few of the locations were “pay-for-play” or restaurants and among the surfacing for this equipment was manufactured mats or a padded floor.

### Witness to Injury Incident and Caregiver Identification

In 31 percent of the injuries, the person responding to the study questionnaire witnessed the events that led to the injury. Thirty-eight percent of the respondents did not see the incident happen (but that does not mean that no one witnessed the incident).

<sup>20</sup> “Pay-for-play” establishments are included in *Other Commercial* setting category.

<sup>21</sup> It is in this category that injuries occurring inside a home or inside home daycare would be found.

Forty-seven percent of the victim's caregivers were their parents, followed by daycare providers (7 percent). An estimated 66 percent of children injured had at least one caregiver supervising the child at the time of the incident, although this does not mean they actually saw the incident as it happened. An estimated 100 injuries occurred with no adult supervising.

### **General Information about the Equipment<sup>22</sup>**

Thirty-three percent of the injuries were associated with play equipment (regardless of the type) that was obtained new, while 7 percent of the injuries were related to used equipment.<sup>23</sup> The type of material used in the construction of the play equipment associated with the most injuries was plastic (33 percent), followed by metal (12 percent) and equipment constructed of both metal and plastic (11 percent). In 54 percent of the injuries associated with home equipment, the equipment was constructed of plastic, followed by wooden equipment (8 percent). Most of the injuries (61 percent) that involved public equipment occurred on equipment made from plastic, metal or a combination of both.

Twenty-one percent of the injuries were associated with play equipment that was less than 5 years old and 29 percent of the injuries involved equipment under 10 years old. An estimated 10 injuries occurred with equipment 20 years or older. Seventy percent of the injuries were associated with equipment of unknown age. The equipment in the study sample cases ranged from brand new to 50 years at the oldest. The oldest equipment associated with the injuries was found at schoolyards and the newest equipment (under 5 years old) was in the yards of homes.

Twenty-two percent of the injuries occurred on part of a multi-use/combination structure.<sup>24</sup> Twenty percent of the injuries with this multi-use equipment were associated with equipment designed for home use and 72 percent were with public equipment.

Overall, in 53 percent of the injuries that occurred, the equipment was characterized as being in good or excellent condition. Eleven percent of the injuries were associated with equipment in poor or fair condition.<sup>25</sup> Seventy-seven percent of the injuries were related to home equipment in excellent or good condition and 4 percent of the injuries occurred with home equipment in fair or poor condition. In 50 percent of the injuries that occurred with public equipment, the condition of the equipment was described as good or excellent and in 21 percent of the injuries with public equipment the condition was fair or poor.

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<sup>22</sup> It is important to note that respondents were not able to provide as much general information about public playground equipment as home equipment in terms of whether it was new or used or the age of the equipment.

<sup>23</sup> In 60 percent of the estimated injury incidents, it was not stated whether the equipment was obtained new or used.

<sup>24</sup> Swing sets are not considered to be a multi-use structure.

<sup>25</sup> Respondents reported rust and abuse among the reasons for the poor or fair condition of the equipment.

### **Surfacing**

Protective surfacing under and around play equipment is recommended to reduce the risk of serious head injuries. The most prevalent type of **protective** surfacing used under the play equipment, involved in 12 percent of the injuries, was wood chips. The most prevalent **non-protective** surfacing was grass, associated with 17 percent of the injuries (overall more injuries occurred where a grass surface was present than any other type of surfacing). More injuries occurred with public equipment (25 percent) where wood chips were installed than any other type of surfacing, followed by injuries where sand was the surface (13 percent). Grass was the most common surfacing associated with the home use equipment-related injuries (45 percent).

The thickness of the surfacing associated with the injury cases in the study sample ranged from .25 inches to 48 inches.<sup>26</sup> However, the surface thickness information may not be entirely accurate given the fact that the measurements were obtained during phone interviews and probably were not based on an actual measurement, but more likely the respondent was relying on memory.

### **Other Factors**

More of the children (41 percent) were injured in the afternoon and early evening (between 12:01 p.m. and 6:00 p.m.) than any other time of day. The involvement of other children in the injury incident occurred with 18 percent of the injuries. Nine percent of the injuries were associated with equipment that had warnings and/or instructions that came with the equipment, or were posted on it. In 2 percent of the injuries there were signs or warnings concerning the use of equipment posted in the play area.

## **B. Public Equipment-Related Injuries**

Forty-one percent of the overall playground equipment-related injuries occurred with public playground equipment. In general, public playground equipment is usually of heavier construction than home equipment, but portable equipment can be found in some public locations, such as daycare facilities.

### **Specific Location and Type of Equipment**

Table 8 (on the following page) details the estimated injuries for each specific public location by the type of equipment associated with the injury. It is important to note that even if the injury was associated with a particular piece of equipment such as a slide or climber, it might have been part of a larger structure (multi-use structure, swing

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<sup>26</sup> The 4 foot thickness of sand associated with this case was supposedly verified according to the interviewer. However, generally speaking the range of thickness was .25 inches to 12-18 inches. The 4 foot thickness is very unusual and seems to be related to the fact that the surfacing at the base of the equipment also served as a sandbox.

set, etc.). Thirty-eight percent of the injuries that occurred with public playground equipment were associated with a multi-use or combination structure.<sup>27</sup>

**Table 8: Estimates of Playground Equipment-Related Injuries to Children Under 2 by Type of Equipment and the Specific Public Location**

Equipment <sup>28</sup>	Specific Public Location								
	Total	Public Park	Apart-ment Complex	School (Outside)	Fast Food	Daycare	Other Com-mercial <sup>29</sup>	Other	Unk
<b>Total</b>	<b>3,390</b>	<b>2,020</b>	<b>280</b>	<b>250</b>	<b>200</b>	<b>60</b>	<b>20</b>	<b>170</b>	<b>400</b>
Slides	2,300	1,320	260	150	130	40	10	150	240
Swings	490	300	20	0	0	20	0	20	130
Climbers	230	200	0	10	0	0	0	0	20
Merry-Go-Rounds	80	80	0	0	0	0	0	0	0
Tubes/Tunnels	70	0	0	0	70	0	0	0	0
Swing Set Structure	10	10	0	0	0	0	0	0	0
Ball Pits	10	0	0	0	10	0	0	0	0
Other	130	30	0	90	0	0	10	0	0
Unknown	70	70	0	0	0	0	0	0	10

Source: National Electronic Injury Surveillance System, Special Study, 10/1/00-9/30/01  
Estimates may not add to the totals due to rounding.

Sixty percent of the injuries related to public equipment occurred at public parks. More injuries (63 percent) were associated with slides in public parks than any other type of equipment in a public setting, followed by 9 percent of the injuries on swings or swing set structures in public parks and 8 percent of the injuries on slides at apartment complexes.

#### **Hazard Pattern by Type of Equipment**

Table 9 (on the following page) presents a breakdown of the types of public equipment associated with the injuries by hazard pattern.

<sup>27</sup> Multi-use structures do not include swing sets.

<sup>28</sup> If a particular type of public equipment (gliders or seesaws, for instance) had no injuries associated with it, then it was not included in Table 8.

<sup>29</sup> "Pay-for-play" establishments are included in the *Other Commercial* setting category.

**Table 9: Estimates of Playground Equipment-Related Injuries to Children Under 2  
Type of Public Equipment by Hazard Pattern**

Type Equipment	Hazard Pattern							
	Total	Fall	Twisted Leg/Foot with Slides	Hit or Struck	Entrap	Pinch	Other	Unk
<b>Total</b>	<b>3,390</b>	<b>1,500</b>	<b>910</b>	<b>510</b>	<b>20</b>	<b>20</b>	<b>90</b>	<b>350</b>
Slides (All Types)	2,300	830	910	190	20	0	70	270
Swings	490	230	0	250	0	0	10	0
Climbers	230	230	0	0	0	0	10	0
Merry-Go-Rounds	80	70	0	0	0	20	0	0
Tubes or Tunnels	70	0	0	0	0	0	0	70
Ball Pits	10	0	0	0	0	0	0	10
Swing Set Structures	10	10	0	0	0	0	0	0
Other	130	130	0	0	0	0	0	0
Unknown	70	10	0	70	0	0	0	0

Source: National Electronic Injury Surveillance System (NEISS), Special Study, 10/1/2000- 9/30/2001  
Estimates may not add to the totals due to rounding.

#### Falls Associated with Public Playground Equipment

Fall-related injuries accounted for 44 percent of all the injuries that occurred with public equipment. More of those fall-related injuries occurred on slides than any other type of equipment, followed by swings and climbers.

Twenty percent of the fall-related injuries were from a height of less than 36 inches, 24 percent occurred from heights of 36 inches or greater. In 56 percent of the fall-related injuries the distance the child fell was unknown. The greatest height a child fell from on a piece of equipment in a public setting was 7 feet from a freestanding slide.

The most frequently reported cause of the falls associated with the injuries involving public equipment was the victim slipping or tripping and falling on or from the equipment (48 percent of the injuries).

The most common types of surfacing the children fell on (accounting for 50 percent of the public equipment fall-related injuries) were mulch, wood chips, sand, gravel, manufactured mats and shredded tires, all protective surfacing. In only 3 percent of the injuries with public equipment did the children fall on non-protective surfacing (grass, concrete, asphalt and dirt).

#### Twisted Leg/Foot with Slides (Public Equipment)

Twenty-seven percent of the injuries that occurred involving public equipment were the result of a child getting his/her leg or foot twisted on a slide. For more

information on this hazard pattern refer to the *General Discussion* section of this document.

#### Impact-Related Injuries with Public Equipment

Fifteen percent of all the injuries incurred with public equipment involved impact. These impact-related injuries involved incidents where either the child collided with stationary or moving equipment, or the equipment struck the child. Eighty-seven percent of the impact-related injuries involved slides and swings.

#### Entrapment or Pinching-Related Injuries with Public Equipment

One percent of the injuries with public equipment involved body part entrapment or children getting body parts pinched in the equipment. The injury estimate was based on only 2 cases from the study sample<sup>30</sup>. An entrapment injury occurred with a slide and a pinch injury occurred with a merry-go-round (non-amusement ride).

### **C. Home Equipment-Related Injuries**

Thirty-three percent of the overall playground equipment-related injuries with the under 2 children occurred with home use equipment. Thirteen percent of the injuries occurring with home equipment involved multi-use or combination equipment. Portable equipment is found in the home setting both indoors and outdoors (see Appendix A for specific examples). Home playground equipment is generally of lighter weight construction (except for some of the multi-use structures).

#### Specific Location and the Type of Home Equipment

Sixty-five percent of all the injuries occurring with home use equipment occurred in the yard of a home and 3 percent of the injuries occurred in the yard of a home daycare provider. Most of the injuries (38 percent) with home equipment were associated with slides, followed by swings and swing set structures with 30 percent of the injuries.

#### Hazard Pattern by the Type of Home Equipment

Table 10 (on the following page) presents a breakdown of the types of equipment associated with the injuries in a home setting by hazard pattern.

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<sup>30</sup> One case involved a sprained foot received when the child got a foot entrapped in part of a slide structure after flipping over on the sliding board. The other case involved a child who nearly severed two fingers from getting them pinched in the center section of a merry-go-round.

**Table 10: Estimates of Playground Equipment-Related Injuries to Children Under 2  
Type of Home Equipment by Hazard Pattern**

Type Equipment <sup>31</sup>	Hazard Pattern							
	Total	Fall	Hit or Struck	Entrap	Twisted Leg/foot w/Slides	Pinch	Other	Unk
<b>Total</b>	<b>2,730</b>	<b>1,450</b>	<b>780</b>	<b>210</b>	<b>70</b>	<b>0</b>	<b>200</b>	<b>20</b>
Slides (Including Tube Slides)	<b>1,050</b>	820	70	70	70	0	10	20
Swings and Swing Set Structures	<b>820</b>	260	400	70	0	0	80	0
Sandboxes	<b>170</b>	0	70	0	0	0	100	0
Play Gyms	<b>160</b>	160	0	0	0	0	0	0
Gliders	<b>160</b>	0	160	0	0	0	0	0
See Saws or Teeter Totters	<b>90</b>	70	20	0	0	0	0	0
Tubes or Tunnels	<b>70</b>	0	0	70	0	0	0	0
Climbers	<b>50</b>	40	0	10	0	0	0	0
Other	<b>170</b>	100	70	0	0	0	0	0

Source: National Electronic Injury Surveillance System, Special Study, and 10/1/00-9/30/01  
Estimates may not add to the totals due to rounding.

#### Fall-Related Injuries Associated with Home Equipment

Fall-related injuries accounted for 53 percent of all the injuries that occurred with home equipment. More of the fall-related injuries occurred on home slides than any other type of home use equipment, followed by injuries on swings and swing set structures, and play gyms.

Thirty-two percent of the fall-related injuries occurring with home equipment were from a height of less than 36 inches and 45 percent occurred from heights of 36 inches or greater. In 23 percent of the injuries the distance the child fell was unknown. The greatest height a child fell from on a piece of equipment in a home setting was 10 feet from a platform of a multi-use structure.

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<sup>31</sup> If a particular type of equipment (merry-go-rounds, for instance) had no injuries associated with it, then it was not included in Table 10.

The most frequently reported cause of falls associated with the home equipment-related injuries was slipping or tripping on or from the equipment, accounting for 49 percent of the fall-related injuries.

The most common types of surfacing the children fell on with home equipment were grass, concrete or dirt (all non-protective surfaces), accounting for 43 percent of the injuries. The most common surfacing they fell on was grass with 25 percent of the injuries. Only 2 percent of the home equipment-related injuries occurred where protective surfacing was in place (wood chips, mulch, gravel and synthetic turf) and none of those injuries were serious head injuries.

#### Impact-Related Injuries Associated with Home Equipment

Twenty-nine percent of the home equipment-related injuries that these young children suffered involved impact. The child either collided with the equipment or was struck by it. Fifty-one percent of these impact injuries occurred with swings.

#### Entrapment-Related Injuries Associated with Home Equipment

Eight percent of the injuries that occurred with home equipment involved body part entrapment. The injuries occurred in equal numbers on slides, swings, and tubes or tunnels. The children in the study sample cases got a leg or foot entrapped (for the most part in gaps in the equipment's structure). There were no reports of head or neck entrapment.

#### Twisted Leg/Foot with Slides (Home Equipment)

This particular twisted leg/foot hazard pattern was not very common with slides that were home use equipment. For more information on this particular hazard pattern refer to the *General Discussion* section of this document.

### **D. Deaths**

From January 1, 1990 to August 15, 2002, CPSC has reports of 6 deaths related to playground equipment involving children under 2 years of age.<sup>32</sup> The last death reported to CPSC occurred in April 1995.

These deaths do not constitute a statistical sample of known probability of selection and may not include all playground equipment-related deaths with children under 2. However, they do provide a minimum figure for deaths associated with playground equipment that occurred during the specified time period.

The ages of the victims were 12 to 21 months and 4 out of the 6 deceased children were female. Four of the fatalities involved head injuries (severe closed head injury, hemorrhage, skull fracture and blunt head trauma). Three of the head injury deaths

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<sup>32</sup> A search was conducted of the In-depth Investigation file, the Injury and Potential Injury Incident file, the Death Certificate file and the National Electronic Injury Surveillance System.

resulted from falls from equipment (a swing, platform and a slide). In the case of the closed head injury from the swing related fall, the type of surface to which the child fell was not stated. The child who suffered a fatal skull fracture fell from a platform leading to a slide and hit his head on the post supporting the platform. The blunt head trauma fatality occurred when the child fell from a slide onto concrete. One head injury fatality occurred when a homemade swing set fell over and impacted the child's head, causing a hemorrhage.

There was one death that occurred when the child became entangled in a homemade rope swing and hung. One child died when a swing set fell on him (the type of injury was not specified).

Three of the fatal incidents occurred with homemade equipment (2 swing sets and 1 rope swing). One death occurred in a public park, 4 deaths occurred in a home setting and one occurred at an unknown location.

Specific details of the 6 deaths involving the children under age 2 are presented in Appendix C.

#### **IV. Conclusions and Recommendations**

Fall-related incidents accounted for more injuries related to playground equipment with children under age 2 than any other hazard scenario. Slides were associated with more fall-related injuries than any other type of playground equipment for these younger children.

This study found 8 cases in the sample count that resulted in injury from a fall of less than 12 inches. There were no serious head injuries among the 8 cases. The most serious injury incurred was a fractured tibia. Since the sample count was small for falls less than 12 inches, any national estimate projected with regard to these cases would also be small and have large variability associated with it.

The second most common injury hazard scenario was where a child either collided with a piece of equipment or was struck by it. Swings were associated with more impact-related injuries than any other type of playground equipment.

Overall, slides were associated with about half of all of the playground equipment-related injuries to children under age 2, regardless of the hazard pattern. In addition to the falls, the next most prevalent hazard with slides, in terms of injury, was where a child twisted his/her leg or foot going down a slide (1,090 or 13 percent of all the injuries). The use of slides by children under 2 is an area where further study could be beneficial.

Portable equipment poses some challenging problems in terms of ensuring proper surfacing and children under 2 are frequent users. Over half (22) of the 36 incidents identified in the study's sample count occurred indoors. Indoor surfacing for portable

equipment may be simply a carpeted floor in a home (20 incidents). All but 2 of the incidents were fall-related.

Ten percent (800) of the total playground-related injuries occurred in an indoor setting, including homes, daycare, “pay-for-play”, and restaurant locations. The surfacing was often flooring (carpeted or tile) and among the types of surfacing reported in the commercial locations were manufactured mats or a padded floor. Sixty-six percent (5,410) of the total injuries occurred outdoors with grass being the most common surfacing followed by wood chips. About three-quarters of the outdoor injuries occurred in either a public park or in the yard of a home. Whether the injury occurred indoors or outdoors, falls were a prevalent hazard pattern.

Since April of 1995, CPSC has not received a report of a playground-related death occurring with a child under 2. Six deaths have been reported to CPSC since 1990 with these younger children. Head injuries were associated with 4 of the 6 deaths and 3 of the deaths involved homemade equipment.

Safety efforts involving children under 2 and their use of playground equipment should take into account the nature of the incidents in which these children are involved. Overall, slides were responsible for about half of all the estimated playground equipment-related injuries to these children, regardless of the hazard pattern.

# **Appendix A**

## **Portable Playground Equipment Spreadsheet**

**Appendix A**

**Portable Playground Equipment\***  
October 1, 2000 to September 30, 2001

Document	Age/Sex	Falls/ Hgt	Hit Equip. or Struck by It	Entrapment	Pinched	Hardware	Other Hazards	Inside or Outside	Narrative
1 001016HEP1121	22 MO F	Yes, 1 ft						Inside	On a plastic alligator teeter-totter on a carpeted floor in home with sister and sister jumped off. Teeter totter came down hard and victim fell sideways, putting her hand down to catch herself. She bent her wrist, fracturing it.
2 001101HEP0401	19 MO F	Yes, 2 ft						Outside	Going up the steps of a slide in yard of home, turned to look at mother and slipped off to the grass. Fractured left elbow.
3 001101HEP8214	18 MO F	Yes, 2 ft						Inside	Child fell off a plastic play set's slide as she was preparing to slide down. Her foot got caught underneath her and she fell, landing on the carpeted floor in the basement of residence. Chin laceration.
4 001102HEP8213	16 MO M	Yes, 1 ft						Outside	Child was playing on a plastic combination slide/fort/platform in the babysitter's backyard. While climbing the step of the slide she slipped and fell to the grass, fracturing her lower left arm.
5 001114HEP8213	22 MO F	Yes, Unk						Inside	Fell off indoor plastic slide while at daycare, landing on head. Concussion.
6 001117HEP8213	18 MO M	Yes, Unk						Inside	At daycare fell off indoor play equipment (not specified) and broke his arm.

	Document	Age/Sex	Falls/ Hgt	Hit Equip. or Struck by It	Entrapment	Pinched	Hardware	Other Hazards	Inside or Outside	Narrative
7	001120HEP0881	21 MO F			Yes				Inside	Child was climbing through a tunnel on a slide/tunnel combo play set in her home. She somehow got her right leg caught in the equipment, causing a sprain.
8	001121HEP8141	19 MO F	Yes, 3 ft						Inside	Playing with her cousin on a play set slide in the grandparent's home. Child climbed to the top of the slide and fell off the side, landing on her arm on the carpet, fracturing her upper arm.
9	001201HEP7521	21 MO F	Yes, 4 ft						Inside	Climbed to the top of the slide on a carpet inside her home and didn't slide down, but tried to climb back down and slipped. Mild concussion.
10	001208HEP1201	13 MO M	Yes, 3 ft						Inside	Child was in his playroom on the platform of his slide and leaned over side too far. He fell to the carpet, landing on his head. One pupil was dilated and he favored one side when he crawled.
11	001212HEP8141	23 MO M	Yes, 4 ft						Outside	Climbing up the steps of a slide and fell backwards from the top step. Hit the back of his head on a slate patio in yard of home. Mild concussion.
12	010103HEP2161	19 MO F	Yes, 3 ft						Outside	Child climbed to the top of a plastic playground set, slipped and fell, hitting another part of the equipment before hitting the grass at home. Bruised shoulder.
13	010103HEP7681	15 MO F	Yes, 8 in						Inside	Playing on slide indoors at home. Mother believes child tried to go up the slide and fell from the first step backwards, hitting her head on the carpeted floor. Stopped breathing for a moment and hit the back of her head. Got wind knocked out of her and no head injury.

	Document	Age/Sex	Falls/ Hgt	Hit Equip. or Struck by It	Entrapment	Pinched	Hardware	Other Hazards	Inside or Outside	Narrative
14	010117HEP1201	18 MO F	Yes, 18 in						Inside	Child was playing on a plastic slide on a rug in the livingroom. She lost her balance while sitting on the slide platform and fell to the floor, bracing herself by putting her left arm out. Dislocated left elbow.
15	010117HEP5601	14 MO M	Yes, 12.5 in						Inside	Child was playing on play slide inside the home. He climbing the steps up to the platform and caught his heel on a piece of the structure, falling back over the side to the tile floor. Bump to head.
16	010120HEP6641	12 MO F	Yes, 3 ft						Inside	Fell off the platform of an indoor plastic play set in day care center, when she lost her balance. Fell on carpeted concrete floor. Nosebleed and swollen face.
17	010123HEP8854	22 MO F	Yes, 3 ft						Outside	Slipped of top of steps of plastic slide and fell to grass in her backyard, sustaining a contusion to her elbow.
18	010124HEP1201	21 MO F	Yes, 18 in						Inside	Climbing up steps of plastic slide in classroom at daycare and slipped, landing on her feet on a foam mat. Sprained knee.
19	010207HEP6001	18 MO F	Yes, Unk						Inside	Sprained ankle falling onto carpeted floor from a small plastic slide at her day care center.
20	010228HEP7601	17 MO M	Yes, 3 ft						Outside	Climbing in the middle of a plastic play gym and fell backwards out of one of the holes to the grass of friend's yard. Contusion to head and abrasion to nose.
21	010305HEP7681	21 MO M	Yes, 2 ft						Inside	Fractured arm when he toppled over from the top of a small plastic sliding board to the floor in his home.

	Document	Age/Sex	Falls/ Hgt	Hit Equip. or Struck by It	Entrapment	Pinched	Hardware	Other Hazards	Inside or Outside	Narrative
22	010409HEP1201	15 MO F	Yes, Unk						Inside	On a toddler slide at daycare, trying to get in position on the platform to slide down and fell over the side of the slide to the floor. Nursemaid's elbow.
23	010430HEP1121	16 MO F	Yes, 30 in						Inside	Child sustained a fracture of her elbow when she fell from a plastic climbing gym onto the carpeted floor of her livingroom.
24	010529HEP7812	17 MO F	Yes, Unk						Inside	Fell off plastic slide to tile floor. Closed head injury.
25	010601HEP8213	15 MO F	Yes, 2 ft						Outside	Climbing up surface of a plastic slide, lost her balance and fell to the grass at home daycare, dislocating elbow.
26	010711HEP2961	17 MO F	Yes, 3 ft						Inside	Climbing the ladder of a plastic toddler slide and lost balance at the top. Fell to carpeted floor in livingroom of home. Contused head and back.
27	010716HEP2961	21 MO F	Yes, 2 ft						Outside	On a toddler's plastic play set and slid down the slide head first, hitting head on concrete in backyard of home. Closed head injury.
28	010722HEP0321	18 MO M	Yes, 3 ft						Inside	On platform of a plastic slide in babysitter's home and slipped, falling to the carpet. Bit tongue.
29	010831HEP2241	22 MO F	Yes, 3 ft						Inside	In an office building on a plastic slide, walking down it and fell off to the tiled floor. Nose contusion.
30	010909HEP5601	19 MO F	Yes, 6 in						Outside	On a toddler slide at her home, going down too fast and hit her face on the sidewalk at the bottom. Bruised face.
31	010912HEP8213	15 MO M	Yes, 30 in						Outside	Fell from a play gym that was a playhouse with a slide to the grass in his backyard. Fractured his right radius.

	<b>Document</b>	<b>Age/Sex</b>	<b>Falls/ Hgt</b>	<b>Hit Equip. or Struck by It</b>	<b>Entrapment</b>	<b>Pinched</b>	<b>Hardware</b>	<b>Other Hazards</b>	<b>Inside or Outside</b>	<b>Narrative</b>
32	010918HEP7812	17 MO F		Struck by equipment					Unknown	Slide from plastic jungle gym tipped over onto child. Leg contusion.
33	010930HEP6985	19 MO M	Yes, Unk						Outside	On a toddler size slide in a toddler playground at daycare facility. Fell to wood chip covered ground, lacerating upper lip.
34	011002HEP8213	17 MO M	Yes, 3 ft						Outside	On a plastic portable slide at home and slipped off the top rung, falling to the grass. Contused wrist.
35	011119HEP6401	18 MO M	Yes, 3 ft						Inside	On indoor plastic slide at commercial daycare and fell off to tile floor, lacerating his forehead.
36	020417HEP8213	20 MO M	Yes, 2.5 ft						Outside	On the platform of a small plastic slide in his backyard and jumped to the grass, sustaining a spiral fracture to his ankle.

**Total= 36**

\* Photographs of the equipment were not available. Staff believes these cases are portable equipment based on description.

## **Appendix B**

### **Children's Leg Injuries on Slides Human Factors' Analysis**



UNITED STATES  
CONSUMER PRODUCT SAFETY COMMISSION  
WASHINGTON, DC 20207

**Memorandum**

Date: April 7, 2003

TO : Joyce McDonald  
Division of Hazard Analysis (EPHA)

THROUGH: Hugh McLaurin, Associate Executive Director  
Directorate for Engineering Sciences  
Robert B. Ochsman, Ph.D.  
Director, Division of Human Factors (ESHF)

FROM : Jonathan D. Midgett, Ph.D.  
Engineering Psychologist, ESHF

SUBJECT : Children's Leg Injuries on Slides

**Introduction**

The ASTM subcommittee for public playground equipment for children under 2 requested that the CPSC staff review common playground injury scenarios. Within this study's research and compilation of incidents, a particular scenario involving slides frequently emerged. This scenario involves either a child sliding alone or being taken for a ride down a slide seated on the lap of a caregiver. This event may lead to children breaking, spraining, bruising, or causing some other injury to a leg. Human Factors staff has been asked to provide a behavioral analysis of this general injury mechanism.

**Analysis**

**Motivation**

The motivation for giving a baby or a toddler a ride on a slide is foreseeable. Toddlers are commonly brought to playgrounds with older siblings and peers before they are mature enough to fully join in the challenges offered by most common types of playgrounds. Their attempts to play on equipment are generally monitored by caregivers who follow them closely and dissuade them from attempting difficult maneuvers and from getting in the way of older playground users. Some of this caregiver dissuasion will likely be frustrating to a toddler struggling to become masterful with motor skills and self-determination. They will want the attention and the challenges found on playground equipment. Not surprisingly, caregivers tend to facilitate as best they can those features of a playground that a toddler can safely enjoy. As caregivers look around for ways to make the playground fun for a toddler, it seems likely that the slide would seem a safe choice, as long as the child is held on the lap, or monitored on the way down with someone to catch them at the bottom. They may reason that the slide down will be fun for the

child, yet “safe,” because it requires no skill on the part of the child except to sit still. No doubt, many times this is the case and no injury is incurred. However, sometimes other relatively unexpected factors alter the outcome. These factors are discussed below.

### Injury Mechanisms

Many incident reports describe the child’s shoes grabbing or catching on the slide and at least one incident describes the child’s bare feet grabbing. This occurrence is unexpected because people think of a slide as being slippery. However, many rubber-soled shoes will easily hold the surface of a slide, and bare skin also grips effectively. To slide down, slide users usually lift their feet slightly, so their shoes don’t drag on the slide. Pressing down with their feet can actually stop a scared slider part of the way down, depending on how clean their shoes are and how fast they are going. Once they have the hang of it, however, slide users stiffen their legs, hold their feet up completely and slide to the bottom. To observers, and to people accustomed to slides, the activity is not obviously one of such careful posture selection. It is so easy, that people forget how much is actually going on during a slide. It requires balance, a slight backward lean of the upper torso, anticipation of the momentum, a stiffening of the legs to lift the heel from the slide, and advance preparation for landing. Without these skills, a slider can roll down a slide, or shoot off the bottom of the slide out of control. It takes some practice.

When children have not had the experience of using a slide before, they do not know what is about to happen. Older children who are experienced in the use of a slide will keep their legs stiffened and their feet up, off of the surface. Very young children will not know to do this and in addition, caregivers probably do not anticipate any danger from a relaxed child. Consequently, the baby’s feet drag loosely on the slide, sometimes with their legs straddling a caregiver’s lap. Then their rubber soles catch on the surface, pulling their leg backwards. The downward momentum, especially with an adult or larger playmate holding them, is enough to pull a baby’s relaxed leg into an injurious position. This combination of the unanticipated plunge, relaxed legs, rubber-soled shoes, grabbing feet and adult-sized momentum can lead to injuries. It can, and has happened, on any kind of slide, metal or plastic, straight, tubular, or spiral.

Additionally, the likelihood of feet grabbing the sides of a slide may be slightly increased for smaller feet because when small feet hit the rim of a slide, they can contact with the full width of the foot. A larger foot hitting a slide’s rim would be more likely to glance upwards and over the rim, like a boat over a wave, before grabbing securely like a small foot can. A child’s short legs are also given ample room by most slides to freely bend backwards, whereas longer-legged children simply do not have enough room on the slide to bend their legs backwards without falling off the slide.

### Injury Diagnosis

According to the reports, caregivers were not always aware that the child’s leg had even been stressed. Injuries varied from fractured bones, usually in the lower leg, to sprained ankles, knees, hips, and other bruises. Because the child may begin crying during the slide, caregivers may believe that she/he is just afraid or distressed by the ride, not by an injury, and may not be as likely to search for an injury. At least one child was in distress overnight before being taken to

the emergency room for x-rays. Many caregivers notice that the child is favoring one leg, or unable to stand, and then diagnose the injury.

## **Conclusion**

Toddlers may lack the coordination and experience to properly use playground equipment. Caregivers sometimes allow toddlers or young children to use a slide or set the child on their lap for a ride down the slide. Unaware that the child's feet can grab on the slide, they allow the child's legs to drag. The child's foot inadvertently grabs the slide rim or surface, pulling the leg hard enough to seriously injure it. Injuries range from minor bruising to serious fractures that take months to heal.

**REPORTED DEATHS RELATED TO PLAYGROUND EQUIPMENT**  
**(JANUARY 1, 1990 - AUGUST 15, 2002)**

DOCUMENT #	DATE	LOCATION	AGE	SEX	HOMEPUB	HAZARD PATTERN	NARRATIVE	DOCUMENT #2	
1 9108013330	910801	DENVER, CO	12 MO	F	HOME	FALL (SEVERE CLOSED HEAD INJURY)	SEATED ON SWING WHICH CAME UNHOOKED AND FELL. SUSTAINED SEVERE CLOSED HEAD INJURY		
2 930211HCC3122	920603	GRETNA, LA	19 MO	M	HOME	TIPOVER/COLLAP SE (HEMORRHAGE)	STRUCK IN THE HEAD BY A HOMEMADE SWING SET AS HE WAS BEING PUSHED IN A SWING AND SWING SET TOPPLED OVER	9222017202	
3 921001HCC2263	920920	REX, GA	20 MO	F	PUBLIC PARK	FALL (HEAD; SKULL FX)	FELL OFF THE PLATFORM LEADING TO THE SLIDE OF A JUNGLE GYM SET IN A PUBLIC PARK. HIT HEAD ON THE POST SUPPORTING THE PLATFORM	X9290094A. 9213038878	
4 9312060661	930530	JACKSONVILLE, FL	21 MO	F	HOME	FALL (BLUNT HEAD TRAUMA)	FELL ONTO CONCRETE FROM SLIDE--BLUNT HEAD TRAUMA	X9376281A	
5 X9397587A	930818	PIMA, AZ	12 MO	M	UNK	TIPOVER/COLLAP SE	DIED FOLLOWING A FALL FROM A HOMEMADE SWINGSET THAT THEN FELL ON HIM		
6 951018HCC3007	950423	STOWELL, TX	12 MO	F	HOME	HANGING	PLAYING ON A HOMEMADE ROPE SWING HANGING FROM A TREE BRANCH AND BECAME ENTANGLED AND DIED DUE TO HANGING	9548048883	
<b>Total=6</b>									