The Risk of Childhood Injury on Boston's Playground Equipment and Surfaces

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ABSTRACT

The Childhood Injury Prevention Program of the Boston Department of Health and Hospitals conducted a survey of injury risk in Boston's playgrounds. A standardized checklist was used to assess a 25% sample of public playgrounds for hazards. Climbers accounted for 34% of the hazards observed and had the greatest proportion of significant hazards. The surfacing material in 100% of the playgrounds observed was unsafe. Urban children risk exposure to hazardous playground equipment frequently situated above unsafe surfacing material. (*Am J Public Health.* 1993;83:731–733)

Introduction

Playgrounds provide a physical environment where children can develop motor, cognitive, and perceptual skills, as well as social interaction. Playgrounds also can play host to injury, hospitalization, and death.[1,2] The Consumer Product Safety Commission has rated playground equipment as the fifth most hazardous consumer product.[3] Lacerations, contusions, and abrasions account for most playground injuries. Swings are associated with 18% to 39% of injuries, while climbing apparatus is associated with 30% to 41% of reported playground injuries.[4–6]

Falling is the most common mechanism of injury in playgrounds, accounting for 70% to 76% of injuries (Massachusetts Department of Health, unpublished data, 1988).[7] The severity of head injury due to falls is associated with the surfacing material at the point of impact. The maximum acceptable impact force is 50*g;* an impact force of 200*g* will deal a fatal blow. A fall from heights ranging from 3–12 inches onto concrete and asphalt could result in death (Table 1).

We report findings of a 1988 survey of urban playgrounds in the city of Boston conducted by the Childhood Injury Prevention Program of the Boston Department of Health and Hospitals.

Methods

A random sample of public playgrounds was drawn from *Boston's Open Spaces Report,* an inventory of all open space in the city of Boston. One hundred eighty-one documented playgrounds were stratified by neighborhood, and a 25% sample was selected from each neighborhood by simple random sampling methods. When a neighborhood stratum contained less than four playgrounds, one playground was selected at random to represent that community. The nearest playground geographically was substituted when a playground could not be located or did not contain play equipment.

Forty-seven Boston public playgrounds in the final study sample were assessed during a 2-month period in the summer of 1988 by a single observer using a structured instrument, the Boston Playground Safety Checklist. (This instrument is available from the authors on request.) The survey instrument, adapted from the Massachusetts Department of Public Health's Statewide Comprehensive Injury Prevention Program Playground Safety Checklist, is a 177-item checklist covering all types of playground equipment, including swings, wooden "adventure" climbers, other climbers (jungle gyms, monkey bars), slides, seesaws (teeter-totters), rocking equipment, sandboxes, tunnels, and merry-go-rounds. The predominant surfacing and its depth (if applicable) beneath each piece of equipment were observed. Each piece of playground equipment was assessed for the presence of hazardous conditions. An observed piece of equipment could have more than one hazard. Each hazardous condition identified was given a hazard score ranked from one to seven, approximating the type of injury that was likely to result from the presence of that given condition, as follows: bruises = 1, minor lacerations = 2, severe lacerations/burns = 3, fracture/digital amputation = 4, severe fracture/spinal injury = 5, strangulation/head entrapment = 6, and head injuries = 7. Hazard scores 1 and 2 were classified as minor; hazard scores 3 through 5 were classified as moderate; and hazard scores 6 and 7 were classified as severe.

Results

Of 1592 hazards cited across all playgrounds assessed, climbers accounted for

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TABLE 1—Drop Height at Which a Fatal Injury Can Occur from a Fall, by Surface and Depth of Surface

Surface	Depth of Surface[a]	Drop Height	G-Force[b]
Concrete	5 in	1 in	210
Asphalt	4 in	2 in	210
Foam matting	1.25 in	4 ft	200
Rubber matting	1.75 in	5 ft	225
Gravel (medium)	9 in	12 ft	190
Sand (coarse)	9 in	6 ft	235
Sand (fine)	9 in	8 ft	215
Wood chips	9 in	11 ft	220
Wood mulch	9 in	12 ft	135

Source. Ramsey and Preston.[11]
[a]At ambient temperature, not compressed.
[b]The threshold for serious injury is a force of 50*g*, the threshold for fatal injury is 200*g*.

TABLE 2—Percentage Distribution of 1368 Hazards That Occurred on 47 Boston Playgrounds, by Severity and Principal Type of Playground Equipment

	Type of Equipment		
Severity of Hazard	Climbers (No. of Hazards = 543)	Slides (No. of Hazards = 479)	Swings (No. of Hazards = 346)
Minor	32.4	36.4	53.5
Moderate	45.5	46.3	45.9
Severe	22.1	17.3	0.6

TABLE 3—Percentage Distribution of Surfacing Material beneath Three Principal Types of Playground Equipment on 47 Boston Playgrounds

	Type of Equipment		
	Climbers (n = 107)	Slides (n = 80)	Swings (n = 576)
Asphalt[a]	21.5	15.0	26.3
Bareground[a]	4.7	2.5	19.3
Grass[a]	12.1	16.2	1.8
Sand	47.7	48.7	43.8
Matting	0.9	8.8	3.5
Wood chips	13.1	8.8	5.3

[a]Unsuitable surfacing material.

34% (543) of hazards, compared with 30% (479) due to slides and 22% (346) due to swings (climbers, slides, and swings combined accounted for 1368 (86%) of the 1592 hazards). Climbers also had the greatest proportion of moderate and severe hazards observed. Nearly 36% of all moderate and nearly half (49.4%) of all severe hazards were found in climbers. Twenty-two percent of all climber hazards were judged to be severe, compared with 17.3% of slide hazards and 0.6% of swing hazards (Table 2).

Surfacing materials in all of the observed playgrounds were unsafe, 63.8% (30) having predominantly appropriate but poorly maintained material (matting, sand or wood chips) and 36.2% (17) having predominantly unsuitable surfacing material (asphalt, grass, bare ground). Sand was the most common surfacing material observed beneath playground equipment (51.1%), followed by asphalt (21.3%), wood chips (10.6%), grass (8.5%), bare ground (6.4%), and matting (2.1%). Nearly half (47.7%) of all swings were located over unsuitable surfacing material (i.e., asphalt [26.3%], bare ground [19.3%], or grass [1.8%]. Similarly, 38.3% of all climbers and 33.7% of all slides observed were located above unsafe surfaces (Table 3). None of the sand surfaces observed under playground equipment were maintained at a depth greater than 10 inches, the depth required to exceed the fatality threshold for a fall from 10 feet. All wood chip surfaces observed were 4 inches or less in depth, well below the 10 to 12 inches required to avoid a fatal fall. All of the observed matting surfaces were thin and patchy.

Discussion

This study demonstrates that in one major US city, urban children who use public playgrounds risk exposure to hazardous playground equipment situated above inadequate or unsuitable surfacing material that does not have sufficient absorbance to prevent serious head trauma from their falls. In this survey it was noted that climbers, the equipment with the most moderate and severe hazards, were situated more frequently over asphalt surfacing.

Our findings are consistent with studies in other urban areas in the United States. In a survey of 57 elementary schools near Philadelphia, 99% of the climbing equipment and slides were judged as unsafe because all were positioned over asphalt or packed dirt.[8] The 1979 through 1982 Massachusetts Statewide Comprehensive Injury Prevention Program survey showed that between 52.5% and 66.7% of playground equipment was situated over packed dirt and 42.5% of climbers were located over grass. In Atlanta day care centers, injuries were closely associated with hazards identified in the playground equipment.[9]

This study did not take into account factors related to the actual use of playgrounds and playground equipment in assessing risk for injury. Proper supervision during play is a key factor in modifying the risk for falls and other injuries.[10] Crowding on equipment may also affect the risk for injury. Inner-city children may be forced to share playgrounds with others engaged in illicit or violent activities (e.g., drug use and sales, interpersonal violence), which may place them at risk for other injuries.

New urban playgrounds must be designed and built in conformance with adequate safety standards.[11] Older city playgrounds must undergo renovation, with an initial goal of achieving appropriate surfacing material. A playground area measuring 400 square feet would require approximately 133 tons of fill sand to achieve an acceptable depth of at least 10 inches. Fill sand can be purchased for about $4 per ton (including delivery); not including labor or other structural modifications, it could cost as little as $500 to resurface a

playground of this size (these estimates are based on competitive bids for playground resurfacing materials in Omaha, Neb, 1992).

Play is the work of children. While adult work site safety is regulated by the Occupational Safety and Health Administration, there is little regulation of the work sites of America's urban children and youth. State and local health departments should work closely with city and county departments of parks, recreation, and public works and with school systems to minimize the risk and lessen the severity of playground injuries through injury prevention outreach, periodic playground surveillance, and rigorous park maintenance. Just as local service organizations in many cities have adopted roads and highways for beautification and litter control, community-based organizations and local businesses can sponsor safe parks for children in America's cities. □

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Surface-Specific Fall Injury Rates on Utah School Playgrounds

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ABSTRACT

The purpose of this study was to estimate surface-specific rates of fall injuries on school playgrounds. Playground injuries related to falls from climbing equipment and the surfaces involved were identified from injury reports for 1988 to 1990 from 157 Utah elementary schools. Enrollment data and playground inspections were used to estimate student-years spent over each surface. The fall injury rates per 10 000 student-years were asphalt, 44; grass, 12; mats, 16; gravel, 15; and sand, 7. These data did not show that impact-absorbing surfaces reduce fall injuries on playgrounds better than grass. Improved field studies are needed to guide policy decisions for playground surfacing. (*Am J Public Health.* 1993;83:733–735)

Introduction

Playgrounds account for almost 200 000 injuries treated in emergency departments annually in the United States.[1] Falls from climbing equipment account for nearly one quarter of injuries on public playgrounds.[2] Climbing equipment is associated with a disproportionate number and severity of injuries relative to its prevalence on playgrounds.[1,3] Impact-absorbing surfaces have been recommended below climbing equipment to prevent fall injuries.[1–5] The merit of this recommendation is based on laboratory tests. The impact-attenuating qualities of synthetic mats and loose-fill materials (pea gravel, sand, wood chips, etc.) are extremely varied and depend on depth of the material, size of particles, drop height, and environmental conditions (e.g., moisture and temperature).[6–8] In actual use, loose-fill surfaces are rarely maintained at recommended depths[3,9,10] and require regular maintenance to loosen compacted material.[6–8] Also, children may be less cautious when playing over resilient surfaces (risk compensation), leading to an increase in frequency and height of falls over these surfaces. Because of the considerable potential differences between laboratory and field conditions and because of variations

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