

## Playground Hazards in Atlanta Child Care Centers

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**Abstract:** We identified 684 playground hazards in 66 child care centers despite regulations mandating that the grounds be hazard-free. Of 21 centers with  $\leq 5$  hazards, 42.9 percent reported a playground-related injury in the previous year; of 25 centers with 6–11 hazards, 52.0 percent reported a playground-related injury; and of 20 centers with  $\geq 12$  hazards, 60.0 percent reported a playground-related injury. Climbing equipment  $\geq 6$  feet tall generally had inadequate impact-absorbing undersurfacing and had over twice the rate of fall injuries as climbing equipment  $< 6$  feet. (*Am J Public Health* 1990; 80:986–988.)

### Introduction

Investigators of medically attended injuries among children attending child care centers found that 47 percent of injuries occurred on the playground.<sup>1</sup> During a 2,000-hour year (40 hours per week  $\times$  50 weeks), an estimated 1.64 percent of children in a center will incur a playground-related injury requiring medical evaluation; 0.98 percent will incur a playground equipment-associated injury, and 0.42 percent will incur a climber-related injury.<sup>1</sup> In an attempt to understand why so many injuries occur on playgrounds, we evaluated playground hazards at 66 child care centers.

### Methods

The methods of the injury study have been described in detail elsewhere.<sup>1</sup> Briefly, 80 of the 605 licensed centers in Atlanta were randomly selected, and 71 participated in a study of medically attended injuries from June 1987 through May 1988. Of those 71 centers, one had no playground; by the time this study began, one center had replaced its playground, and three centers had closed. Directors of the remaining 66 centers allowed us to evaluate their playgrounds.

Between July and October 1988, two of three evaluators (KWH, LSC, and JMB) visited each participating center. Safety hazards evaluated are listed in Table 1 and included those defined by the Statewide Comprehensive Injury Prevention Program of the Massachusetts Department of Public Health and others.<sup>2–5</sup> Any hazards from playground changes made after March 1, 1988 were excluded from analysis. After the inspection, the director was shown the safety problems identified and given information about playground safety.

Equipment height was measured from the ground to the maximum height that a child's feet can reach. The undersur-

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**TABLE 1—Playground Equipment-associated Hazards Identified, Atlanta Child Care Centers, 1988**

Type of Equipment-associated Hazard	Number of Times Identified	
	All Equipment	Climbers Only
Rock, concrete, root or stump in fall zone	171	35
Inadequate clearance*	56	30
Sharp protrusion	42	17
Contaminants in undersurface	38	9
Missing part	31	11
Blunt protrusion	29	14
Trip-and-fall hazard	27	4
Loose parts	21	7
Open "S hook	20	0
Tip-over hazard	18	8
Entrapment hazard	16	12
Hard swing seats	13	0
Broken parts	12	0
Other**	34	10
All equipment-associated hazards	528	157

\*Inadequate clearance was defined as an obstruction (fence, wall, etc.) within 4 feet of a climber or within 8 feet of the arc of a swing.

\*\*Other includes all equipment-associated hazards appearing  $< 12$  times in surveyed playgrounds.

face (grass, sand, wood chips, etc.) below each piece of equipment was recorded. The undersurface's minimum depth was measured below the point of maximum attainable height.

### Results

The 66 centers had 135 playgrounds. At 21 (15.6%) playgrounds we identified no hazards; at 114 playgrounds we identified a median of five hazards (range 1–16). Only one center had no playground hazards identified; the other centers had a median of eight playground hazards (range 1–28).

### Hazards Unrelated to Equipment

At 66 (48.9 percent) playgrounds we identified a total of 156 hazards unrelated to equipment (median = 2; range = 1–8). Twenty-eight (20.7 percent) playgrounds had gaps in the fencing wide enough for a child to go through. At 11 playgrounds, children could enter a hazardous area within the playground (e.g., a storage shed). Poison ivy was found on four playgrounds, briars on five, and broken glass on five. Other hazards noted included 33 trip-and-fall hazards, 27 protruding rocks, tree stumps, or concrete pieces; and 23 sharp protrusions.

### Equipment-associated Hazards

One hundred and eleven (82.2 percent) playgrounds had an equipment-associated hazard (median = 4; range = 1–13). Although climbers, swings, and slides accounted for 52.2 percent of the equipment (Table 2), they were associated with 65.3 percent of the hazards. Hazards were associated with 36.1 percent of the equipment; by type, swings were the most frequently associated with a hazard, followed by spring riders

**TABLE 2—Playground Equipment: Number of Each Type, Number of Hazards, and Percentage with Hazards, Atlanta Child Care Centers, 1988**

Type of Equipment*	Number	Total Number of Hazards Identified	Percentage of Equipment with a Given Number of Hazards**		
			0	1	≥2
Climbers	249	157	55.4	30.5	14.0
Swings***	165	119	47.9	36.3	15.7
Slides	138	69	66.7	22.5	10.8
Barrels	64	6	90.6	9.4	0.0
Seesaws	63	27	65.1	28.6	6.4
Merry-go-rounds	63	33	63.5	22.2	14.3
Spring riders	58	37	51.7	39.7	8.6
Balance beams	47	10	83.0	14.9	2.1
Sand boxes	44	16	75.0	13.6	11.4
Other	166	54	75.3	16.9	7.8
All equipment	1057	528	63.9	25.4	10.7

\*Only shown for those types of equipment appearing ≥40 times in surveyed playgrounds.

\*\*Not including inadequacy of undersurface.

\*\*\*Number of swing seats = 518.

and climbers. The most frequently encountered equipment-associated hazards were hard objects in fall zones (Table 1).

#### Undersurface below Climbers

The most common surface below climbing equipment was earth or grass (60.6 percent) (Table 3). Impact-absorbing loose-fill materials (e.g., sand or wood chips) were beneath 38.2 percent of climbers, but only 4.2 percent had depths of ≥4 inches. About 27 percent of the climbers were ≥6 feet high and only two (2.9 percent) of those had rubber matting or ≥4 inches of loose-fill material beneath.

#### Relationship of Hazards to Injuries

During the one-year injury study,<sup>1</sup> of 21 centers with ≤5 hazards, 42.9 percent had reported a playground-related

**TABLE 3—Surface and Surface Depth Beneath Climbing Equipment, by Height of Climber and Number and Rate of Medically Attended Fall Injuries, Atlanta Child Care Centers, 1988**

Surface	Depth (inches)	Number of Climbers by Height (feet)						Total
		≤3	4	5	6	7	≥8	
Earth/grass	NA	43	40	24	26	12	6	151
Mulch/wood chips/pine straw (inches)	≤1	7	12	8	9	2	0	38
	2-3	8	4	3	0	0	0	15
	4-6	1	1	1	1	0	0	4
Sand (inches)	≤1	4	3	2	0	0	0	9
	2	0	4	0	3	2	1	10
	3	2	0	1	1	0	0	4
Pea gravel (inches)*	≤1	4	2	4	2	1	1	14*
	2	0	0	1	0	0	0	1
Wood Planking	NA	0	1	0	0	0	0	1
Rubber matting	1	0	0	0	1	0	0	1
Total		69	67	44	43	17	8	248*
No. injuries**		1	3	3	3	3	0	13
Fall injuries/100 climbers		1.4	4.5	6.8	7.0	17.6	0.0	

NA = Not applicable.

\*Height unknown for one climber with a 1 inch pea gravel undersurface.

\*\*Injuries ascertained from reference 1. Heights of 2 climbers associated with a fall injury were unknown.

injury; of 25 centers with 6-11 hazards, 52.0 percent reported a playground-related injury; and of 20 centers with ≥12 hazards, 60.0 percent reported a playground-related injury. This same trend was noted for equipment-associated and climber-related hazards and reporting of equipment- and climber-related injuries.

We could not identify two involved climbers for 15 climber-related fall injuries reported in the injury study.<sup>1</sup> Of the 13 pieces of climbing equipment associated with a fall injury, 46.2 percent were ≥6 feet compared to 26.4 percent of climbers unassociated with a fall injury. Climbers ≥6 feet tall had 8.8 medically attended fall injuries per 100 pieces of equipment compared to 3.9 per 100 for climbers <6 feet tall (Table 3).

Six other injuries appeared associated with identified hazards. One head injury occurred from a fall from a broken swing seat. A dental injury resulted from a fall off a bridge with no handrail. One fracture occurred from a fall off a 6.3 foot high slide with an earth undersurface and exposed concrete anchoring. One fracture occurred from a fall off a balance beam 3.3 feet above ½ inch of pea gravel. One fracture and one bruise caused by tripping occurred on playgrounds with tripping hazards.

#### Discussion

At child care centers, most injuries that require medical attention occur on playgrounds.<sup>1,6,7</sup> Of the playgrounds we studied, 84 percent contained a hazard. As the number of hazards increased, so did the likelihood a playground-related injury was reported.

Climbers have been associated with a disproportionate number of playground injuries.<sup>1,6,8-10</sup> Although climbers constituted 23.6 percent of study center equipment, they were involved in 42.5 percent of the equipment-associated injuries.<sup>1</sup> Moreover, the rate of fall injuries increased with the height of the climbing equipment.

In our study, 27 percent of climbers were ≥6 feet high and 61 percent had earth or grass underneath. Earth and grass are not considered suitable undersurfaces for climbers ≥4 feet high.<sup>11-12</sup> If loose-fill material is the undersurface, depths of ≥6 inches are recommended<sup>2,11</sup>; yet, the centers we studied rarely had loose-fill materials at recommended depths. Those responsible for school playgrounds have been found legally negligent for failing to provide adequate under-surfacing beneath equipment.<sup>13</sup>

Despite Georgia State regulations for child care centers mandating that climbing equipment be securely stationed, 5 percent of climbers had tip-over hazards. These regulations require that the playground be fenced; yet, 21 percent of the playgrounds studied had fencing gaps large enough to permit a child to pass through. Although prohibited on center grounds, "hazardous conditions" are not defined in the regulations. Although Georgia codes mandate "resilient surfaces" beneath climbers, they do not specify the types and depths of surfaces that satisfy this definition.

We believe that regulations regarding child care center playgrounds should be more specific and better enforced. In addition, regulators, center directors, and parents should be educated about playground hazards and prevention of playground injuries.<sup>3,14,15</sup>

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## A Personal Monitoring Study to Assess Workplace Exposure to Environmental Tobacco Smoke

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**Abstract:** We enrolled 15 nonsmoking volunteers to evaluate the feasibility of measuring personal exposure to environmental tobacco smoke (ETS) at work and to characterize workplace exposures. During one workshift, we obtained questionnaires on exposure, saliva and urine for cotinine, and personal air samples for respirable particles and nicotine. The levels of cotinine, respirable particles, and nicotine varied widely with self-reports of exposure to ETS, but on average increased with increasing exposure. (*Am J Public Health* 1990; 80:988-990.)

### Introduction

While health effects of passive smoking on children and adults have been identified, the principal location of exposure investigated has been the home.<sup>1,2</sup> Workplace exposure has received less attention, and health effects of environmental tobacco smoke (ETS) in the workplace remain controversial.

We enrolled 15 nonsmoking adults to determine the feasibility of measuring personal exposure to ETS at work and to characterize workplace exposures of this small group of subjects. Indicators of exposure, measured during a workday, included questionnaires, personal samples for respirable particles (RSP) and nicotine, and urinary and salivary cotinine.

### Methods

Between October 1986 and May 1987, 15 nonsmoking volunteers (eight men, seven women), 18 years of age and

older, were recruited from the Albuquerque, New Mexico area. We obtained exposure questionnaires, saliva, urine, and personal air particle samples during one workshift. The saliva and urine specimens were obtained before and after the workshift. Cotinine was quantitated by a double antibody radioimmunoassay, as described by Langone, *et al.*<sup>3</sup> Details of the assay in our laboratory have been reported previously.<sup>4</sup>

During the workshift, each subject wore a personal monitoring pump running at 1.7 l/min with a 10 mm nylon cyclone clipped to the shirt collar.<sup>5</sup> RSP samples were collected on 37 mm Fluropore filters (Millipore Corp). Nicotine was collected on a glass fiber backup filter treated with sodium bisulfate to minimize volatilization; after extraction from the filter, analysis for nicotine was done on a gas chromatograph with a flame ionization detector.<sup>6</sup> The recovery of nicotine by this procedure has been shown to be 98 percent efficient.

From the questionnaires, we derived measures of exposure including the total number of cigarette smokers and total number of hours exposed during the workshift. To describe the relationships among the measures of ETS exposure, Spearman correlations were calculated. Data analysis was performed with standard programs.<sup>7</sup>

### Results

Occupations of the subjects were diverse (Table 1); mean age was 44.8 years; average duration of the workshift and of the personal monitoring was 6.5 hours (SD  $\pm$  2.0).

Exposure to cigarette smokers at work was reported by 13 of the 15 participants. Of the 13 reporting exposure, two reported exposure to crowds of smokers during their workshift and the remaining 11 encountered a mean of 8.8 smokers (SD  $\pm$  6.7). The mean reported hours of exposure was 3.4 (SD  $\pm$  2.1).

Respirable particle and nicotine concentrations varied widely with the reported number of smokers and hours of exposure. The mean concentrations for RSP and nicotine were 63.9  $\mu\text{g}/\text{m}^3$  (SD  $\pm$  41.5) and 20.4  $\mu\text{g}/\text{m}^3$  (SD  $\pm$  20.6), respectively. Correlations between the atmospheric markers

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