Strategies for Playground Injury Prevention: An Overview of a Playground Project

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ABSTRACT

Preventing injuries to children, especially debilitating and life threatening, requires an awareness of where these types of injuries occur during the school days. This review examines falls from playground equipment, events that have been identified as the leading causes of nonfatal unintentional injuries for children. Thus, the issue of playground safety is a topic of concern for health educators. School health educators play an essential role in developing safe and healthy outdoor play environments for children. This paper highlights the importance of injury prevention awareness and outlines different strategies that health educators can take for preventing playground injuries. In addition, this paper examines a project that was conducted in the state of Iowa in relation to what effects playground surfacing materials and staff training may have on injury prevention on school playgrounds. The results of the project concluded that with the addition of proper surfacing material and staff training, playground injuries could be reduced. Health educators need to investigate the types of playground injuries in current programs and develop a strategy to keep children healthy and active.

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INTRODUCTION

Childhood obesity is a key topic of discussion for health organizations and school health officials.[1-3] As the nation faces the plight of children who are overweight, fighting diabetes and struggling with cardiovascular disease, front line child health professionals and other health educators need to provide a variety of avenues for children to develop healthy minds and bodies. Research studies have shown that the use of playgrounds is a fundamental part of school days in which they enhance children's physical, emotional, social and intellectual skills.[4] A position paper from the National Association for the Sport and Physical Education states:

> Recess provides children with discretionary time and opportunities to engage in physical activity that helps to develop healthy bodies and enjoyment of movement. It also allows elementary children to practice life skills such as conflict resolution, cooperation, respect for rules, taking turns, sharing, using language to communicate and problem solving in situations that are real. Furthermore, it may facilitate improved attention and focus on learning in the academic program.[5(p1)]

Playgrounds are the ideal place for children to engage in motor, cognitive and social skill development during school hours. Unfortunately, playground injuries remain a major source of unintentional injuries for children under the age of 14

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in the United States.[6] In fact, 205,860 preschool and elementary children each year receive emergency medical treatment for playground-related injuries. About 76% involve injuries that happen on public equipment.[6] The Centers for Disease Control and Injury Prevention study revealed that children aged 5 to 9 years are injured more frequently (56%) than children younger than 4 years old (30%) and children aged 10 to 12 years (12%) on public playgrounds.[6] Child injuries interfere with students' ability to be in the classroom making the most of the learning opportunities. It is the goal of health educators to improve school health and provide for safe environments for child to be physically and socially active at school. Thus, health educators need to be aware of different strategies to use for playground injury prevention.

REVIEW OF THE LITERATURE

Falls are the leading cause of nonfatal unintentional injury for children.[7] The National Electronic Injury Surveillance System (NEISS) shows that falls from playground equipment (205,850 hospital cases) accounted for approximately 79% of the injuries on public playgrounds.[6]

Several research studies in the 1990s and 2000s have pointed to the increased probability of injury with increased playground heights. Findings indicated that the probability of injury increased when the height of the equipment increased.[8] In addition, the fall height issue was so important that the Connecticut Safe Kids and the Connecticut Children's Medical Center reported a press release that read "It's a matter of physics, the higher the fall and harder the surface, the worse the injury."[9(p1)]

Recent studies also point to the severity of injuries resulting from falls off equipment. In 2005, Fissel and colleagues examined major and minor fractures received on the playground. The study revealed that fractures from equipment falls were 391 times more likely to require reduction than were fractures from standing-height falls.[10] The research evidence is clear that the height of the equipment and the surface material below the equipment contribute to the severity of an injury.

Although there has been great movement to understand playground injuries by examining fall injuries and pinpointing that the height of the equipment, the posture of body at impact with the ground, and the type of surface onto which children fall are important risk factors, there are still important pieces to playground injury prevention that need to be examined. The Consumer Product Safety Commission (CPSC) published its first series of playground safety equipment and surfacing guidelines in 1981.[11-12] CPSC states that there are many factors associated with playground safety. The intent of the publication of the handbook was to promote greater safety awareness among those who purchase, install, and maintain public playground equipment. The initial standards were revised in 1991, 1994, 1997 and 2008.[11-16] The 2008 handbook recognizes that the majority of playground-related injuries are a result from falls. In addition, CPSC also implies that other playground hazards have resulted in child injuries and that the hazards need to be examined. Hazards highlighted by CPSC that have resulted in playground-related injuries and deaths include:

- Falls from equipment that has not included impact attenuating protective surfacing under and around equipment.
- Impact with equipment.
- Openings with the potential for head entrapment.
- Playground design not suited for the age of the user.
- Installation and maintenance procedures.
- General hazards presented by protrusions, sharp edges, and crush or shear points.[16(p3)]

After completing a review of the literature using the University of Northern Iowa's multiple database search engine (Panther Prowler) and cross referencing playground research articles, we have concluded that there have been no published research papers discussing findings from an injury prevention program that have targeted playground surface materials and playground safety training. This paper will describe a project that focused on playground injury prevention in the state of Iowa. Specifically, this paper will report on an injury prevention program involving the reduction of playground injuries caused by falls to unsafe surfaces under and around playground equipment through installing a playground surface material that meet both the CPSC guidelines and those of the American Society for Testing and Materials standards and educating professionals about playground injury prevention.[15,17-18]

PROJECT OVERVIEW

The injury prevention project was part of the Iowa Safe Surfacing Initiative. The Iowa Safe Surfacing Initiative was a three-year program funded by the Rebuild Iowa Infrastructure Fund. The goals of the program were to: (1) Reduce playground injuries, (2) Provide improved infrastructure by creating markets for scrap tires, and (3) Provide safety training by educating elementary school staff about injury prevention.

Participation

Every public school district (N= 368) was contacted in the state of Iowa to apply for the legislative funded program that involved playground injury prevention training and a rubber tile surfacing material to be installed under and around the playground equipment. School superintendents were informed of the program through the Iowa Department of Education, the Iowa Area Education Agencies, and by e-mail. Schools that applied were sorted and placed into the 10 Iowa Area Education Agency regions. Twenty sites applied the first year, 47 sites applied the second year, and 87 sites applied the third year. Eight sites per year were randomly selected from the Iowa Area Education Agency regions to participate.

Eligibility criteria for the school districts included: (1) having existing playground equipment that complied with the American Society for Testing Materials (ASTM) standards[18] and the Consumer Product Safety Commission (CPSC) guidelines;[15] (2) allowing a playground safety expert assess the playground equipment for compliance; (3)

providing pre program playground injury data and post program playground injury data; and (4) sending two school personnel staff to a 3½ day intensive playground safety training program.

Data Collection

After schools were randomly selected, a safety assessment of the playground equipment was conducted by an individual certified as a playground safety inspector to determine whether or not the equipment was compliant with the national safety standards. Playground injury data was also collected from the previous school year. Schools mailed a hard copy of each child's documented playground incident. In addition, each school district was asked to submit their injury report form. As a side note, there were no common forms or reporting procedures by any of the schools. The data were sorted and categorized by each school district to describe the type of injury. Injuries were sorted into six categories previously used by the authors when analyzing data from the National Electronic Surveillance System supplied by the Consumer Product Safety Commission.[19] The categories included: (1) collision with a person, (2) hit by an object, (3) fall, (4) collision with an obstacle, (5) self-inflicted injury, and (6) other. In addition, the data were further sorted and categorized as to whether the child was: (1) referred to a doctor, (2) sent home, or (3) returned to class. It is important to note that no specific student identification was made regarding who received the injury.

TRAINING IMPLEMENTATION AND SURFACE INSTALLATION

After the site inspection was completed and injury data were received, two representatives of the selected school attended an intensive three and half day playground safety workshop which consisted of injury prevention topics regarding playground environment.[19] The representatives included a variety of personnel such as school nurses or health educators, principals, playground supervisors, or physical education/health teachers. Participants were taught how to identify the most common playground hazards that lead to injury and how to correct them. In addition, participants examined ways to make informed decisions about supervising, planning, age appropriate design, maintaining surfacing materials and playground equipment, and preventing playground injuries.

Once training was completed, ASTM/CPSC tested synthetic rubber-tiles were professionally installed at the selected sites. Synthetic rubber tile materials were chosen for this project because they met the ASTM standards,[17] were appropriate for the age of the user and had the ability to maintain the fall absorption characteristics in the Iowa weather. In addition, unlike loose fill materials that migrate and need constant inspection in order to maintain the appropriate depth, the rubber tiles provided a consistent impact attenuation surface throughout the period of study. Post-playground injury data was collected the school year following the installation and training program.

Because falls are the leading cause of playground injuries, the surfacing material found during the initial assessment needs to be discussed. All 24 playground sites had some type of loose-fill material present under and around the playground equipment prior to the start of the study. Loose-fill materials that were present included wood products, pea gravel and sand.[15,19] One of the sites had installed a mixture of sand and pea gravel.

However, none of the loose-fill surfacing was compliant because the loose-fill material did not meet depth standards for shock absorbency. Loose-fill materials must be maintained at an appropriate depth and be dispersed in the proper use zone.[15,17] In this study, 50% of the surfacing material prior to the installation of the synthetic rubber tile was pea gravel. On average, the pea gravel was maintained at three inches. This is problematic because the maximum height of playground equipment for 12 inches of pea gravel is 6 feet.[15] Further, pea gravel has been reported to have the worst impact attenuation performance for loose-fill material under and around playground equipment installed over five feet.[20] In addition, the surface that had mix material was also not appropriate. Mixed-surface materials have not been tested to determine whether or not the impact attenuation would cushion a fall.[20]

SUMMARY OF PROJECT

A summary of the injury data during the duration of the program found that there was a 70% reduction of severe injuries that needed to receive medical treatment and a 30% reduction of all playground injuries as a result of the training and appropriate surfacing materials. Table 1 illustrates the pre program injury data and post program injury data that was collected for entire project. Prior to injury prevention training and installation of synthetic rubber tiles, 1,081 children received a playground-related injury. Of those, 70 injured children received medical treatment. Medical treated injuries resulted in a child visiting an emergency room, doctor's office, or a hospital. After training and installation of rubber tiles, 754 children received playground-related injuries. Of the post program injury data,

Table 1. Pre and Post Program Injury Summary

	Medical Treatment	Sent Home	Returned to Class	Total Injuries
Pre Program Injuries	70	7	1004	1081
Post Program Injuries	21	2	731	754
Reduction of Injuries	(-70%)	(-71%)	(-27%)	(-30%)

21 children received injuries that required medical treatment.

Injuries that required medical treatment were reduced for each program year after the synthetic tiles were installed and playground safety training was received. The findings concluded that medical-treated injuries were reduced by 45% the first year (2002-2003), decreased by 83% the second year (2003-2004), and lowered by 67% the third year (2004-2005). Table 2 highlights pre program injuries and post program injuries for each year.

The findings of this program suggest that with proper training and with an installed appropriate surfacing material that playground injuries can be substantially reduced. However, it is unrealistic to think that all playground injuries can be eliminated. The CPSC addresses many risk factors that lead to an injury. Thus, the *CPSC Handbook for Public Playground* handbook draws attention to the actuality that the prevention of playground injuries is a complex issue.[18] The document highlights that when risk factors, such as surfacing, equipment design, layout and arrangement of equipment, and unsafe behaviors of children and inappropriate behaviors of supervisors are not properly maintained or managed could potentially lead to injury.

Due to the complex issue of playground injury prevention, limitations of this project need to be addressed. Limitations of this project include: (1) the sample size of eight Iowa elementary schools per year due to funding sources (Note: a small *N* can cause a significant drop in injuries); (2) the data collection examined injuries one year prior to the project and injuries one year after the project; and (3) the project managers assumed injuries were reported accurately. However, these results do suggest that it is important for health educators to take a close examination of current injury prevention techniques in order to determine if programs are being proactive in keeping children healthy and active.

PLAYGROUND INTERVENTION STRATEGIES

A comprehensive review of the playground literature indicates that playground injuries can be prevented by taking appropriate injury prevention steps. What follows is a discussion of a four-step strategy that can be followed.

Because falls are the number one factor cited of nonfatal unintentional injuries suffered by children interacting with playground equipment,[21] the first strategy step is to examine the surfacing material under and around the playground equipment. Proper fall-surfacing under and around the playground equipment is a crucial element in providing a safe play environment.[16-17,22-23] In fact, several research studies have concluded that the height of the equipment and the inadequacy of fall surfacing contribute to fall injuries.[24-26]

In 2004, the National Program for Playground Safety conducted a survey of 1000 school playgrounds in all 50 states. Overall, schools received a grade of a C+.[27] The survey concluded that 89% of schools had some type of suitable material. However, only 30% of loose-fill material was not at the proper depth. The findings are alarming since the CPSC guidelines have been available since 1981.[11,12] The need to provide and properly maintain the surfac-

Table 2. Yearly Injury Summary for Pre Program Injuries and Post Program Injuries

		Medical Treatment	Sent Home	Returned to Class	Total Injuries
Year 1					
	Pre Program Injuries (2002)	11	1	393	405
	Post Program Injuries (2003)	6	1	322	329
	Reduction of Injuries	(-46%)	(-0%)	(-18%)	(-19%)
Year 2					
	Pre Program Injuries (2003)	29	1	593	623
	Post Program Injuries (2004)	5	1	405	411
	Reduction of Injuries	(-83%)	(-0%)	(-68%)	(-34%)
Year 3					
	Pre Program Injuries (2004)	30	5	17	52
	Post Program Injuries (2005)	10	0	4	14
	Reduction of Injuries	(-67%)	(-100%)	(-76%)	(-73%)

ing material under and around equipment is essential.

According to CPSC guidelines, acceptable playground surface materials include unitary or loose-fill material.[16] Unitary materials include rubber mats, rubber tiles, or a synthetic grass. Unitary materials are available from a number of different manufacturers and unitary materials are not appropriate unless they are tested to and comply with the American Society for Testing Materials (ASTM) F 1292.[16,19] School programs should request ASTM F1292 test data from the manufacturer identifying compliance.

The CPSC also states that loose-fill materials provide an option for surfacing playgrounds.[16] Some examples of loose-fill material include wood products (engineered wood fiber, wood chips), shredded/recycled rubber mulch, sand and pea gravel. CPSC recommends that loose-fill materials have been tested to and comply with ASTM F1292.[16] The appropriate depth of the surfacing material should be installed a minimum of six feet in all directions of the use zone of stationary equipment. Because of the momentum of the child when on a slide or on a swing, these pieces of equipment have different use zone requirements. Slides should have a minimum use zone of six feet. For slides greater than six feet in height, the use zone in front of the exit area should be at least as tall as the slide up to a maximum of eight feet. Use zones for belt swings should extend to the front and rear of a swing with a distance of twice the vertical distance from the pivot point and the surface.

Along with surfacing requirements, health educators should evaluate the height of the equipment. Numerous studies reported that the higher the equipment, the higher the injury rates. Researchers recommend that playground equipment pieces should have some type of height restriction.[18,20,26] In addition, the CPSC guidelines have addressed maximum height for a few pieces of playground equipment for preschool and school-age children.[16] For example, the maximum height recommendation is 60 inches for preschool children and 84 inches for school-age children for upper body equipment (i.e. horizontal ladders), 12 and 18 inches for balance beams, and 8 feet for full bucket swings.

The second strategy involves the training of the maintenance personnel with regard to the need to maintain both the surfacing material and the equipment in a safe condition. The lack of maintenance program in a play area can void manufacturer's warranty, put children in physical danger, and waste dollars on unusable equipment. A well-designed maintenance program is proactive, training about the standard of care for playgrounds. Routine maintenance on both the equipment and surface materials ensures that the play area is safe and in good condition. Health educators can promote the need of routine maintenance.

The third strategy is for health educators to educate decision-makers about the developmental characteristics of children in order to aid in the purchase of developmentally appropriate equipment. Schools should make sure that equipment and other elements in the outdoor environment fit the child's developmental abilities. The developmental characteristics of children are different. Before selecting playground equipment, the developmental characteristics of children need to be considered by the decision-makers. A kindergartner is physically, emotionally, socially and intellectually different than a fourth grader. Health educators can be instrumental in assisting the school officials on developing separate play areas based on developmental abilities. Instead of a one-size-fits all playground, school environments should develop grade level play areas separating play areas for Pre-K, K-2, 3-4, and 5-6.[28]

The fourth intervention strategy involves the training of all adults who supervise children about safe and unsafe children's play behaviors. Health educators have the most complete understanding of the types of playground injuries since they are the ones who report and document playground injuries and teach the children about appropriate play behaviors. Supervision training is crucial in order to save lives, prevent injuries, avoid litigation and comply with the standard of care.[18] Studies have shown that training of supervisors can significantly reduce injuries to children on playgrounds.[29] Health educators can play a role in making sure that supervisors are trained in playground inspection and how to prevent inappropriate behaviors and injuries.

In conclusion, the results of this project provide a strong argument for the importance of developing a four-step strategy for playground injury prevention. Clearly the findings and literature review reveal that playground injuries can be reduced by training individuals and using appropriate surfacing materials. Strategies to consider for a playground injury prevention program include encouraging appropriate supervision practices, providing age-appropriate equipment, maintaining appropriate and ASTM tested surfacing materials that are suitable, and keeping the playground equipment and surface material in good condition.

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