RISKY BUSINESS

4-H COMMUNITY ATV SAFETY PROGRAM

A RESEARCH REVIEW OF RISK-INHERENT RECREATIONAL ACTIVITIES, POTENTIAL PREVENTION STRATEGIES, AND POSSIBLE APPLICATIONS TO REDUCING INJURIES AND FATALITIES

BACKGROUND

4-H helps young people build their critical thinking and life skills. We want youth to make good decisions to avoid risks while recreating. Parents and other adults have a lot of power when they partner with young people to support their safe behaviors. They need to exercise that power, by directly supervising and educating youth.

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EXECUTIVE SUMMARY

In order to discover how child and adolescent deaths and injuries from accidents might be reduced, a team of researchers conducted an exhaustive review of literature and research about a broad range of risk-inherent recreational activities. The purpose of this review was to examine risk-inherent leisure activities to discern what, if any, successful strategies have been developed with focus on the parental adults and other adult caregivers who have supervisory control over their children. Based on this review, they were also asked to suggest any recommendations about the next steps in designing effective prevention approaches for reducing risks.

The review found very few successful prevention strategies that focused on parents or other adult caregivers that have worked to reduce childhood deaths and injuries. Those efforts that have been successful have required intensive enforcement and monitoring, and would likely be infeasible in the United States. Mandatory training for both children and their parents shows some promise for reducing the high level of injuries and deaths.

The review did identify common elements of successful community-based approaches. First, the use of multiple strategies grounded in a theory of social-behavior change is critical. Second, to maximize success, interventions should be integrated into the community and approaches should be tailored to meet unique community needs. Third, community stakeholders should be included in the development of community-based strategies. This community involvement and ownership of the intervention increases the likelihood of affecting modeling and positive peer pressure that are paramount for increasing the widespread adoption of a safety behavior.

Complex problems demand comprehensive solutions. The issue of youth recreational injury and fatality prevention is one that is complex and embedded in social customs. Practical solutions will not emerge from a short-sighted "one size fits all" approach, which over-simplifies the issue and results in polarizing key stakeholder groups at a time when identifying commonalities and sharing resources is needed. The solution to reducing recreational deaths and injuries is social in nature and therefore must engage both parents and youth in designing realistic strategies for improving recreational safety. Research clearly shows that the most effective prevention strategies involve multifaceted, community-based approaches that include educational efforts aimed at children and parents, as well as enforcement and media campaigns.

The issue of youth recreational injury and fatality prevention is one that is complex and embedded in social customs.

PRELUDE: THE PEOPLE BEHIND THE STATISTICS

The morning of March 1, 2003, started out like any Saturday for David (age 40) of Auburn, Alabama, but would end in a month-long hospital stay and a near death experience due to an all-terrain vehicle (ATV) accident (D. H., personal communication, July 9, 2003). David was completing chores around his house, and the primary task on his "to-do" list was to ride around his property on his ATV with his trailer in tow and gather stones to be used for building a new fire pit. To assist him were his 9-year-

old nephew and his 13-year-old son, who rode in the trailer while he drove his vehicle. None wore helmets, because they viewed their effort not as a joy ride, but one described as a very placid work task.

At one particular place on his property, he approached a hill that required climbing so he had the children get out of the trailer, because as he reported to the authors, "I would never put my kids in harm's way." He began his short ascent like he had done hundreds of times before, but found out the track was too narrow to turn on and he needed to back the ATV and trailer down the hill on this particular ride. Again, he reported that he was very experienced with trailers and confident in his ability to maneuver his machine. Yet the wheels skidded on the rocks and he lost control of the vehicle as the brakes locked up, and the trailer jackknifed. This resulted in the ATV catapulting back on top of him and rendering him unconscious. The kids ran home and were able to summon help and got David to the hospital. His injuries were extensive and included a bruised kidney and lacerated intestines that required multiple surgeries, a month-long hospital stay and a near-death experience. David admits he is lucky to be alive.

During a phone conversation, the authors asked him what could have prevented this accident. After a period of silence, he admitted he did not know. He stated that he is very experienced with trailers, and that knowledge about risks was not the issue. In fact, David is a professional prevention specialist at Auburn University and says he lives what he preaches regarding healthy decision-making. "The problem," he reflected, "was not about a decision to take a risk or not - because I didn't see what I was doing as a risk. I had done this same maneuver time and time again and I never perceived it as a risk. I especially would not put my kids at risk."

Behind each of the statistics referencing an injury or fatality is a personal story like David's. David's story establishes a context for the complexity of issues involved in designing effective recreational safety programs; not only for adults, but also for the children who learn from them. Risk reduction must go beyond knowledge alone and must impact parents as well as youth. Clearly, perceptions of young recreationists and their parents need to be understood and altered in order for programs to be effective because choices, judgments, attitudes, and behaviors concerning recreation are all a result of people's perceptions.

Risk reduction must go beyond knowledge alone and must impact parents as well as youth.

PURPOSE OF THE STUDY

The purpose of this study was to conduct an extensive examination of a broad range of risk-inherent recreational activities to discern what, if any, successful strategies have been developed focusing on the parental adults who have supervisory control over their children. By examining leisure activities where child and adolescent deaths or injuries may occur, and understanding what motivates parents to insist on, follow, and reinforce safe practices during such activities, National 4-H Council hoped to identify specific recommendations for further study and pilot testing. The aim is to improve recreational safety practices, thereby reducing future injuries and deaths among youth.

GUIDING RESEARCH QUESTION

Through the research process, work focused primarily on searching for answers to the following question: What, if any, successful prevention strategies have been developed in risk-inherent activities to influence adults to insist upon, follow, and reinforce safety practices that would reduce injuries and death to their own children and adolescents?

METHODS

In the preparation of this review, the authors investigated the research base for a variety of risk-inherent leisure activities in which youth may be involved, including:

- Use of pedestrian cross walks
- Bicycles
- Skateboards, in-line skates and scooters

- Personal watercraft
- All-terrain vehicles
- Skiing and snowboarding
- Sleds and toboggans
- Snowmobiles
- Equestrian riding and rodeos
- Trampolines
- Seat belt use
- Motor vehicle safety through driver's education training
- Motorcycle helmet use
- Firearms
- Hunter safety training
- Tractors

The following databases were searched for the period January 1980 through June 2003:

- National Library of Medicine (MEDLINE)
- National Technical Information Service (NTIS)
- Transportation Research Information Service (TRIS)
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- PsychINFO
- Educational Research and Information Clearinghouse (ERIC)
- EMBASE
- Searches of the web sites of government agencies and organizations in Asia, Australia, Europe, and North America

In addition, conference proceedings and technical reports from the Association for the Advancement of Automotive Medicine, the Human Factors and Ergonomics Society, and the Society of Automotive Engineers were reviewed.

Using the reports identified through these electronic search sources, additional reports were identified from each article's reference list. The Thompson ISI-Science Citation Index was used to identify more recent reports that cited the articles found through the before-mentioned sources. Personal interviews with key informants were also conducted for the purpose of this report.

This study was prompted by a desire to find any successful interventions that might reduce child and adolescent recreational deaths and injuries. It summarizes research results from a variety of risk-inherent recreational activities. It also reviews some of the challenges and realities involved in designing successful prevention efforts, as well as reviewing the fundamental elements of positive youth development along with some of the most salient prevention models. Finally, it makes specific recommendations for furthering prevention efforts.

Complex problems demand comprehensive solutions. The solution to reducing recreational deaths and injuries is social in nature and therefore must engage both parents and youth in designing realistic strategies. Research clearly shows that the most effective prevention strategies involve multi-faceted, community-based approaches that include educational efforts aimed both at children and parents; enforcement; and media campaigns.

SECTION 1
A REVIEW OF RISK-INHERENT ACTIVITIES

A REVIEW OF RISK-INHERENT ACTIVITIES

Many leisure and recreational activities are viewed as healthy, rewarding and fun - particularly for children - and therefore not considered risky or even dangerous by most people. In fact, experts estimate that more than 6,000 deaths each year in the United States are associated with recreational activities (Harborview Injury Prevention and Research Center, 2001). Unfortunately, though, data on injury and morbidity is not collected in an organized fashion. Despite the flaws in data collection, the realities of the risks to children who participate in the wide range of leisure activities are real.

As indicated above, the review of research focused on a number of related leisure activities that could be considered "risk-inherent." The purpose was to discover any successful prevention strategies that have proven to be effective, especially those that have focused on parents and other caregivers who have supervisory authority over their children when they engage in such activities. By reviewing these risk-inherent activities, National 4-H Council hoped to learn valuable lessons in successful prevention strategies. In this section, the authors summarize the review of the literature for a broad range of risk-inherent recreation activities and any useful findings.

CHILDREN'S USE OF PEDESTRIAN CROSSWALKS

One of the first arenas authors investigated was the field of children using pedestrian crosswalks - particularly for getting to and from school. What was found is that many parents tend to overestimate or misperceive the developmental abilities of their children to perform tasks safely (Sandels, 1975). One study found that about one third of parents believe that their kindergarten-aged children have the necessary skills to cross residential streets alone and that first grade children can safely cross more heavily-traveled streets and walk to school alone - even if they must cross streets with high-speed traffic. One-half of parents took pride in having taught their young children how to safely cross busy streets at crosswalks without traffic signals or stop signs (Rivara, Bergman & Drake, 1989).

Children from 6 to 9 years old can sometimes cross the street safely but cannot be depended upon to do so. They are likely to forget to look in every direction and are particularly at risk for being struck by turning vehicles. Children of this age have not yet developed the ability to reliably localize sounds and they have impaired perception of movement in their peripheral visual fields (Avery & Avery, 1982; David, Foot, Chapman & Sheehy, 1986).

Classroom instruction has not been particularly successful in improving pedestrian safety behavior among children, although skills training has been slightly effective (Schieber & Vegega, 2002). For example, crashes between child pedestrians and vehicles declined after classroom education programs, but the degree of change was not large. By comparison, correct behavior for certain road-crossing skills had increased from 40-70 percent among children exposed to skills training interventions in Britain and 30-50 percent for lower elementary school children exposed to such training in the United States (Schieber & Vegega, 2002).

Yet, this may be a case of deciding whether the cup is half-full or half-empty. A recent systematic review of community-based education studies aimed at reducing child pedestrian injuries concluded that such programs have modest and limited benefit, and that "even after training, young children remain at substantial risk for pedestrian injuries" (Klassen, MacKay, Maher, et al., 2000). Some experts believe that reductions in such injuries will only come about from environmental (roadway) changes and the passage of pro-pedestrian laws and ordinances, such as enforcement of speed laws. The authors could find no studies or citations of prevention strategies aimed at parents to reduce childhood injuries at crosswalks.

BICYCLE SAFETY AND HELMET USE

Bicycle accidents are among the most common causes of serious brain injuries in children, and most of these injuries are preventable by wearing helmets (Weiss, 1994; Sacks, Holmgreen, Smith & Sosin, 1991). Although the protective effect of wearing helmets is well-documented (Harborview Injury Prevention and Research Center, 1997; Kopjar, 2000; Thompson, Rivara & Thompson, 2000), many child and adolescent bicyclists do not wear them. The prevalence of bicycle helmet wearing among children and adolescents remains far below the Centers for Disease Control and Prevention Healthy People 2000 national goal of 50 percent (Healthy People, 2000). A survey of parents found that helmet wearing prevalence ranged from 9.3 percent in Mississippi to 62.8 percent in Oregon with a national median value of 23.1 percent (Bland, 1999). Self-report survey data are likely to be inflated. Parents are known to overestimate helmet use in their children (Ehrlich, Longhi, Vaughan & Rockwell, 2001).

Bicycle helmet use laws influence parents to establish rules requiring that their children use the helmet every time the child rides (Caplow & Runyan, 1995). The first bicycle helmet use law was enacted in Victoria, Australia in 1990 (Centers for Disease Control and Prevention, 1993). Several years prior to the passage of this law, bicycle safety advocates had conducted a comprehensive, multifaceted school- and community-based education program aimed at increasing helmet use. The program was not successful and the prevalence of helmet use was only about 30 percent. One year after the law was enacted, the prevalence of helmet use increased to 75 percent, and the number of riders hospitalized or killed with a bicycle-related head injury decreased by 51 percent.

The first mandatory helmet use ordinance in the United States was passed in Howard County, Maryland (Scheidt, Wilson & Stern, 1992). The prevalence of helmet use among children increased from 4 percent before the ordinance to 47 percent after the ordinance was enacted and did not increase significantly in two adjacent counties without a law (Cote, Sacks, et al., 1992). Helmet use has been shown to reduce head injuries among cyclists (Thompson, Rivara & Thompson, 2000; Sacks, Holmgreen, Smith & Sosin, 1991).

Other states have had similar experiences when they enacted helmet laws. When Oregon passed a statewide bicycle helmet law the observed prevalence of helmet use among children attending school increased from 20.4 to 56.1 percent (Ni, Sacks, Curtis, et al., 1997). When the state of Georgia strengthened its existing mandatory helmet law by authorizing police officers to temporarily impound the bicycle of any child not wearing a helmet, the prevalence of helmet use among children increased from essentially zero percent before the augmentation to more than 70 percent. As of the early summer of 2003, 19 states, the District of Columbia, and numerous local jurisdictions had existing laws requiring that children wear bicycle helmets. At least five states now require children to wear a helmet while participating in other wheeled sports (e.g., for scooters, inline skates, skateboards) (National Safe Kids Campaign, 2003a). Wearing a helmet is the single most effective step to preventing injury and death while bicycling.

Helmet use has been shown to reduce head injuries among cyclists.

The prevalence of helmet use among adults who were not covered by the Georgia law mentioned above remained at 0 percent (Gilchrist, Schieber, Leadbetter & Davidson, 2000) - clearly the modeling of an undesirable norm (non-helmet use by adults) promotes a hypocritical modeling of "do what I say - not as I do." Such dichotomous behavior by adults is highly problematic for a variety of reasons but the most obvious is that it sends an unhealthy "rite of passage" message that essentially communicates to young people, "being adult means growing old enough to take unhealthy risks." Clearly such mixed messages could undermine even the most well designed intervention.

Several factors are positively associated with bicycle helmet use in children:

- Legislation mandating helmet use (Leblanc, Beattie & Culligan, 2002; Rodgers, 2002; Bland, 1999; Ni, Sacks, Curtis, Cieslak & Hedberg, 1997; Cote et al., 1992)

- Strict enforcement of legislation (Gilchrist, Schieber, Leadbetter & Davidson, 2000)
- An urban environment (Harlos et al., 1999)
- Higher family income (Harlos et al., 1999)
- Younger age (Finnoff, Laskowski, Altman, & Diehl, 2001)
- Strict parental rules about helmets (Miller, Binns & Christoffel, 1996)
- Having friends and siblings who wear helmets (Finnoff et al., 2001)
- Support from school teachers (McLellan, Rissel, Donnelly & Bauman, 1999)
- Injury prevention counseling at pediatric clinics (Quinlan, Sacks & Kresnow, 1998)

Barriers to children using helmets are:

- Lack of peer support (Liller, Morissette, Noland & McDermott, 1998)
- Perception that helmets create a silly or dumb appearance (Berg & Westerling, 2001)
- Discomfort (Loubeau, 2000)
- Poor role modeling by parents and other adults (Berg et al., 2001; Twomey, Bevis & McGibbon, 2001)
- Negative feedback from parents (Hendrickson, Becker & Compton, 1997)
- Helmet cost (Harlos et al., 1999)

As children grow older, they appear to gravitate toward adult and older adolescent norms associated with greater risk. Gradually, they tend to stop wearing bicycle helmets. The prevalence of bicycle helmet use among adolescents is usually much less than the prevalence of helmet use among younger children in the same areas even after promotion campaigns (Cameron, Vulcan, Finch & Newstead, 1994; Povey, Frith & Graham, 1999; Sissons, Beckett & MacFarlane, 1994; Wood & Milne, 1988; Kirsch & Pullen, 2003). One study of 12- to 15-year-olds found that 80 percent said that they regularly used helmets when they were younger but at the time of the study only 3 percent of the 14- to 15-year-olds said that they ever used helmets. They said that they quit using bike helmets because they were ugly, silly, uncomfortable, or inconvenient. Even among those who didn't use helmets, 75 percent said that they believed helmets to be an important safety measure. There was a strong association between parental involvement, children's attitudes, and helmet use.

When combined with the development and enforcement of laws or rules, the marketing of safety is likely to be even more successful. One study examined the prevalence of helmet wearing among three groups of elementary and junior high students: 1) in an area with a bicycle helmet ordinance but at a school without safety education, 2) in schools that had bicycle safety training and were in an area that had a helmet ordinance, and 3) at schools without safety training and in communities without a helmet ordinance. The prevalence of helmet wearing was much higher in the school with safety training that was in a community with a helmet ordinance than in the community with an ordinance but no safety training. The prevalence among students in the schools without training and without legislation was much lower than the other groups (Macknin & Medendorp, 1994).

Bicycle safety fairs and 'rodeos' are common efforts to teach safe riding practices and to promote the use of helmets (Hart & Daughtridge, 1998). These activities have mixed results for improving safe riding skills but generally have been shown to improve the prevalence of helmet use (at least in the short term) among young children (Liller, Smorynski, McDermott, Crane & Weibley, 1995; Rivara et al., 1994; Rourke, 1994).

Counseling by a physician has been recommended as a viable prevention strategy aimed at parents. While Schneider et al. (1993) found that physician counseling can influence parents' perception of the threat imposed by helmet-less cycling and influence their attitudes, messages to parents from physicians or other authority figures alone have not been found to improve the prevalence of helmet use among children and are only effective when used in combination with other strategies (Otis et al., 1992; Puczynski & Marshall, 1992; Moore & Adair, 1990).

Individual counseling with a child can also occur in pediatrician's offices. Research that evaluates the effectiveness of this approach has failed to demonstrate that counseling alone increases bicycle helmet ownership or use. However, counseling has been shown to increase helmet use when it is a part of a broad-

er community-wide intervention that involves multiple prevention methods (DiGuiseppi & Roberts, 2000).

Community-based programs concentrating upon influencing behavior through increased knowledge and skills have had mixed results (Klassen et al., 2000). In theory, because most bicycle crashes among those 12 years old and younger are the result of rider error rather than the fault of automobile drivers (Spence, Dykes, Bohn & Wesson, 1993), improving skills should improve safety. In fact, research indicates that almost 70 percent of the children of 6 to 9 years of age who are injured in bicycle traffic crashes were at fault and rode into the path or into the motor vehicle (National Highway Traffic Safety Administration, 2003a). Most children of this age group lack the strength and coordination to safely operate a bicycle's rear wheel coaster brakes (Avery & Avery, 1982) or to reliably select the proper hand grip to stop the rear wheel - as opposed to the front wheel. Most 8-year-old children are not competent on a bicycle in traffic. Many children don't become fully competent riders until 13 years of age (Arnberg, Ohlsson, Westerberg & Ostrom, 1978).

Quine et al. (2001) applied the Elaboration Likelihood Model of Persuasion (Petty & Cacioppo, 1986) to provide insight into how to bring about an enduring change in beliefs that are resistant to counter-persuasion in the promotion of helmet use among 11- to 15-year-old cyclists. They implemented a school-based intervention based upon paper and pencil tasks, question and answer flowcharts, and responses to questions about short narratives. The beliefs shown to be important in the formation of intention to use a helmet and to actually use the helmet were determined to be:

Behavioral:

- Wearing a helmet while cycling to and from school would make me ride more carefully.
- Wearing a helmet while cycling to and from school would protect my head in an accident.

Normative:

- My parents think that I should wear a helmet while cycling to and from school.
- Most of the other cyclists think that I should wear a helmet while cycling to and from school.

The project was successful at changing behavior - the prevalence of helmet wearing in the intervention group at the concluding evaluation (five months after the intervention) was 25 percent (at the start of the intervention it was zero) while none of the control group wore helmets at the concluding evaluation. A significantly higher proportion of the intervention group stated acceptance of the two normative beliefs. However, the intervention group didn't differ significantly from the controls in the belief that helmets would protect their heads if in a crash.

These are promising results in a population that is notoriously resistant to adopt behaviors like helmet wearing. The evaluation, however, was not as useful as it could be. Although the intervention protocols were well described, the authors didn't demonstrate that the protocols were precisely followed. Although a process evaluation of a program is considered by many to be trivial, without knowing that intervention protocols were followed exactly, it is impossible to draw any firm conclusions about effectiveness. This issue becomes particularly important when, as in this case, the evaluation reports results that are far better and more lasting than other similar interventions.

In another study (Berg & Westerling, 2001), parental rules were considered important by 80 percent of the younger children and 63 percent of the older children. All children reported a low (2 percent) prevalence of bike helmet use by their parents. By age 15 only about 10 percent of the students reported that their parents had or enforced a rule about cycling with a helmet. Children with parents who have rules requiring helmets have a much higher prevalence of helmet use than children in families without rules (Caplow & Runyan, 1995; Finch, 1996; Hu, Wesson, Parkin, Chipman & Spence, 1993; Miller, Binns & Christoffel, 1996; Otis, Lesage, Godin, Brown, Farley & Lambert, 1992). However, although the prevalence of helmet wearing was higher among children subject to parental rules, only about 20 percent of the 15-year-olds who said that their parents required them to wear helmets actually wore them (Berg & Westerling, 2001).

Lohse (2003) described how a school-based program for first and second graders impacted parental knowledge about bicycle safety and attitudes about wearing helmets. Parents with children who participated in the program were found to be more knowledgeable about bicycle safety than parents of children at similar schools that did not offer the safety program. Parents whose children participated were more likely to report being in favor of bicycle helmet legislation. There was no attempt, however, to assess the impact of this attitude change on the helmet wearing behavior of the children.

Finnoff et al. (2001), in a study of barriers to child and adolescent helmet use, discussed the importance of involving parents when promoting helmet use among children but didn't provide specific direction. Similarly, a recent review of the behavioral literature on influencing helmet wearing described the vital role parents play, but reported no evaluations of successful efforts to influence parents to better support helmet use (Thompson, Sleet & Sacks, 2002). Many community education programs have not been effective at reaching parents (Stanken, 2000; Mulligan-Smith et al., 1998).

Like the research related to tractor safety (see following), children (Dannenberg, Cote, Kresnow, Sacks, Lipstiz & Schmidt, 1993; Finnoff, et. al., 2001; Forjuoh, Fiesinger, Schuchmann & Mason, 2002; Gielen, Joffe, Dannenberg, Wilson, Beilenson & DeBoer, 1994; Jacques, 1994; Stevenson & Lennie, 1992), adolescents (Finnoff, et. al., 2001; Lajunen & Rasanen, 2001) and adults (Dannenberg, et. al., 1993; Everett, Price, Bergin & Groves, 1996; Jacques, 1994) are more likely to use a bicycle helmet if their peers use them or if the peers have a positive attitude towards helmet use. This is a consistent theme throughout this study regarding the importance of impacting perceptions of norms.

Many young adolescents refuse to use helmets because they believe that helmets make them appear "dumb" (Loubeau, 2000). Having been in a bicycle crash or knowing someone who was in a bicycle crash doesn't appear to have much if any influence on a child or adolescent wearing a helmet (Dannenberg, Gielen, Beilenson, Wilson & Joffe, 1993; Sissons, Beckett & MacFarlane, 1994; Lajunen, et al., 2001). Knowing someone who has been in a crash increased the likelihood of an adolescent owning (but not using) a helmet (Lajunen, et al., 2001). Scare tactics appear to have only a limited impact.

As with the prevention of other types of injuries, research clearly shows that the most effective prevention activities involve multifaceted approaches (Klassen et al., 2000). Broad efforts to change individual behavior, community norms, and alter the physical environment have greater short- and long-term impact (Lee, Mann & Takriti, 2000; Britt, Silver & Rivara, 1998; Mock, Maier, Boyle, Pilcher & Rivara, 1995) than single-strategy projects (Klassen et al., 2000; Rivara, Thompson, Patterson & Thompson, 1998; Seijts, Kok, Bouter & Klip, 1995). The multi-faceted approach can be particularly important for childhood safety because it seeks to change the attitudes and behaviors of both children and their parents (Coffman, 2003). Education for children and parents when combined with enforcement of bicycle helmet laws is clearly more effective than either approach alone (Wesson, Spence, Hu & Parkin, 2000; Borglund, Hayes & Eckes, 1999).

Although there are many reports on promoting helmet use to children, there are few reports that describe a focus upon parents either as the main focus of the promotion or as a key target. Clearly, an important barrier to helmet use is not owning a helmet. Many strategies include programs that provide free or very low-cost helmets to the children who participate, thereby sidestepping the task of motivating parents to buy one. The authors found no reports of research on strategies that included teaching parents about buying an appropriate bicycle for their child. Many parents believe that their children who ride bicycles do not need helmets to be safe (Macpherson, Parkin & To, 2001; Hu, Wesson, Parkin & Rootman, 1996; Hu, Wesson, Parkin, Chipman & Spence, 1993; Towner & Marvel, 1992).

Broad efforts to change individual behavior, community norms, and alter the physical environment have greater short- and long-term impact than single-strategy projects.

Parent involvement in improving bicycle safety for their children is essential. They make decisions about buying the bicycle and must take into consideration their budget, the size of the bike, and the fit to the size of their child. In most cases, it is the parent who buys the bicycle helmet. It is the responsibility of parents to establish firm rules and to serve as role models by wearing helmets when they ride.

SKATEBOARDS, IN-LINE SKATES AND SCOOTERS

Skateboarding is an increasingly popular activity with today's teens, but it is also one that can result in numerous unintentional injuries. Skateboard injuries peaked in 1977 with 150,000 reported injuries, and these injuries subsequently declined to 16,000 in 1983 with skateboarding's decreasing popularity with young people. However, since the early 1990s, skateboarding has

experienced a resurgence in popularity. Nearly six million youth are estimated to participate in recreational skateboarding (American Academy of Pediatrics, 2002).

With this increase in popularity have come increased injuries. Skateboard-related injuries now account for about 50,000 emergency room visits each year, and 1,500 hospital stays every year. In fact, one study indicates that skateboarding injuries doubled between 1993 and 1998 (Warner, 2002). About 16,500 fractures, sprains and cuts each year are attributed to skateboarding. Sixty-one percent of the injuries are to youth 5-14 years of age, and 87 percent of those injured are males (Committee on Injury and Poison Prevention, 1995). Deaths, while rare, often result from collisions with motor vehicles (National Safety Council, 2003a). The kinds of injuries experienced are related to developmental stage and patterns of skateboard use, with younger children riding near home and older youth riding on streets and highways (Committee on Injury and Poison Prevention, 1995).

Like skateboarding, in-line skating has seen a substantial increase in popularity and a concomitant increase in injuries related to this form of recreation. In the United States, there has been a 169 percent increase in emergency room visits associated with in-line skating since 1993 (Schieber, Branche-Dorsey, Ryan et al., 1996). Because of this, many groups have advocated the use of four types of personal protective equipment: helmets, wrist guards, knee pads, and elbow pads. Skaters in New York have been required to wear helmets since 1996 (New York Times, 1995) and Oregon skaters have been required to wear them since 1993 (Michels, 1993). We can infer that helmets will provide protection to skaters, since helmet use by bicyclists has been shown to reduce the occurrence of head injuries of bicyclists in the same environments to which a skater is exposed (Sacks, Holmgreen, Smith & Sosin, 1991). In terms of other protective equipment, Schieber et al. (1996) found the odds ratio for wrist injury for those who did not wear wrist guards was 10.4 to 1.

Non-powered scooters have also experienced a resurgence of interest among today's youth. These methods of transportation accounted for about 9,400 emergency room visits in less than one year (January through August of 2000), and 90 percent of the patients are children under the age of 15 years. Children under eight years of age accounted for 31 percent of the injuries (American Academy of Pediatrics, 2002). Non-powered scooters are so new in their appearance on the American cultural scene that there are no extant studies of their use or effective preventative measures.

The primary risk to children and adolescents from human-powered wheeled transportation devices such as scooters, skates, and skateboards is traumatic brain injury from falls. Other serious injuries include fractures and lacerations to the face or limbs. Although some of the injury events happened when the child was engaged in particularly risky behavior, falls or collisions can occur even when the child is behaving responsibly. The National Electronic Injury Surveillance System, an ongoing national survey of emergency departments, reports that over 129,000 children under 15 years of age were treated for injuries related to these devices (scooters > 24,000; in-line skates > 60,000; skateboards > 45,000) (US Consumer Product Safety Commission, 2001).

The primary risk to children and adolescents from human-powered wheeled transportation devices such as scooters, skates, and skateboards is traumatic brain injury from falls.

There are several published studies of observed safety behavior of children who use these recreational products (Kubiak & Slongo, 2003; Beirness, Foss & Desmond, 2001; Sherker & Cassell, 2001; Osberg & Stiles, 2000; Young, Seth & Mark, 1998). The prevalence of helmet use ranged from about 5 percent to 15 percent. The structured literature search, however, produced no reports of program evaluations promoting the use of safety equipment for users of any of these human-powered machines.

The use of helmets and protective equipment is often required at stunt parks designed for users of these products but, except for the four states that have helmet laws, they are not required elsewhere (National Safe Kids Campaign, 2003a).

While pediatricians recommend the same kinds of protective clothing (e.g. helmets, pads, wrist braces, etc.), for these activities as for other related recreational pursuits the authors could not find any examples of successful prevention approaches to having youth wear such protective clothing or following safe riding practices. As in other risk-inherent leisure activities, use of personal protective equipment is highly influenced by group norms.

Clearly, safety equipment is underused by skaters and riders nationwide. Given the high rate of injuries, this is cause for concern. The authors found no published studies of evaluation research on this topic, nor reports of unevaluated programs to encourage the use of protective equipment. Laws mandating the use of helmets have only been in place a short time, and there has been insufficient time to assess the effectiveness of this legislation.

The literature does not address the preventive role of parents in the safety of children who participate in these activities. Unlike bicycling, parents are also less likely to engage in skateboarding or riding scooters and so are not likely to provide positive role modeling as another influence on children for safe practices. A growing number of parents participate in in-line skating, however. Recommendations similar to those listed in the previous bicycle section are likely to produce a reduction in injury occurrence and severity in these leisure activities, but there is no evidence that this has been accomplished by any program that was reviewed.

PERSONAL WATERCRAFT

Personal watercrafts (PWCs) were first produced in the mid-1970s as one-seat vessels with engines of no more than 40 horsepower. Current models have engines with 145 horsepower (Kawasaki, 2003) to 165 horsepower (Yamaha Motor Company, 2003) for two- or three-seat models, and engines producing 185 horsepower for "muscle" single-seat models (Bombardier Sea Doo, 2003a). Modern PWCs can reach speeds approaching 100 mph. Small increases in speed lead to great increases in kinetic energy transfer when a crash occurs. A 10 percent increase in speed translates to a 40 percent increase in risk of fatality (Joksch, 1993). These speeds impose great risks to PWC riders and to nearby swimmers. The lure of speed and mobility at a relatively inexpensive price has proven irresistible to many recreational boaters.

The use of PWCs has increased dramatically during the past decade. Between 1990 and 1995, the number of PWCs in operation more than tripled from 240,000 to 760,000 (Barach & Baum, 1998; Branche, Conn & Annest, 1997). Annual sales of PWCs rose from 29,000 in 1987 to 200,000 in 1995 (National Transportation Safety Board, 1998). Current estimates suggest that more than 1 million PWCs are now in use (Bly, 1998).

However, there are no current accurate estimates of the number of PWCs in use because many states do not have a separate registration classification for these vessels (US Coast Guard, 2003). The Coast Guard estimates that fewer than 10 percent of non-fatal water recreation incidents are reported (Hamman, Miller, Fallat & Richardson, 1993). Thus, statistics on the rate of PWC-related injuries and measures of injury risk are unavailable. According to Branche, (1998), the US Consumer Product Safety Commission stopped collecting data on these injuries after 1995. This lack of information is unfortunate because good information is necessary to develop effective injury prevention programs.

There is, however, limited information from the early 1990s. PWC injuries for persons of all ages who were treated in hospital emergency departments increased from about 2,800 in 1990 to more than 12,000 in 1995 (Branche, Conn & Annest, 1997).

Data from the US Coast Guard and from other injury research demonstrate that children are involved in a greater percentage of PWC-related crashes and injuries than other age groups (US Coast Guard, 1996; Hamman et al., 1993). The most common sites of injury are the brain, head and neck, and the leg (Haan, Kramer & Scalea, 2002; Beierle, Chen, Langham, Jr., Kays & Talbert, 2002; Jones, 1999; Jones, 1998; Shatz et al., 1998; Francis & Vize, 1994). Drowning occurs, but is rare because most PWC riders use personal flotation devices.

Despite the increased popularity of PWCs, many communities are limiting or banning their use because of environmental concerns and the risk of injury. In 1994, 56 people died in the United States as the result of accidents involving personal watercraft. Generally, no license or training is required to rent them, and they can be driven by anyone as young as 14, although Yamaha's web site (Yamaha is the main manufacturer of personal watercraft) recommends that these craft be restricted to persons 16 years and older with a valid driver's license (Barach & Baum, 1998). PWCs are the only recreational boats for which the leading cause of death is not drowning; most fatalities result from blunt trauma. When the cause of death is drowning, most victims are not wearing personal flotation devices. An estimated 7 percent of injuries in PWC accidents are to persons aged 14 years and younger (Branche, Conn, & Annest 1997).

A report by Jones (2000) summarizes state regulations that apply to PWCs. Most states have some sort of minimum age restriction for vessel operators but they can be as low as 10 years and may not apply if a person who is of age is with the child. Some places have restrictions on the maximum speed at which vessels are allowed to travel and some waterways have banned PWCs altogether. Although most states require personal flotation devices for vessel operators and passengers, there are no laws pertaining to helmet use.

No published studies exist dealing with the effectiveness of protective equipment to prevent injury sustained while riding

PWCs. Experts in the field have recommended specific training for PWC users to reduce injuries, but there is no evidence that such training would result in such an outcome (Branche, Conn & Annest, 1997). Although some manufacturers make PWCs that are available with a device that will limit speed and power while learning to operate it, such as the Sea Doo Learning Key (Bombardier Sea Doo, 2003b), these devices limit the vessel speed to about 35 mph. This is still quite fast.

The Personal Watercraft Industry Association recommends wearing eye protection, a wet suit, footwear, and gloves. The U.S. Coast Guard requires that all boats, including PWCs, carry one wearable personal floatation device per person, which should be Coast Guard approved, in good and serviceable condition, and the appropriate size for the intended user. The fact that drowning is rare indicated that state regulations concerning personal flotation devices are effective at influencing riders to use them.

There are no published reports of programs to prevent PWC-related injuries. Although there are boating operation and safety courses available, and some are required by law, none of these specifically address PWC users (Jones, 2000). The PWC handles and maneuvers quite differently than other water vessels and a generic boating course is not likely to be of much use. Courses on PWC operation could provide the necessary experience and an appreciation of the responsibilities that come with operating a PWC (Jones, 2000).

The literature does not address the role of parents in the safety of children who use these devices. Parents should insist that their children receive training in the safe use of PWCs before they are allowed to operate one. Children should wear an approved personal flotation device, and a wetsuit to protect against abrasions and injuries to body orifices. Children who operate PWCs should be within sight of a responsible and attentive adult at all times.

ALL-TERRAIN VEHICLES

All-terrain vehicles, "ATVs" or as they are popularly known today - "quads" - were first designed in the late 1960s by Honda. The first ATV was sold in the United States in 1971. This began an era of great popularity for the ATV. The first ATVs were designed in a three-wheel tricycle-like configuration. This design was the industry standard until the mid-1980s. Recreational use of ATVs has created significant injury potential for child and adolescent riders. Recent attempts to reduce the number and severity of ATV-related injuries have met with less than resounding success.

All-terrain vehicles are very popular with children and adolescents. By far, children and adolescents use ATVs primarily for recreation. One study found that less than 20 percent of adolescents used ATVs primarily for work purposes (Tormoehlen & Sheldon, 1996). The US Consumer Product Safety Commission (CPSC) estimates that in 2001, 7.2 million children under age 16 rode ATVs for a total of 575 million riding hours. This comprises about 31 percent of all ATV riders (Levenson, 2003). In 1997, most (88-96 percent) children and adolescent ATV users rode adult-sized vehicles labeled with warnings against their use by children under the age of 16 (Rodgers, 1998; Kyle & Adler, 1998; Tormoehlen et al., 1996).

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ATV-related injuries occur when the rider loses control and is thrown off the vehicle, the vehicle rolls over and crushes the rider, or there is a collision with a fixed object or another vehicle (Accident Prevention Committee - Canadian Paediatric Society, 1987). Most of these incidents involve the vehicle rolling over (Newman, 1986).

High rates of serious injury and death among inexperienced drivers and among children and adolescents may be due to the unique dynamic properties (high center of gravity, capacity for very high speed) of ATVs and the high level of skill and coordination needed to operate them safely (Deppa, 1986). The increased risk of injury among young motor vehicle drivers is caused by both the independent effects of inexperience and their immature development (Levy, 1991).

A driver must constantly make decisions about current risk status and about the need for changing vehicle speed or direction. These decisions are based upon the driver's perception of potential hazards in the environment and the driver's perception

of his and the vehicle's capacity to avoid the hazard in a way that avoids a crash (Brown & Groeger, 1988).

Safe motor vehicle operation depends primarily upon the ability of a driver to constantly evaluate risk and adapt speed and path appropriately. This ability is a function of driving experience and familiarity with the road (McKenna, 1991). Children and adolescents often lack the necessary depth of experience.

ATV use is growing in popularity, and as a result, so is the risk for serious injury with improper use. In 1997, the rate of injury from ATV-related injuries was 1.5 per 100 vehicles (Kyle and Adler, 1998). It was estimated in the early 1990s that, for riders under 16 years of age, there was a one-in-three chance of having an ATV-related injury during the average usable life of the ATV (US Consumer Product Safety Commission, 1992).

The risk of injury for adolescent ATV drivers is much higher than that for older drivers. In 2001, children and adolescent ATV operators under the age of 16 faced an injury risk of 10.2 injuries per thousand drivers and 70.6 injuries per million driving hours (Levenson, 2003). Children 15 years of age and younger had about 2.5 times the risk for injury than did drivers 16 to 34 years old (US Consumer Product Safety Commission, 1998) and 12 times that of adults over 45 years of age in 1997 (Rodgers and Adler, 2001).

Between 1985 and 1997, the overall number of four-wheel ATVs in use approximately doubled while the number of four-wheel ATV injuries per year dropped by about half. Much of this decrease in the number of injuries may be due to the marked drop in the number of three-wheel ATV injuries after they were no longer distributed in the U.S. market, starting in 1988 (Kyle and Adler, 1998). Likewise, emergency department visits from ATV injuries among children younger than 16 years old declined from the highs of the mid-1980s to about half that level through the mid-1990s. However, from 1995 forward, there has been a steady increase in the number of ATV injury-caused emergency department visits among children and adolescents. In 2001, there were about 33,000 children and adolescents under age 16 treated in hospital emergency departments for ATV-related injuries (Levenson, 2003). Serious nonfatal injuries include life-altering brain and spinal cord disabilities, open and closed abdominal injuries, and multiple fractures (Committee on Injury and Poison Prevention - American Academy of Pediatrics, 2000a).

The CPSC estimates that children under the age of 16 accounted for approximately 37 percent of the injuries from 1985-2001 and about 38 percent of the approximately 4,541 ATV-related deaths that occurred in the United States from January 1, 1982 through December 31, 2001 (Ingle, 2002). Most of these deaths are from head injuries (Hargarten, 1991).

SKIING AND SNOWBOARDING

Although the literature search found 97 reports on skiing and snowboarding injuries that mentioned children, children were the main focus in only 17 of these studies. Essentially all of the reports on skiing and snowboarding were based upon case-series research - how many injuries of certain diagnoses were seen at a medical facility and what was the participant's skill status and behavior at the time of the injury. This means the researchers worked without a good estimate of the population in which the injuries occurred. Thus, injury rates are unavailable. There also was no information about the number of people who exhibited any particular behavior. Therefore, it is impossible to draw any conclusions about the magnitude of risk imposed by any specific behavior or combinations of behaviors. The lack of good information about the occurrence of injuries and injury risk factors is surprising given the age of the sport and its reputation for placing participants in danger of limb fractures and head injuries.

There is acceptable evidence to conclude that inexperience places skiers and snowboarders at higher risk than seasoned participants (O'Neill & McGlone, 1999; Pigozzi, Santori, DiSalvo, Parisi & Di Luigi, 1997; Bladin & McCrory, 1995; Moreland, 1982). Even when controlling for experience, children and adolescents are at much greater risk of injury when skiing (Federiuk, Schlueter & Adams, 2002; Diamond, Gale & Denkhaus, 2001; de Loes, Dahlstedt & Thomee, 2000; Harborview Injury Prevention and Research Center, 2001; Macnab & Cadman, 1996; Jansson &

Safe motor vehicle operation depends primarily upon the ability of a driver to constantly evaluate risk and adapt speed and path appropriately.

Bauer, 1991; Berestka, 1989) and snowboarding than adults (McDonah, 2000; Sacco, Sartorelli & Vane, 1998).

The evidence is strong enough to conclude that snowboarders are injured more frequently than are skiers (Dohjima, Sumi, Ohno, Sumi & Shimizu, 2001; Hagel, Meeuwisse, Mohtadi & Fick, 1999; O'Neill et al., 1999; Abu-Laban, 1991). This is likely the case because snowboarding inherently involves jumping (Fukuda, Takaba, Saito & Endo, 2001; Yamakawa et al., 2001; Nakaguchi et al., 1999; Machida et al., 1999).

Several researchers have recommended that participants attend training courses (Matsumoto, Miyamoto, Sumi, Sumi & Shimizu, 2002; Dohjima et al., 2001; Yamakawa et al., 2001; Tarazi, Dvorak & Wing, 1999; Pigozzi et al., 1997; Garrick & Requa, 1979), use helmets (Levy, Hawkes, Hemminger & Knight, 2002; Macnab, Smith, Gagnon & Macnab, 2002; Hentschel, Hader & Boyd, 2001; Hackam, Kreller & Pearl, 1999), use other protective gear (Dohjima et al., 2001), and properly use and maintain equipment (Yamakawa et al., 2001; Bladin et al., 1995; Ungerholm, Gierup, Gustavsson & Lindsjo, 1984). Although these recommendations make sense intuitively, with the exception of one report on ski bindings (Finch & Kelsall, 1998) and one on helmets (Macnab et al., 2002), there is no published evidence to affirm that injuries would decrease if they were followed.

Despite the exhaustive search, there appear to have been no evaluations that demonstrate that training will reduce injuries. A Google search found more than 1,000 ski and snowboard training opportunities in the United States alone, but there does not seem to be a standard for training curricula or institutions. Some slopes require that skiers and snowboarders use helmets, but this is far from universal. Some slopes limit participants to those who have achieved a certain skill level, but there is no evidence that these restrictions are effective at keeping inexperienced and determined participants from using them.

In the 1970s, the manufacturers of skiing equipment radically reduced the incidence of broken legs by developing quick release bindings, and the number of accidents was also reduced by the development of ski brakes, which prevent 'run away ski' injuries (Josefson, 1998). Although there is anecdotal evidence that existing ski and snowboarding helmets may reduce the occurrence of traumatic brain injury, this has not been clearly demonstrated as with helmet use in other recreational activities. Only one study had a design that allowed for a measure of helmet effectiveness (Macnab et al., 2002). Failure to wear a helmet was associated with a 2.2 times greater risk of head, face, or brain injury. By examining patterns of collisions, the researchers concluded that helmets did not lead to a loss of peripheral vision sufficient to place a wearer at increased risk of crashing into an object or other skier.

The patterns of head injury among snowboarders and skiers are different. Injuries to the back of the head are much more common among snowboarders than to skiers and may require a special helmet design to offer the necessary brain protection (Nakaguchi & Tsutsumi, 2002; Fukuda et al., 2001; Nakaguchi et al., 1999).

SLEDS AND TOBOGGANS

Every year, thousands of youths and adults are injured while sledding down hills in city parks, streets, and resort areas. In 2000, hospital emergency rooms treated 23,680 injuries among children younger than 15 that were related to sleds, toboggans, and inflated or plastic tubes and disks used in sledding (US Consumer Product Safety Commission, 2003). In a typical year, children experience two-thirds of all Emergency Department-treated sledding injuries. Half of all emergency visits are for injuries to arms and legs; 17 percent, spine; 15 percent, head; and 11 percent facial injuries (American Academy of Orthopaedic Surgeons, 1997).

Although a majority of downhill skiers and snowboarders use open terrain with few obstructions, most sledding is done on neighborhood slopes with numerous obstacles. While ski areas are typically well-groomed, patrolled and closed down if conditions become hazardous, most sledding areas are never groomed or patrolled and frequently end in a parking lot or neighborhood street (Finnegan & Tongue, 2003).

Compared with older adolescents and adults, young children are at increased risk for any injury and are at especially high risk of severe injury (Manary & Hollifield, Jr., 1993; Landsman et al., 1987; Hedges & Greenberg, 1980). This is likely due to the anatomy and physiology of the young child - larger head, higher center of gravity, and lower levels of coordination and strength.

Although there are numerous studies on winter sliding-related injuries and risk factors, there are no published reports on programs to prevent them. Sledding produces head, brain, and facial injuries while tobogganing produces primarily leg and lower body injuries (Dershewitz, Gallagher & Donahoe, 1990). This is almost certainly due to rider position.

Risk factors for snow sliding injuries among children are:

- Icy conditions (Major, Guest, Smith, Barker & Burns, 1999; Lewis & Lasater, 1994; Dershewitz et al., 1990; Landsman et al., 1987)

- Sledding in a street (Shugerman, Rivara, Wolf & Schneider, 1992)
- Sled run ending on a road or street (Voaklander, Kelly, Sukrani, Sher & Rowe, 2001; Lee, Osmond, Vaidyanathan, Sutcliffe & Klassen, 1999; Bernardo, Gardner & Rogers, 1998)
- Lack of adult supervision (Federiuk et al., 2002; Shugerman et al., 1992; Landsman et al., 1987)
- Fixed objects on the slope or at the bottom of the slope (Major et al., 1999; Shorter, Mooney & Harmon, 1999; Grober, Maurer, Eingartner & Weise, 1998; Bernardo et al., 1998; Rowe & Bota, 1994; Manary et al., 1993; Dershewitz et al., 1990)
- Riding head first (Landsman et al., 1987)
- Not wearing a helmet or protective boots (Voaklander et al., 2001; Wynne, Bota & Rowe, 1994; Manary et al., 1993; Dershewitz et al., 1990; Landsman et al., 1987)
- Sledding before daylight, at dusk, or at night (Wynne et al., 1994; Rowe et al., 1994)
- Use of special high-speed sleds, such as ski-sleds (Wynne et al., 1994)
- Using a non-steerable sled (Hackam et al., 1999; Sahai et al., 1998; Wynne et al., 1994)

The authors found no reports of studies evaluating sledding injury prevention, nor reports that described an organized prevention activity. Organizations such as the National Safe Kids Campaign (2003b) and the National Safety Council (2003b) have produced web pages with safety recommendations for sledding.

Although one of the authors of this report has personal knowledge of communities that have ordinances regulating where sledding is not permitted, no mention was found of enforcement as a measure to promote sledding safety.

SNOWMOBILES

Snowmobiling has been a popular sport ever since the first snowmobile was invented. In 1998, there were more than 2.3 million registered snow machines in the United States (Committee on Injury and Poison Prevention - American Academy of Pediatrics, 2000b). In 1988, when the American Academy of Pediatrics issued its first statement on snowmobiles, 18 percent of all injuries were in children younger than 14 years of age and 48 percent occurred in people 15 to 24 years of age (Rice, Alvanos & Kenney, 2000). The age at which a child may legally operate a snowmobile varies from state to state. Generally, there are fewer restrictions on the operation of snowmobiles than other motorized vehicles.

There has been little research on the prevention of accidents and injuries while operating a snowmobile. Ghent (1970) reported on a study of snowmobile-related injuries and made the following familiar recommendations:

- All operators should have a driver training course
- Snowmobiles should not be driven on roads
- Speed should be adjusted to terrain and visibility
- Snowmobile operators should use the buddy system
- Soft hitches and attachments should be avoided
- All available safety equipment should be used

Despite these warnings more than 30 years ago, snowmobile accidents have remained common and prevention efforts have failed to reduce deaths and injuries from operating a snowmobile.

The only example of a successful prevention effort that the authors could identify took place outside the borders of the United States. An adult-directed community-based public education and police surveillance program to reduce snowmobile injuries was introduced in Northern Ontario (Canada) in the mid-1990s. The intervention focused on the enforcement of snowmobile regulations by a group of intensively trained volunteers who patrolled local trails. During these patrols, the volunteers promoted safe practices and assisted police officers. The effort was successful in reducing the incidence of both injuries and deaths from snowmobile crashes (Rowe, Thierrien, Bretzlaff, et al., 1998). In the opinion of medical experts, education and enforcement campaigns that are age-appropriate and targeted to specific at-risk groups would be the most effective prevention strategy in this arena (Rice, Alvanos & Kenney, 2000).

The authors found no published research on prevention strategies aimed at parents to influence the snowmobile riding practices of their children or other youngsters in their care.

EQUESTRIAN RIDING AND RODEOS

The 4-H program has long been involved in teaching young people to ride horses - both for pleasure and in competition. Understandably, then, the authors considered looking into this field to see if there were lessons to be learned. Horseback riding is a popular activity in the United States, with about 30 million people who ride regularly (Bixby-Hammett, 1987). The rate of serious injuries to riders per hour of exposure is higher for horseback riders than for motorcyclists and automobile racers (Firth, 1985). Each year more than 90,000 people are treated in emergency departments for horse riding-related injuries, with the highest rate of injury among girls and young women (Centers for Disease Control and Prevention, 1990). Because of the way that horse-related deaths are coded from death certificates and the international standard categories for death coding, there are no useful estimates of the annual number of horse-rider deaths in the United States.

Although most horse-related injuries are not severe, fatal or disabling brain and spinal cord injuries are, nonetheless, a significant problem for riders. This is not surprising given that participants are unrestrained, usually helmet-less, and riding large, often unpredictable animals capable of 40 mph speeds and a kicking force of about 2,000 pounds (Nelson & Bixby-Hammett, 1992; Brooks & Bixby-Hammett, 1988). Brain injuries account for about 60 percent of horse-related deaths (Bixby-Hammett & Brooks, 1990).

Falls account for most horseback riding-associated injuries (Bixby-Hammett et al., 1990; Gierup, Larsson & Lennquist, 1976), especially among children (Bond, Christoph & Rodgers, 1995). The overall prevalence of helmet wearing is low (less than 20 percent,) particularly among riders who use a western-style saddle (Nelson, Rivara & Condie, 1994; Grossman, Kulund, Miller, Winn & Hodge, Jr., 1978). Even when riders wear headgear, the headgear may be primarily decorative or improperly secured, thereby providing limited or no protection (Firth, 1985; Mahaley & Seabar, 1976; Barber, 1973). Because of the potentially severe lifelong consequences of head injury, horseback riders should wear a properly secured hard shell helmet lined with expanded polystyrene or similar material. Helmet use has been endorsed by several medical and trade organizations, and national performance standards for helmets are available (Committee on Sports Equipment and Facilities (ASTM-F08.53), 2003; Moss, Wan & Whitlock, 2002; Nelson et al., 1992; Brooks et al., 1988).

Rodeo injuries are less well-described and understood, especially for young participants. Although there are many, the exact number of young rodeo participants is difficult to assess because there are several sponsoring organizations with overlapping memberships. (One of the groups, the National High School Rodeo Association, has more than 12,000 members ([National High School Rodeo Association, 2003]).

It is known that the most popular rodeo event, bull riding, is the most dangerous. Bull riders sustain 37 percent of all rodeo-related injuries and these are more likely to be severe than injuries that occur during other events (Justin Sportsmedicine Program, 1995; Griffin, Peterson, Halseth & Reynolds, 1987). In competitive bull riding, the rider holds with one hand a length of braided rope wrapped around the bull's midsection. The rope is not tied in any way; only the force of the rider's grip on the rope keeps the rider on the bull. Riders must remain on the bull for 8 seconds, during which their free hand cannot touch the bull, themselves, or the rope (National High School Rodeo Association, 1995; Professional Rodeo Cowboys Association, 1995). Because riders and bulls are matched by random draw, injuries are more likely to occur when a younger, less experienced rider draws a high-spirited bull. Bull-riding schools for experienced riders exist, but are not widely used (Centers for Disease Control and Prevention, 1996a).

While there is considerable literature available on the types of injuries incurred in horseback riding, there is little on the prevention of these injuries. Case-control or other studies evaluating the effectiveness of the countermeasures suggested by authors do not

While there is considerable literature available on the types of injuries incurred in horseback riding, there is little on the prevention of these injuries.

seem to exist. There is a good body of epidemiology that supports the proper use of approved helmets as a means of preventing injury in these equestrian sports. However, protective helmets do not always prevent injury, and many riders will not wear them because of personal preferences or perceived poor design. The most effective prevention efforts focus on training, proper equipment, body protectors, safety stirrups, knowledge of horse behavior, falling techniques, and a knowledge of first-aid in the event of an accident. Even though the injury rate for equestrians is relatively low by comparison with other sports, the injuries incurred are usually severe. The authors could not uncover any studies that identified prevention approaches that have successfully reduced injuries in equestrian activities, and the influence of group norms seems the most important influence to wearing protective clothing.

There were no reports in the literature on proven individual or community-wide interventions that promote helmet use by horse or bull riders. Watt and Finch (1996) reported on a thorough review of the health and sports literature seeking any evaluation of prevention strategies for equestrian injuries, but found none. One of the authors of this report had similar results after conducting a review seeking rodeo injury prevention strategies to prepare a report on brain and spinal cord injuries to high school bull riders (Centers for Disease Control and Prevention, 1996a).

Protective headgear designed for bull riding exists (Brandenburg & Archer, 2002) but is not recommended by rodeo organizations (Ketai, Temes, Deis, Allen & Wernly, 2000). Protective vests designed for bull riding are required for youth competition but not for professional competition (National Little Britches Rodeo Association, 2000; National High School Rodeo Association, 1995; Professional Rodeo Cowboys Association, 1995). Use of protective headgear recommended to prevent horseback riding-associated traumatic brain injuries (Committee on Sports Medicine and Fitness - American Academy of Pediatrics, 1992) may decrease the risk for brain injury in bull riding, but has not been assessed for that use. Potential barriers to using protective equipment include cost and a perception that some protective equipment detracts from the desired rugged, western appearance (Centers for Disease Control and Prevention, 1996a).

Although there are numerous reports of injuries and risk-factors, a thorough search found no well-controlled evaluations of interventions to reduce the risk of injuries to young horseback riders or rodeo participants.

TRAMPOLINES

Home use of outdoor oval or circular trampolines is a popular activity for children but is associated with a number of orthopedic injuries, especially in children between the ages of 5 and 15 years (Black & Amadeo, 2003). These injuries are often serious. Because of the amount of energy a trampoline can impart, a child can never be truly safe on a trampoline. A 65-pound child displacing the jumping surface only two feet will generate about 3.3 g of force (Black et al., 2003). This is more than enough energy to cause fractures and even death if the child lands imperfectly. Compared with adults, children are at increased risk for injury when exposed to situations with potential for transfers of large amounts of energy because of their anatomical characteristics, such as open bone epiphyses.

Because of the amount of energy a trampoline can impart, a child can never be truly safe on a trampoline.

Children are at particularly high risk when jumping with a partner, especially one who weighs more than the child. The amount of force with which a trampoline mat recoils following a bounce by a heavier person will impart even greater forces than mentioned above (Boyer, Jaffe, Nixon & Condon, 1986).

As the popularity of trampolines has increased during the past 10 years, so has the number of injuries sustained using them (Esposito, 2003). There are currently about 3 million backyard trampolines in the United States and about 640,000 were sold in 1998 (US Consumer Product Safety Commission, 2000). Although most of the injuries were not permanently disabling, trampolines were responsible for over 6,500 pediatric cervical spine injuries in 1998. This represents a five-fold increase in just 10 years. While most have been relatively minor, paraplegia, quadriplegia, and death are all reported (Brown & Lee, 2000). Disabling trauma-

induced stroke in healthy children, although rare, is known to occur with trampoline use (Wechsler, Kim & Hunter, 2001).

Hospital emergency room-treated trampoline injuries almost tripled in the last decade - from an estimated 37,500 in 1991 to almost 100,000 in 1999. Nearly two-thirds of the victims were children 6 to 14 years of age. About 15 percent of the injuries treated in hospital emergency rooms involved children younger than 6 years old. There are many trampoline-related fractures and other injuries that are treated in physician's offices and orthopedic clinics.

Greater than 95 percent of the children treated for trampoline-related injuries were injured on home-based equipment (Furnival, Street, & Schunk, 1999; Woodward, Furnival, & Schunk, 1992). Since 1990, the US Consumer Product Safety Commission (CPSC) has received reports of 11 deaths related to trampoline use (US Consumer Product Safety Commission, 2000).

Most trips to the emergency room are the result of jumpers colliding with one another, falling on the trampoline springs or frame, falling or jumping off the trampoline, or attempting somersaults and stunts. Although falls to the ground are an important problem (Chalmers, Hume & Wilson, 1994), most trampoline-related injuries to children in the United States occur on the body of the trampoline itself (Black et al., 2003; Furnival et al., 1999; Smith & Shields, 1998; Woodward et al., 1992; Torg & Das, 1985). Although lack of supervision is a risk factor for trampoline injuries among children (Woodward et al., 1992; Routley, 1992), serious injuries can occur to children even when under direct adult supervision (Smith et al., 1998). Disabling spinal cord injuries are known to occur even when the trampoline jumper was closely monitored by a trained instructor or coach (Torg & Das, 1984; Hammer, Schwartzbach & Paulev, 1981; Kravitz, 1978), and despite the use of "spotters" along the sides of the trampoline who are responsible for catching jumpers who begin to fall (Silver, Silver & Godfrey, 1986; Hammer, Schwartzbach & Paulev, 1982; Hammer et al., 1981; Rapp & Nicely, 1978).

A thorough review of the literature found no information on activities to prevent trampoline-related injuries to children. The American Academy of Pediatrics recommends that physicians advise parents never to purchase a home trampoline or to allow their children to use a home trampoline elsewhere. Children should not be allowed to use a trampoline at a playground or jump center (Committee on Injury and Poison Prevention and Committee on Sports Medicine and Fitness - American Academy of Pediatrics, 1999). The effectiveness of this recommendation has not been assessed.

To reduce injuries, CPSC has worked with the industry to develop a new voluntary standard for trampolines, which went into effect in 1999 (US Consumer Product Safety Commission, 2000). Four new requirements were added to the existing ASTM standard (ASTM International, 1999) to make trampolines safer and alert consumers to potential dangers:

- Padding must completely cover the metal frame, hooks, and all springs
- There must be a label on the trampoline box which states that trampolines over 20 inches tall are not recommended for children under 6 years of age
- Ladders cannot be sold with trampolines; this prevents access by young children
- Warnings on the trampoline bed must alert consumers against allowing somersaults and multiple jumpers, which can lead to paralysis and death

There are no published studies about programs or projects to improve trampoline safety. Several of the recommendations by groups such as the American Academy of Orthopaedic Surgeons (American Academy of Orthopaedic Surgeons, 1996) include a recommendation for using spotters to guard against falls from the mat surface. This recommendation, as well as those addressing mat size, surrounding with energy-absorbing material, and lowering the mat to ground level would, at best, prevent only a few of the injuries to children in the United States because almost all of the injuries occur on the jumping surface (Smith et al., 1998). Trampolines are sold with warning labels and safety instructions according to guidelines set out by the CPSC and ASTM. However, warning labels and product instructions have not satisfactorily prevented injuries to children associated with other consumer products (Smith, Bowman, Luria & Shields, 1997; Ferrari & Baldwin, 1989), and research on trampoline injuries demonstrates that these strategies provide similarly inadequate protection. A majority of parents allow their children to perform flips and to jump with partners even though they admitted that they knew of the warnings and the potential consequences (Furnival et al., 1999; Smith et al., 1998; Smith, 1998).

SEAT BELT USE

One of the most significant efforts at reducing automobile injuries and fatalities has been requiring seatbelt use through state legislation. Seat belt legislation falls into two categories of enforcement. In areas with a "primary enforcement" law, an officer can stop any vehicle and write a citation for violating the seat belt law. In areas with "secondary enforcement," officers cannot stop a vehicle for the seat belt infraction alone, but can cite for not wearing belts after stopping a vehicle for some other cause. More young drivers and riders use seat belts in states with seat belt laws and the prevalence is higher in states where the law requires primary enforcement (Bland, 1999; Creighton, 2002; Derrig, Segui-Gomez, Abtahi & Liu, 2002; Rivara, Thompson & Cummings, 1999).

Grossman and Garcia (1999) reported on a systematic review of the literature to assess the effectiveness of health promotion programs to increase motor vehicle restraint use among young children. They surveyed multiple sources of literature to find reports about clinical or community interventions that were evaluated using criteria and observed restraint use as an outcome. Eighteen reports met the standard for inclusion. The types of activities included in the interventions were: 1) curricula targeted at children in preschool; 2) counseling or education sessions with parents; 3) demonstrations of correct car seat usage to parents; 4) distribution of educational materials such as pamphlets, posters, and films; 5) home visits by designated health care personnel; 6) health care provider messages; 7) mass media campaigns including print, billboard, and television advertising; 8) incentive programs with prizes or other rewards; 9) car seat loaner or rental programs; 10) coercive programs excluding police or legal intervention, and 11) institutional policies providing guidelines for parents to follow, such as a day care policy that all children arriving must be in a car seat. Many programs used more than one of these methods in the intervention. Only a few of the programs were effective in the short term. Of those that had short-term effect, there was no meaningful long-term (one or more months after the intervention) improvement in the prevalence of child restraint use. Educational programs, in the absence of laws mandating their use, didn't make lasting improvements in the prevalence of child restraint use.

A recent study conducted by one of the authors of this report found an increase in adult seatbelt use (ages 18 to 80 years) across the state of Montana. This increase was a result of a social norms media campaign which corrected adult (ages 18 to 80 years) misperceptions about their underestimation of the strong norm of seatbelt use. The media intervention promoted positive messages that focused on the fact that most Montana adults (3 out of 4) wear their seatbelts (Linkenbach, Perkins & Cornish, 2003). Such findings might also have relevance to younger adolescents who have also been found to harbor the same misperceptions as the majority of their peers about seatbelt use.

MOTOR VEHICLE SAFETY THROUGH DRIVER'S EDUCATION TRAINING

Driver education for young automobile drivers has been extensively studied and found to have no positive effect on reducing young driver crashes and injuries (Insurance Institute for Highway Safety, 1997). Indeed, one multi-state study found that among 16- and 17-year-olds, driver education was associated with a greater increase in the number of licensed drivers, but did not decrease the fatal crash involvement per 10,000 licensed drivers. Thus, the net effect was much higher death involvement rates per 10,000 population in states with greater proportions of 16- and 17-year-olds who received high school driver education (Robertson & Zador, 1978). This was validated by several other studies. For example, in 1976, Connecticut eliminated state funding for high school driver education and nine school systems dropped the courses from their high school curricula. Other communities, however, used local funds to continue the education program. Substantial reductions in the numbers of 16- to 17-year-olds who became licensed occurred in the communities that dropped the course. As a result, the numbers of crashes involving 16- to 17-year-old residents in such communities were also substantially reduced (Robertson, 1980). There is no convincing evidence that high school driver education reduces motor vehicle crash involvement rates for young drivers, either at the individual or community level (Ian & Irene, 2001; Lund, Williams & Zador, 1986; Vernick, Li, Ogaitis, MacKenzie, Baker & Gielen, 1999).

Although there are indications that adolescents who are closely monitored by their parents are somewhat more likely to exhibit safer automobile driving practices than adolescents who are less closely monitored, the existence of laws and law officers to enforce them are more likely to help with compliance than with parental rules alone (Beck, Hartos & Simons-Morton, 2002; Hartos, Eitel & Simon-Morton, 2001; Hartos, Eitel & Simons-Morton, 2002).

Parental teaching of driving skills does not have an important impact upon adolescent risk taking (Beck, Shattuck & Raleigh, 2001). Even if parents begin to buy into safety concepts and set rules, adolescents may not abide by them. There are indications that adolescents who exhibit high levels of sensation-seeking behavior perceive a low risk of detection for improper vehicle

operation (Jonah, Thiessen & Au-Yeung, 2001). Even adolescents who do not exhibit risk-taking driving behavior have a much higher crash rate than older drivers because of inferior skills (Ballesteros & Dischinger, 2002), slower hazard recognition (Cox, Cox & Tuite, 2001) - particularly when experiencing demanding driving tasks (Chapman & Underwood, 1998; Crundall & Underwood, 1998; Deery & Fildes, 1999) - and slower and inappropriate response to a hazard once recognized (Deery, 1999).

Young drivers tend to significantly overestimate their ability to operate a motor vehicle. This misperception is particularly strong when their training primarily involved teaching skills such as hard braking and collision avoidance maneuvers. A study by Gregerson (1996) compared self-assessed abilities between groups of young drivers who received skill training and those who received skill training plus a presentation to provide the driver with insight into the fact that his own skills in braking and avoidance may be unpredictable in a crisis situation. When the drivers were tested one week after the training, the skills-only group estimated their skills higher than the skills-plus-insight group, but there was no difference in their actual skill (Gregerson, 1996).

Most drivers think that they are much more skilled than the majority of other drivers (Groeger & Brown, 1989; DeJoy, 1989; McCormick, Walkey & Green, 1986; Matthews & Moran, 1986; Svenson, 1981). Even drivers who have recently been hospitalized for a crash-related injury believe in their superior skills (Preston & Harris, 1965). Although parents support graduated licensing laws for young drivers, most expressed their belief that their own children had the skills and discipline necessary to drive under most conditions (Ferguson & Williams, 1996).

A recent effort in Montana seeks to use an educational strategy to educate young drivers about safe and legal driving practices. In order to engage young drivers in a fun, educational traffic safety process, the Montana Social Norms Project at Montana State University has developed and distributed 12,000 copies of an interactive CD-ROM in a game show format titled Montana Rules. Although outcome data are not yet available on the effectiveness of this teaching tool, anecdotal evidence demonstrates that both driver's education instructors and students are enhancing their knowledge about operating motor vehicles (Montana Social Norms Project/MOST OF USTM Campaign, 2002).

Most drivers think that they are much more skilled than the majority of other drivers.

MOTORCYCLE HELMET USE

Although the topic of motorcycle safety has an extensive literature base, only some of the key issues are addressed here - those affecting perceptions of hearing, seeing and comfort which all influence actual helmet use.

For instance, the effects of motorcycle helmets on the rider's hearing have been studied extensively. A motorcycle's engine and air turbulence from the vehicle and rider in motion produce a masking noise and any auditory signal, to be heard, must be louder than the level of the masking noise. Since the helmet doesn't increase the hearing threshold to a level above the masking noise, any signal loud enough to be heard without a helmet would also be heard with a helmet (Henderson, 1975). The helmet does not change the ratio of signal to noise. It reduces both noises equally. Other researchers, some using microphones placed in the ears of riders to objectively measure sound levels with and without helmets, concluded that if a sound is loud enough to be heard over the noise of the engine and the road-travel, it can be detected while wearing a helmet (Aldman, Gustaffson, Nygren & Wersall, 1983; McKnight & McKnight, 1993; VanMoorhem, Shepherd, Magleby & Torian, 1977). Considering that many motorcycle owners take steps to alter their exhaust systems to change the quality and volume of their unit's engine noise, some objections to helmet wearing and hearing may have more to do with aesthetics than with the ability to detect sounds.

Helmet effects on vision have been studied as well. Although there is no question that helmets, especially full-coverage styles, provide some restriction of peripheral vision, even the most restrictive helmets were no more restrictive than wearing goggles (Gordon & Prince, 1975; McKnight & McKnight, 1993). The effect of a motorcycle helmet on a driver's ability to see is, at most, extremely small (McKnight & McKnight, 1993). For practical purposes, the questions must concern the point at which narrowing

of the field of vision becomes unsafe relative to the protections afforded by a helmet. The safest drivers do not rely upon detecting and responding to potential hazards seen in their far peripheral field. Good drivers don't rely upon "seeing out of the corner of their eye," but actually turn their heads continuously and frequently back and forth (Burtt & Forbes, 1930; Forbes, 1936).

Like drivers' education courses, motorcycle skills training has also been demonstrated to provide unrealistic expectations (misperceptions) of one's capacity and an increased risk of injury (Kraus, Riggins & Franti, 1975). This is not to say that skill level is not important, but instead to suggest that our perceptions of our skills and of risk may have greater influence on young riders' behavior.

FIREARMS

Though the rate of fatal firearm injuries among children and youth in the United States has declined somewhat over the past 10 years, it remains high compared with historical values. In 2000, there were 1,011 firearm-related deaths to children between the ages of 3 and 16, with male deaths outnumbering females by more than five to one. About half of these were recorded as homicides, 10 percent were unintentional shootings, and 37 percent were self-inflicted (National Center for Injury Prevention and Control, 2003). The U.S. firearm death rates among children are far higher than those of other industrialized nations. In a typical year, the firearm homicide rate for children younger than 16 in the United States is 16 times that of the average for other industrialized countries; the firearm suicide rate is 11 times higher, and the unintentional firearm death rate is nine times higher (Krug, Dahlberg & Powell, 1996). For every child aged 3 to 16 who was killed by a firearm in 2000, seven received emergency department treatment for gunshot wounds (National Center for Injury Prevention and Control, 2003).

Although there is a wealth of information about motor vehicle traffic-related fatalities because detailed information is collected by the National Highway Traffic Safety Administration in the Fatality Analysis Reporting System (National Highway Traffic Safety Administration, 2003), there is currently no nationwide data system to collect similar information about violent deaths. Information on the type of firearm used, the relationship of the shooter to the victim, and other useful data are not available except through fragmented law enforcement sources. Coordinated public and private efforts are underway to establish such a system (National Violent Injury Statistics System, 2002).

The authors of this review support efforts to encourage parents to take steps to reduce access to firearms by their children. As with prevention of any injury, working with parents to reduce their children's likelihood of injury presents several obstacles. These include parental beliefs that their children are at little risk of injury and parental misperceptions about their children's ability to account for their own safety. These problems are compounded by the emotionally charged ideas people often hold concerning firearms.

Approaches to address child firearm access may focus upon parents or upon the children themselves. Few behavioral approaches to reducing firearm injuries among children have been evaluated, and those that have been were not shown to have been successful. Passive prevention efforts require little or no effort on the part of individuals (for example, choosing not to own a firearm). Some active strategies require a moderate amount of effort (such as locking up a gun after each use or placing and keeping a trigger lock on a gun), and still others require constant effort (such as closely supervising children). The more effort a strategy requires, the less likely it is to be effectively implemented (Christophersen, 1993; Williams, 1982).

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Parents are naïve about the fascination firearms hold for their children. It is well demonstrated that parents are unable to predict how their children, when unsupervised, will behave around guns. In a study of boys ages 8 to 12, only 13 percent of the boys' parents believed that their sons had a high interest in firearms; 64 percent believed that their sons had a low interest (Jackman, Farah, Kellermann & Simon, 2001). The children believed themselves to be alone in a room, but they were observed. After a few minutes, they began exploring their environment. Of the boys whose parents perceived them to have a low interest in guns, 65

percent handled a .38-caliber semiautomatic handgun when they found it in a drawer. Thirty-five percent pulled the trigger. Another study found that 23 percent of parents surveyed said that they trust their 4- to 12-year-old children alone with a loaded firearm (Farah, Simon & Kellermann, 1999). Efforts to teach parents about firearm safety will have to go beyond traditional educational approaches that only include convincing them of the risks guns hold for their children. The importance of identifying and correcting parental misperceptions of youth gun behavior cannot be overstated.

When included as a part of other prevention strategies, counseling by authority figures, such as physicians, can be effective at promoting safe behavior (Bass, Mehta, Ostrovsky & Halperin, 1985). There are, however, difficulties with using physician counseling as the primary method of prevention. Parents can become confused by the variety of injury prevention messages they receive (DiGuiseppi et al., 2000). Another factor is that in the current pediatric practice environment, there is little time for counseling by the physician and the effectiveness of counseling by other office staff is unproven. Even when physicians believe that they should counsel the parents of their child patients, they don't find the time to do it. In a recent survey of health care providers who serve families with children ages 5 years and younger, 80 percent reported that they believe they should counsel on firearm safety, yet only 38 percent reported that they actually do (Barkin, Duan, Fink, Brook & Gelberg, 1998).

Individual counseling may not be the most effective way to convince patient families to change their firearm use and storage practices in any case. In a survey of patients in 11 family practices, respondents reported that they did not view their physician as a credible source of information on firearm safety (Shaughnessy, Cincotta & Adelman, 1999). Furthermore, according to a recent randomized, controlled trial involving 311 families, a single 60-second firearm safety counseling session during a well-child visit did not result in significant changes in gun ownership or storage practices among the families who initially reported owning guns. Only 6.7 percent of gun-owning families reported removing any gun from their homes following the intervention. This was not significantly different from the 5.7 percent of families in the control group who did not receive counseling, but who also removed guns from their homes. Similarly, gun-owning parents in the study group were no more likely to store their guns safely than parents in the control group (Grossman et al., 2000). Even more discouraging are the results of a recent study involving parents of depressed youth. Among gun-owning families advised to remove the guns from their home because of the significant risk of suicide by their depressed adolescent, only 27 percent actually did so (Brent, Baugher, Birmaher, Kolko & Bridge, 2000).

Overall, interventions with parents have shown little success in decreasing children's access to guns in the home. Unfortunately, as the rest of this section indicates, interventions with children have not shown much promise for improving gun safety either.

Gun safety programs, typically administered by local firearms dealers and clubs, are designed to teach older children and adolescents how to properly handle a firearm (typically for hunting). Although no study has systematically evaluated such programs for children, gun safety programs have been found to be ineffective in decreasing the firearm injury and death rate among adults (Cole & Patetta, 1988) and to have had no positive effect on storage practices by gun owners (Hemenway, Solnick & Azrael, 1995). Some researchers suggest that gun safety courses for children are likely to increase children's interest in obtaining and using guns, and that children cannot be expected to consistently use guns safely even with training (Wilson, Baker, Teret, Shock & Garbarino, 1991).

Gun avoidance programs are more common than gun safety programs, particularly for young children. The curricula of gun avoidance programs depend upon the age of the targeted audience. For younger children, the focus is on avoiding accidental injury; for older children and adolescents, the focus is on preventing the intentional carrying and use of guns. The best-known curriculum for gun avoidance is the Eddie Eagle Gun Safety Program for pre-kindergarten children through sixth graders, developed by the National Rifle Association (National Rifle

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Association, 2003). The program advocates teaching children who find a gun not to touch it and to leave and find an adult. The program does not give children a reason for avoiding guns (such as that guns are dangerous), but program developers do emphasize that children should be taught that real guns are not toys. The NRA offers no empirical evidence that its approach is effective, but relies instead on testimonials, awards, and correlational data to demonstrate efficacy.

Only two studies have empirically investigated an avoidance approach to firearm use among children (Hardy, 2002b; Hardy, Armstrong, Martin & Strawn, 1996). In the 1996 study, half of a sample of 48 preschool children were randomly assigned to participate in a firearm safety program in which they and their parents listened to a community police officer discuss the dangers of guns. After promising never to touch a gun if they saw one, the children were paired with a playmate that had not heard the officer speak and were observed in a setting where they had access to disarmed but real firearms. The children who had heard the officer speak were just as likely as the children in the control group to play with the guns. Furthermore, they were just as likely to play with the guns after the intervention as before. The 2002 research involved a randomized control study in which 34 children aged 4 to 7 years participated in a week-long firearm safety program; the control group was composed of 36 children. After the program, pairs of children were observed playing in a structured setting in which they had access to a semiautomatic pistol. A total of 53 percent of the pairs played with the gun, and there was no difference in gun-play behavior between those children who did and those who did not receive the intervention.

As of 2001, 17 states had some type of law concerning child access to firearms kept in the home (Hardy, 2002a). The need for these laws is justified by the fact that when young children gain access to a gun, it is usually from their own home (Wintemute, Teret, Kraus, Wright & Bradfield, 1987), and that in half of the homes with guns, the weapon is stored unlocked (Azrael, Miller & Hemenway, 2000; Cummings, Grossman, Rivara & Koepsell, 1997; Senturia, Christoffel, & Donovan, 1996).

The effectiveness of parental responsibility laws concerning firearms has been evaluated. Researchers in one study found that unintentional shooting deaths in 12 states, particularly among children younger than age 10, had declined by 23 percent in the years following the introduction of child-access-to-firearm laws from 1990 to 1994 (Cummings et al., 1997). Further research found that statistically significant declines occurred primarily in the states in which violations of the law were a felony (Webster & Starnes, 2000).

The demonstrated effectiveness of child access prevention laws notwithstanding, these laws have been questioned by those who assert that such laws intrude upon the privacy rights of gun owners and upon the rights of parents to raise children as they see fit (Cahn, 1996; Maute, 1995). Some suggest that these laws are unlikely to be enforced because punishing parents who have lost children to injuries is cruel (Peterson & Roberts, 1992; Christoffel, 1991). This debate concerning the balance between personal privacy and freedom versus safety is common to most efforts at regulating injury prevention.

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Injury prevention experts often suggest two key strategies for reducing youth firearm injury and death. One option is to focus on behavior modification, changing how young people and their families behave regarding guns. Another is to focus on product modification, changing the design of guns so that they are more difficult to fire unintentionally or more difficult to use if stolen or obtained illegally. These two strategies do not present an either/or choice; one does not preclude the other.

There are no published studies that evaluate the effectiveness of preventing childhood injuries by changing the design of guns. Few design changes have been made and, until the United States has a national data system on firearm-related deaths, a well-controlled study is unlikely.

Except for the limited success of legislation requiring parents to store firearms safely, there are no programs that have been demonstrated to be successful at decreasing access to guns by children - especially through a normative influence model.

HUNTER SAFETY TRAINING

Perhaps one of the longest running prevention programs in the recreational field is hunter safety training. These mandatory courses exist in most states, and as Tom Baumeister with the Montana Department of Fish, Wildlife and Parks observed: "I don't know of anyone in the hunter education field who would question whether training has helped reduce injuries and fatalities. It definitely has had this effect" (T. Baumeister, personal communication, June 21, 2003).

Ron Fritz, Hunter Safety Education Program Coordinator with the Idaho Department of Fish and Game reported that prior to mandatory training in 1979, the state averaged 29.9 non-fatal hunting accidents and 8.9 fatalities per year. After the institution of mandatory training in 1979, however, there was a dramatic reduction in hunting fatalities, averaging about 5.9 non-fatal accidents and 1.9 fatalities per year (R. Fritz, personal communication, June 15, 2003). Even though the number of hunting licenses sold declined, the drop in hunting accidents is attributed to the implementation of mandatory hunter safety programs (R. Fritz, personal communication, June 15, 2003).

Mandatory hunter education courses, combined with hunter orange laws and designated shooting hours, have all combined to reduce hunter injuries since such laws were enacted beginning in 1949. The confounding effect of these multiple strategies makes it impossible to attribute the declines to any one approach. However, it is possible to examine the impacts in states that have not yet passed hunter orange laws. For example, New York conducted a 10-year study of the effect of hunter orange on shooting fatalities during hunting season. Approximately 120,000 hunters did not wear orange during this period, and 18 were mistaken as wildlife and killed. During the same period, 580,000 hunters wore hunter orange and none were mistaken for wildlife and killed (R. Fritz, personal communication, June 15, 2003).

In New York, the first state to require such training in order to obtain a hunting license, the number of hunting accidents in 2000 declined 17 percent from the previous low of 52 injuries reported in 1994 (New York State Department of Environmental Conservation, 2002). Professionals in this field point to the required hunter education courses as a reason for reduced injuries and fatalities.

TRACTOR OPERATION

Rural parents report that 65 percent of farm boys and 23 percent of farm girls ages 10 and 11 years are allowed to operate a tractor independently (Tevis & Finck, 1989). However, children who attempt to perform tasks that are beyond their developmental capability are at great risk for serious injury. Driving on public roads is prohibited for children of this age, but the operation of farm equipment is seen as role enhancing.

The operation of machines is seen by children and parents as a rite of passage and is looked upon with pride. A study of Illinois farm families and childhood tractor operation found that 60.7 percent of 10-year-olds are allowed to drive tractors while performing agricultural tasks, many without supervision. Although it is well known that a driver should use a seat belt on a tractor equipped with rollover protection structures (ROPS) (Campbell, 1990), more than two-thirds (70.1 percent) of these child-operators said that they reject using a seat belt on tractors that are equipped with ROPS because seatbelts were perceived as inconvenient (DeBarr, Ritzel, Wright & Kittleson, 1998).

One study found that the single best predictor of adolescents' behavioral intention regarding safe farm tractor operation was his or her perception of friends' and family members' expectations of their behavior (DeBarr, Ritzel, Wright & Kittleson, 1998).

In addition, many farm experts believe that farm-dwelling children will only exhibit safe behavior and that there will only be fewer children injured when adult farm workers adopt safe behaviors (Coffman, Martin, Prill & Langley, 1998; Owensby, 1990) - thereby communicating a consistent adult standard (DeBarr, Ritzel, Wright & Kittleson, 1998; Owensby, 1990). Therefore, children and youth are not likely to exhibit safe behavior with farm equipment unless both they and their parents are motivated to change their behavior. This appears to be especially influenced by modeling and communicating desirable attitudinal (injunctive) norms in conjunction with modeling appropriate behavioral norms of safety. Reinforcing factors such as political, legal and economic incentives may also be necessary in addition to education about the value of safety (DeBarr, Ritzel, Wright & Kittleson, 1998).

SECTION 2

CHALLENGES TO SUCCESSFUL PREVENTION STRATEGIES

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Any prevention strategies designed to influence individual behavior must take into account a number of existing realities. One of these realities is perception. The overwhelming role that misperceptions play on individual health cannot be overstated because what we see and believe to be true usually becomes true to us in its consequences.

Most people, for example, no longer believe that what are commonly called "accidents" are random acts of fate or "just bad luck" (Girasek, 2001; Girasek, 1999; Smith, Sullivan, Bauman, Powell-Davies & Mitchell, 1999; Mulligan-Smith et al., 1998; Smith et al., 1995; Russell, 1993; Savage, 1993; Eichelberger et al., 1990; Purdy, 1990). Instead, they believe that most injuries are preventable. By and large, a belief in destiny or fate does not keep people from using seat belts or helmets (Tremblay et al., 1999; Byrd, Cohn, Gonzalez, Parada & Cortes, 1999) although one researcher (Colon, 1992) reported a weak association between fatalism and nonuse of seatbelts.

Many people, even when they accurately identify the level of risk to others imposed by a hazard, greatly underestimate their own or a family member's risk of an adverse outcome (Taylor, 1989; Weinstein, Klotz & Sandman, 1988; Weinstein, 1987; Weinstein, Grubb & Vautier, 1986; Weinstein, 1982). The prevalence of this underestimation of risk is as high as 95 percent (Taylor & Brown, 1994). Weinstein did the classic study in this area (1980). He reported that most people believe themselves to be substantially less likely to experience negative life outcomes, such as a heart attack or a car crash, than their peers. Essentially all subjects rated their risks as below average.

In this section, the authors will explore some of the factors that must be accounted for in designing successful prevention efforts.

CHILDHOOD DEVELOPMENTAL ISSUES

While parents exert some measure of influence over their children throughout their lives, one must also acknowledge the developmental realities that present challenges to prevention strategies in risk-inherent recreation. The prevention of injuries to children who participate in risk-inherent activities must take into account some of the normal developmental issues related to adolescence. For example, risk taking is often viewed as a demonstration of control (Hammond & Horswill, 2001). Boys, but not most girls, believe that they are less vulnerable to an injury than their peers (Morrongiello & Rennie, 1998). They believe that if an injury happens to them, it is primarily due to "bad luck," and they perceive that they don't usually have bad luck.

A number of developmental issues during adolescence affect individual perceptions, and thereby increase the risk of serious injury. These include a need for experimentation, susceptibility to peer pressure, a drive for independence, a feeling of infallibility, and perceptions of social norms. Prevention requires an awareness of these issues by both parents and the adolescents themselves.

By age 6, both boys and girls already have differential beliefs about injury vulnerability for boys and girls. Although boys routinely experience more injuries than girls, both male and female children misperceive this reality by inaccurately rating girls as having a greater risk of injury than boys (Morrongiello, Midgett & Stanton, 2000). In a study of the safety values of adolescents and young adults, Crowe (1995) found that young women were much more safety conscious than young men, and that safety values were the best predictors of safety practices. Other researchers have found that males are less likely to use seat belts than are females (Lerner, Jehle, Billittier, Moscati, Connery & Stiller, 2001; Sahai, Pitbblado, Bota & Rowe, 1998; Schootman, Fuortes, Zwerling, Albanese & Watson, 1993). The male's casual attitude toward risk crosses racial, ethnic, and national classifications and is, more or less, universal (Palmer, 2003).

Rebellious, risk-taking behavior and perception of immortality puts adolescents at risk for injury. Children of this age are still concrete thinkers (here and now), and although they understand the immediate results of behavior ("If I roll this machine, I'll probably get hurt"), they have limited sense of any long-term consequences such as disfigurement or disability. They also have the capacity to believe that bad things "won't happen to me."

Even much older, more experienced drivers don't usually drive with the anticipation that the unexpected will suddenly happen - that an animal or a child will dart out in their path. Most drivers have passed hundreds of children who have not run into the street in front of their vehicles. Experience has taught them that such things don't occur and needn't be allowed for.

Driving a motor vehicle is a symbol of independence and sexual potency to a male teen. Voluntarily taking risks is seen as conforming to gender attributes that are highly valued by the teen (Lupton & Tulloch, 2002). To some young girls, riding in a fast vehicle with her boyfriend helps prove to her and to others that she is a woman, not a girl (Dunn, 1972; Fielding, 1972). However, an attractive girl's condemnation of risky behavior can be an important incentive for more moderate driving (Fielding, 1972).

Teens may know that risk taking can have unpleasant consequences, but believe that the consequences won't happen to them (Elkind, 1967; Jack, 1989; Milam, Sussman, Ritt-Olson & Dent, 2000). They are often driven by a need to experiment and to seek thrills (Abend & Hallman, 2003; Shutske, 1997). There is some evidence that risk taking for its own sake is increasing. Once primarily for observers, participation in "extreme" sports is becoming more common (Patel & Luckstead, 2000; Stranger, 1999). Lyng (1990), described the excitement and satisfaction felt by those "living on the edge" and experiencing a magnified sense of self. For parents, this means a heightened need for setting and enforcing consistent rules. Increased supervision is necessary (National Children's Center for Rural and Agricultural Health and Safety, 2001).

PARENTS' AND CHILDREN'S UNDERSTANDING OF INJURY RISKS

Parents have a poor understanding of the risks for unintentional injuries to their children. For example, almost half of parents believe that the likelihood of their child being kidnapped or assaulted by strangers was greater than that of their child's death in a car crash (Becker, Hendrickson & Shaver, 1998; Coffman, Martin, Prill & Langley, 1998; Eichelberger, Gotschall, Feely, Harstad & Bowman, 1990; Glik, Kronenfeld & Jackson, 1991). In reality, the risk of a child dying in a motor vehicle crash is many times the risk of his or her being abducted or assaulted.

There are many examples demonstrating that parents knew of but ignored evidence that products or behaviors were hazardous for their children. The continued widespread use of baby walkers (Bar-on, Boyle & Endriss, 1998) and parents preferring to place their young children in the passenger-side front seat instead of the safer rear seat (Ferguson, Wells & Williams, 2000) are but two examples. Jones found that despite their concern for bicycle safety, most of the adult caregivers of children who did not wear/own helmets (70 percent) stated that they had not considered purchasing a helmet even though they believed that helmets are very effective at preventing serious injuries (Jones, King, Poteet-Johnson & Wang, 1993).

More than two-thirds of parents believe that they don't need literature or instruction on child safety because they are already confident that they have enough information to keep their child safe (Eichelberger, Gotschall et al., 1990). Further, most parents believe that experiencing a serious injury, such as a fracture, is an inevitable part of childhood (Coffman, Martin, et al., 1998; Morrongiello & Dayler, 1996; Bennett Murphy, 2001; Mulligan-Smith, Puranik & Coffman, 1998; Tremblay & Peterson, 1999), and that children learn best about risk avoidance from injury experiences (Morrongiello & Dayler, 1996). It may be particularly difficult to implement childhood safety measures in a rural population (Neufeld, Wright & Gaut, 2002), where parents show strong beliefs that using machinery is highly beneficial to their child's development.

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Many adolescents, particularly adolescent males, tend to find risk taking intrinsically rewarding (Fuller, 1991). If risky behavior is viewed as exciting or is praised by peers, this would tend to increase the behavior in the future. The parents' responses to risk taking or to an injury (attention in the form of scolding, comforting, lectures) may also reward the dangerous behavior. Parents who take risks themselves are more likely to have children who take risks (Fuller, 1991; Wilder & Watt, 2002; Williams, 1976).

Risk-seeking and non-risk-seeking adolescents are aware of the risks associated with operating a motor vehicle, but modify their thinking about these risks in ways that facilitate their continued participation in their chosen driving behavior and style (Gerrard, Gibbons, Benthin & Hessling, 1996).

Risk compensation theory has been shown to relate to how individuals behave in areas such as traffic safety and consumer product safety. Morrongiello and Major (2002) studied parents' judgments about school age children's permissible risk taking when using and not using safety equipment. Parents reported they would allow significantly greater risk taking by their children with safety gear than without gear. Children with more experience in an activity were allowed even greater risk taking, even when not wearing safety gear. No gender differences emerged in any analyses. Their results highlight the need to communicate to parents by correcting their misperceptions about risk in relation to the fact that safety gear moderates injury risk, but does not necessarily guarantee the prevention of injury, particularly if children are allowed greater risk taking when wearing safety gear.

SOCIETAL ISSUES

For many hazards where the perceived emotional or other benefit is high, most people will perceive a lower risk than the true risk (Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978). Very simply, if an individual likes an activity, he will tend to judge its risks to him personally as low (Alhakami & Slovic, 1994; Finucane, Alhakami, Slovic & Johnson, 2000). Thus, because of the human tendencies to underestimate personal risk and to underestimate the risks of things that give pleasure, it is unlikely that warnings alone are likely to produce compliance with safety measures (Weinstein, 1984). This applies even more forcefully when the safety message runs counter to a behavior that is seen as enhancing self-esteem (Weinstein, 1984).

IMPLICATIONS AND PROMISING APPROACHES – THE THREE "E'S" OF PREVENTION

Modern approaches to injury prevention are grounded in a framework that considers an injury to be the product of the interaction between an individual (the "host"), energy (the "agent" that causes injury), and the physical or social environment. Injury prevention strategies can target any one or more of these factors.

Although public health has provided a theoretical foundation for injury prevention efforts (agent, host, environment), it is the interdisciplinary nature of prevention activities that can be credited with successful reductions in the occurrence of unintentional injury. These efforts draw on the expertise of behavioral science, medicine, urban planning, engineering, law, law enforcement, public policy, and other disciplines. They can focus prevention at the level of the individual, the community, or a broader focus such as the state or nation.

Interventions may be active or passive. Active strategies require that a child or caregiver change his or her behavior each time the child begins an activity that has the potential to cause injury. Educating parents to test the temperature of tap water before bathing a child is an active strategy. Passive strategies, such as padded dashboards and shatterproof glass in automobiles, provide automatic protection independent of any individual behavior (Deal, Gomby, Zippiroli & Behrman, 2000).

Injury prevention specialists speak of the Three E's of prevention: Educating about safe behavior, Engineering and design changes to make products safer, and Enforcement of laws, codes, standards, and rules.

Education

In the past, most efforts to prevent injuries have focused on educational strategies that require individuals to take active steps to change their behavior. These strategies are based upon the premise that when parents and children learn how to prevent injuries, they will change their behavior to do so. However, individual action to prevent an injury, a potential event, requires an assessment that a current effort (often inconvenient or less aesthetically pleasing) will lessen the likelihood of a potential adverse outcome sometime in the future. This can be a powerful disincentive. Thus, the link between changes in knowledge and attitudes, and changes in behavior is, at best, weak. Many educational efforts, such as distribution of brochures or isolated public service announcements, have not worked to prevent injuries. Education used in isolation from other prevention strategies (engineering and enforcement) is likely to be ineffective.

Education efforts that connect specific injury problems with specific solutions - particularly those that combine counseling with visual information and free or low-cost safety devices - such as car safety seat use (Christophersen & Sullivan, 1982; Greenberg & Coleman, 1982; Liberato, Eriacho, Schmiesing & Krump, 1989; Miller & Pless, 1977; Scherz, 1976) and smoke detector ownership (Kelly, Sein & McCarthy, 1987; Thomas, Hassanein & Christophersen, 1984) can modestly increase parental adoption of safety behaviors. These behaviors are, in turn, linked to reduced occurrences of injury (Centers for Disease Control and Prevention, 1991; Runyan, Bangdiwala, Linzer, Sacks & Butts, 1992). Unfortunately, the benefits are often relatively small and tend to diminish over time. For example, an intensive educational campaign (group meetings and distribution of literature and posting of signs) directed to staff at a regional trauma center produced only a modest improvement in seat belt use prevalence, and this small improvement disappeared after three months (Scheltema, Brost, Skager & Roberts, 2002).

Education alone - distributing literature, showing videos, speaking of the need to follow or avoid certain practices - is seldom successful at changing injury-producing behavior, and what successes these methods provide usually degrade in a few weeks or months (Dershewitz & Williamson, 1977; Greenberg & Coleman, 1982; Miller & Pless, 1977; Geddis & Pettengell, 1982; MacKay & Rothman, 1982; Reisinger, Williams, Wells, John, Roberts & Podgainy, 1981; Reisinger & Williams, 1978). One evaluation (Dershewtiz & Williamson, 1977) found that one month after mothers had attended a home safety training program where they received training, a booklet of specific safety recommendations, and childproofing items, there was no difference between the intervention group and a control group in either home safety practices or knowledge of household risks. Mothers who attended the program, however, rated their homes as much safer than before they took the training. Mothers who didn't receive the training did not have a measurable change in their opinions of the safety of their homes during the evaluation period.

In fact, there are some indications that safety training may actually increase injuries. Driver education (as seen in the previous section) has been shown to increase the number of adolescents injured in motor vehicle crashes because more and younger drivers are allowed on the road after this training (Robertson, 1980). There is evidence that this works in ways other than simply increasing exposure opportunity. Some adolescents seem to follow temptations to perform activities that are contrary to the safe behaviors described in safety training (Bass, Gallagher & Mehta, 1985; Chilton, 1977; Halperin, Bass, Mehta & Betts, 1983; Stuart, 1974).

Community-based education campaigns using broadcast media, newspaper and magazine ads, pamphlet distribution, and similar traditional techniques are well documented to be ineffective (Berfenstam, 1979; Ellsasser & Berfenstam, 2000; Gustafsson, Hammarstrom, Linder, Stjernberg, Sundelin & Thulin, 1979; Minchom, Sibert, Newcombe & Bowley, 1984; Sundelin, Rasmussen, Berfenstam & Troedsson, 1996). Perhaps a primary reason for these program failures is the same reason why many youth anti-alcohol or anti-drug media campaigns fail - because they are based upon fear appeals or scare tactics. Such campaigns are founded upon the belief that people (youth) can be motivated to stop life-threatening or high-risk behaviors through vivid graphics and emotionally charged messages designed to scare the health into the target population (Linkenbach, 2001).

The problem is that while most experts have concluded that fear campaigns are extremely difficult to execute and rarely succeed (Job, 1988), they are still widely used in the media and training formats. In fact, it is argued that the real risk associated with fear-based approaches is that they will backfire and make the problem behavior even more resistant to change (DeJong and Winsten, 1998). Worse yet is that such scare tactics might actually have what the medical profession refers to as "iatrogenic" or unintended harmful effects opposite from those which were intended. Because of the extent to which these media influences have boomerang effects that result in distorting misperceptions of accurate health norms they should be viewed as iatrogenic risk factors (Linkenbach, 2001) and should be avoided for accident prevention efforts.

Education alone... is seldom successful at changing injury-producing behavior, and what successes these methods provide usually degrade in a few weeks or months.

When an educational program is tailored to specific individuals or groups and includes such features as home visits, neighborhood team building, monthly newsletters, etc., some interventions seem to provide better and more lasting improvements (Bass, Mehta & Ostrovsky, 1991; Bass, Mehta, Ostrovsky & Halperin, 1985; Gallagher, Hunter & Guyer, 1985; Guyer, Gallaher, Chang, Azzara, Cupples & Colton, 1989; Spiegel & Lindaman, 1977; Thomas, Hassanein & Christophersen, 1984).

Engineering and Environmental Change

Engineering may approach injury prevention from two strategies: prevention of the event that may lead to an injury, or prevention of the injury given that the event itself cannot be practically prevented. When examining the possibilities, it is not necessary for the engineer to know why someone behaves in a risky way with a product but that they are likely to do so.

Engineering environmental or product modification increases safety by altering children's physical surroundings or by changing the design of toys or other consumer products. For example, safer physical surroundings may be created by surrounding residential swimming pools with four-sided fences that have self-latching gates, thereby preventing the drowning of young children. Similarly, strangulation may be avoided by narrowing the space between slats in cribs so that an infant's head cannot be trapped.

When an environmental and a behavioral intervention can each accomplish the same goal, the environmental intervention is almost always preferable, because it is less likely to need repetition and more likely to have a far-reaching impact (Peterson, Farmer & Mori, 1987). In some instances, however, environmental interventions are not feasible and behavioral interventions that target the parent, child, or both are necessary (Cataldo et al., 1985; Peterson & Mori, 1985; Roberts, Elkins & Royal, 1984).

To be effective, a strategy must not only work, it must be used (Wilson & Baker, 1987). Thus, it is often the case that both environmental and behavioral interventions must be used; the seat belt, an environmental intervention, must be behaviorally fastened; childproof caps on bottles must be properly replaced (Peterson et al., 1987).

Most of the progress made in making automobile travel safer has come from engineering solutions - cars are more crashworthy, roadways are better designed, roadsides have break-away sign posts, guard rails are sturdier and have softened ends. Transportation and automotive engineers acknowledge that most drivers will make mistakes and have built in protections so that they, their passengers, and their fellow road users will not suffer severe consequences for those lapses in attention or judgment.

Enforcement of Laws and Rules

Enforcement of laws and regulations can lead to changes in behavior. For example, legislation requiring the use of bicycle helmets has increased their use where riders expect the law to be enforced. Regulations can lead to changes in industry standards, such as child-resistant packaging for medications and toxic household products.

Campaigns that combine education and enforcement can be quite effective. In North Carolina, where an education campaign (including broadcast media and outdoor advertising) about the benefits of seat belts and the likelihood of being ticketed for not using them, was combined with an intensive enforcement campaign, the prevalence of seat belt use increased dramatically (Insurance Institute for Highway Safety, 1993a; Insurance Institute for Highway Safety, 1993b). The effectiveness of education when combined with enforcement of laws was demonstrated elsewhere (Alvarez & Jason, 1993).

Enacting legislation and enforcing laws and regulations can be a powerful way to improve safety practices among individuals and populations. However, the use of regulations and laws to provide incentives for compliance with injury prevention strategies is often resisted because it is viewed as an infringement upon personal freedom. These objections should be taken in context. Public health measures such as centrally disinfecting drinking water, pasteurization of milk, and vaccination of children before entering school were all initially resisted because they were viewed by some as impinging upon personal freedoms (Baker, 1980).

SECTION 3
POSITIVE YOUTH DEVELOPMENT AND RELEVANT HEALTH PROMOTION MODELS

AN OVERVIEW OF POSITIVE YOUTH DEVELOPMENT AND RELEVANT HEALTH PROMOTION MODELS

POSITIVE YOUTH DEVELOPMENT

In order to reduce injuries and fatalities in risk-inherent activities, one must employ a theoretical framework that holds out the greatest potential of being effective in reaching our goal. The first framework subscribed to that which supports all 4-H efforts is called "positive youth development."

Over the past several decades, a variety of approaches to youth development have emerged. One set of such approaches focuses on prevention or intervention as the strategy of first importance. In this approach, there is an assumption that something is already wrong, and that "broken" kids just need to be "fixed" or "repaired" and sent back out in the world after they are repaired. These approaches focus on the problems. Such approaches often are characterized by a medical context of "inoculation" or "prescription." These "problem-focused" approaches were popular in the 1970s and 1980. Yet, as Karen Pittman poignantly observes: "Problem-free is not fully prepared" (Pittman, 2002).

As a result, there is another model (positive youth development) that has gained support more recently that suggests that we work with all kinds of kids, not just those labeled "at-risk" or from "high-risk" environments. In this approach, the problems and challenges of adolescence aren't ignored, but the focus is more on those "protective factors" which can offset and often overcome the negative influences present in young people's lives. This approach focuses on building a web of supports, relationships and opportunities for all young people in order to foster healthy lifestyle choices. This approach looks for ways to prepare young people with useful life skills for adulthood and promotes the nurturing of assets as a way to successfully make the transition to adulthood.

A positive youth development approach is different from traditional "deficit-reduction" or "risk-reduction" strategies that have been popular in the prevention field in previous years. What exactly do we mean by positive youth development?

- Youth development is the natural process of developing one's capacities. While it occurs through the youth's daily experiences with people, places, and possibilities, it is far too important to be left to chance.

- Positive youth development occurs from an intentional process that promotes positive outcomes for young people by providing opportunities, relationships and the support to fully participate. Youth development takes place in families, peer groups, schools, neighborhoods, and communities.

- 4-H Youth Development Programs provide just such opportunities, relationships, and the support for youth to help them acquire the life skills necessary to meet the challenges of adolescence and adulthood. 4-H Youth Development uses experiential, research-based educational opportunities that help youth become competent, caring, confident, connected, and contributing citizens of character.

Recent research conducted by the National Research Council (Eccles & Gootman, 2002) indicates that positive youth development settings exhibit certain features:

- Opportunities to experience supportive relationships

- Appropriate structure
- Physical and psychological safety
- Opportunities to belong
- Positive social norms
- Support for efficacy and mattering
- Opportunities for skill building
- An integration of family, school and community efforts

Kress (2004) describes four essential categories for positive youth development: Belonging (having a positive relationship with an adult; an inclusive environment; and a safe environment); Mastery (being engaged in learning and having an opportunity for mastery); Independence (having an opportunity to see oneself as an active participant in the future and having an opportunity for self-determination); and Generosity (having an opportunity to value and practice service for others). From this and other research, we know that to be effective in promoting positive youth development, all youth development efforts must include these critical elements.

Positive youth development experiences must provide high quality, sustained engagement with young people as partners and resources, and be designed to meet their developmental needs at every stage of their lives. Positive youth development is relevant to the needs of all young people, not just those in high-risk situations.

In addition, the fundamental principle of youth development work is that youth are at the center of their development. They have certain developmental needs - emotional, social, intellectual and physical - and attempt to meet those needs throughout their day-to-day lives. Each young person does this in his or her own way. Our role as adults is to help play an active role in guiding and meeting these needs.

Youth development occurs whether by intent or happenstance. Whether or not we are present in the lives of young people, they will seek to have these needs met - consciously or unconsciously! They will grow up with or without our help. Youth development is a natural process, but the work we do is founded on the principle that it is too important to be left to chance.

So, when we speak about positive youth development, we specifically refer to intentional efforts that promote positive outcomes for young people through a variety of supports, relationships, and opportunities. Youth development is designed to focus on the positive outcomes we desire for young people, not just on preventing the negative outcomes we hope to eliminate.

Youth development can take place almost anywhere - with peers, in families, in communities, even at school. For many youth, though, out-of-school, community-based organizations are the one place to be a part of ongoing, intentional efforts that promote optimal, healthy development of the body, mind, and spirit.

Positive youth development integrates prevention models of the past that focused solely on correcting youth problems and the negative outcomes we hope to prevent. Many in the prevention field have acknowledged that the practice of trying to "fix" young people was not adequate and was not helping them develop in positive ways. We know from experience that efforts that rely solely on risk reduction strategies fail to adequately prepare young people to assume productive roles as adults.

Positive youth development is also holistic in its approach by addressing both protective factors and risk factors. Positive youth development shifts the dialogue from one that just focuses on youth with problems to one that asks how communities can help youth develop the confidence, competence, compassion, connections and character to contribute in meaningful ways so that they grow up into healthy adults. This understanding is central to the work of the 4-H youth development movement.

HEALTH PROMOTION MODELS

There are a number of prevention models in existence that purport to be effective in reducing risk behaviors. In this section, the authors review some of these models.

Social Norms Theory: The Science of the Positive

For the last few decades, health promotion has been largely based on informing the public about the negative consequences of harmful behaviors. Yet, after years of using this approach, there is little or no evidence to suggest that it changes behavior. The naïve belief in this approach is that one could "scare" people into healthy behaviors.

The social norms approach is grounded in a model of scientific inquiry and discovery. It investigates what the reality of social behavior of people is, and contrasts it with perceptions of this same behavior. It then offers a theory predicting behavior based

on actual and perceived norms, proposes a model of intervention based on this theory, and considers the empirical evidence of effectiveness when the model is implemented in practical intervention environments (Perkins, 2003). As a result, it is often more of an environmental strategy rather than a behavioral strategy.

This theory states that behavior is influenced by our perceptions of how other members of our social group think and act, and that those perceptions may be incorrect (Perkins and Berkowitz, 1986). Thus, overestimates of dangerous behavior among peers will tend to increase an individual's or group's problem behavior and underestimates of safe behavior patterns will discourage individuals from adopting or continuing safe behavior. For adolescents, peer influences (real and perceived) have a greater impact on individual behavior than biological, familial, religious, and cultural influence (Berkowitz, 2003; Berkowitz & Perkins, 1986; Perkins, 2002). These peer influences are based as much upon what youth believe their peers think and do as upon their real beliefs and actions. If individuals are presented with the correct information about healthy peer norms concerning attitudes and behavior, the pressure to conform to an inaccurate image of peer beliefs and actions is reduced (Perkins, 2002).

This prevention model was first demonstrated to be successful at reducing initiation to binge drinking among students on several college campuses. In fact, the utilization of a social norms based marketing campaign reduced so-called "binge drinking" in various colleges by as much as 18 to 21 percent in as little as two-year periods of time (Perkins, 2003). Most impressive about these results is that they occurred against a national backdrop of colleges that remained virtually unchanged in binge drinking behavior in spite of the fact that most of them were engaged in some sort of prevention process (Perkins, 2002). In addition to reducing high-risk drinking behavior in college students, the social norms approach has also been applied to the issue of reducing alcohol and tobacco use in adolescent populations (Haines, Barker & Rice 2003; Linkenbach & Perkins, 2003), impaired driving in statewide populations of young adults (Linkenbach & Perkins, 2003), as well as increasing statewide seatbelt use in a statewide population of adults (Linkenbach, Perkins & Cornish, 2003).

Other relevant studies of the social norms approach have focused on misperceptions of parents and misperceptions of policies. In a statewide study of parent perceptions of others parents' attitudes and behaviors, it was found that parents misperceive the healthy protective behaviors and attitudes of other parents (Linkenbach, Perkins, & DeJong, 2003). In essence, they are operating from a misguided position of assuming that they were unique in their positive actions and attitudes about raising their teenagers when in fact they were part of a majority norm of other parents across the state. The implication of this misperception is that parents often don't receive feedback about these protective actions - especially from their kids, who often inaccurately state, "all the other parents let their kids do it." Such a misperception, when corrected, could have a positive impact on reinforcing parents for the positive protective attitudes and actions (norms) that they are already practicing. Social norms theory might also have application to misperceptions of public policy. In the same way that individuals underestimate the actual health norms that surround them, they also tend to underestimate the attitudes of others in regard to strengthening public health policies. Recent studies have demonstrated that a greater percentage of individuals actually support stricter policies for reducing alcohol abuse in their communities than what they perceive their peers think (DeJong, W. 2003; Dunnagan, et al. 2003).

For adolescents, peer influences (real and perceived) have a greater impact on individual behavior than biological, familial, religious, and cultural influence.

Precede-Proceed

This model (Predisposing, Reinforcing and Enabling Constructs in Educational and Ecological Diagnosis-Policy Regulatory and Organizational Constructs in Educational and Environmental Development) highlights the importance of identifying the predisposing, enabling, and reinforcing factors that influence the behavior of interest (Green & Kreuter, 1999). Predisposing factors consist of knowledge, beliefs, values, attitudes, and confidence. These motivate recreationists to behave in a particular way; i.e., for a snowmobiler to travel at a particular speed. Enabling factors, using the snowmobiler example, include availability of a vehicle, the vehicle's capacity to travel at high speed, access to property upon which to drive, etc. Reinforcing factors consist of

the influence that other people hold over the behavior of interest. These include peers, family, law enforcement officers, policy-makers, etc. The degree to which people provide snowmobilers with an incentive to operate the vehicle in a risky way contributes to a driver continuing to operate in a risky way. Enabling factors would also be parents having few rules, lax monitoring of rules or minimal penalties for breaking rules (Gabany, Plummer & Grigg, 1997).

Developing a valid inventory of the factors that predispose, enable, and reinforce a recreationist to behave in a risky way is an important first step toward conducting a safety promotion campaign.

Theory of Reasoned Action

According to the Theory of Reasoned Action, a personal or attitudinal component and a social or normative component are the two primary factors affecting the formation of behavioral intentions. The attitudinal component is comprised of behavioral beliefs (outcome expectations) and outcome evaluations, and the social component is comprised of normative beliefs and motivations to comply. Behavioral intentions are usually accurate predictors of behavior (Ajzen & Fishbein, 1980). Other theorists (Grube, Morgan & McGree, 1986) suggest that including behavioral norms (the perceived behavior of significant others) greatly improves the Theory of Reasoned Action model. According to Bandura (Bandura, 1969; 1971; 1977) imitation is an important means of learning behavior.

Theory of Planned Behavior

The Theory of Planned Behavior grew out of the Theory of Reasoned Action (see above). The Theory of Reasoned Action was intended to be applied to the prediction of purely volitional behaviors. However, according to the Theory of Planned Behavior, many behaviors are not under complete volitional control (Ajzen, 1988). According to Ajzen (1988), perceived behavioral control should predict behavioral intention and, when people correctly perceive that they have control over a behavior, should predict the actual performance of the behavior. This model can identify key beliefs that can be targeted in an intervention but does not specify how to change the beliefs or how to choose arguments to include in messages intended to modify the beliefs (Sutton, 2002).

Active and Passive Approaches To Prevention

Injury prevention specialists differentiate between active and passive prevention strategies. Active prevention strategies typically require frequent repeated action by individuals in order to achieve any protective benefit. For example, the skater must actively put on a helmet, knee pads and wrist pads each time he rides. Passive protection requires infrequent or no individual action but provides protection to large numbers of people at the same time. Childproof caps on medicine or household chemical bottles and airbags in automobiles are examples of passive protection. Soft surfaces under children's playground equipment reduce injuries from falls regardless of the child's behavior or the caretaker's attentiveness.

There are some prevention strategies that are classed between these extremes on the active-passive continuum. Smoke alarms must be purchased, installed, and the battery must be occasionally replaced and the unit tested. A hot water heater must be turned down to a safe temperature (once) to prevent scalds from hot tap water.

Individual and Population Approaches to Injury Prevention

There are two or perhaps three schools of thought about whether prevention activities should focus primarily on individuals or on populations. Although this idea is evolving, many psychologists prefer changing an individual's behavior to promote safety (Harris, 1981; Califano, 1979). Others argue that population-based interventions are not only more efficient but also more effective, and that an emphasis upon personal responsibility ignores the vital role of social, political, and economic factors and the importance of physical environments (Davis, Schletty, Ing & Weisner, 1984; Baker & Dietz, 1979). In most cases, a combination of approaches is necessary.

Injury prevention strategies may involve conflicts with societal values and tradeoffs of public safety versus individual freedoms (Pearn, 1985). It is one thing to argue that, among mature adults, the freedom to choose one's own destiny trumps the regulation of dangerous behavior. It is quite another thing to make the same argument about children. Society recognizes that children and adolescents are ill-equipped to make judgments about how to behave and how current actions may shape their future.

Sometimes an environmental modification intervention to prevent one type of injury may increase the risk of another problem. Examples of this include the problem of children riding in the front seat of airbag-equipped cars (Braver, Ferguson, Greene & Lund, 1997; Centers for Disease Control and Prevention, 1996b) and the application of certain flame-retardant chemicals to children's sleepwear that in some instances put carcinogens in contact with the child's skin (Blum & Ames, 1977). Sometimes other factors affect the occurrence of injuries. In the 1970s there

were several gasoline-saving policies that had effects on injury rates. In addition to saving gas, the national 55 miles-per-hour speed limit significantly reduced the death rate from highway crashes. However, another gas saving measure, allowing right turns on a red traffic signal, led to increases in pedestrian injuries (Roberts & Brooks, 1987). Every injury prevention program should be evaluated to confirm that it works and that it has no unintended harmful consequences.

The likelihood that a given injury prevention strategy will be successful at reducing injuries in a population depends upon the frequency of action required. The likelihood that injuries will be prevented is greatest when the frequency of action required is lowest. In general, strategies that require frequent action - especially action every time there is exposure to a hazard, for example helmet wearing - are least likely to be successful at preventing injuries to the entire population at risk (Baker, 1981). When frequent action is required, it is rarely taken consistently. People find it troublesome to take such measures to prevent a relatively rare event, particularly when the measure is viewed as uncomfortable or inconvenient and there are few reinforcers to sustain the prevention action. When a particular active strategy is viewed as being in opposition to convenience, comfort, thrift, or self-image, it is unlikely to be successful without strong incentives to balance the resistance. In fact, many hazards are unlikely to be eliminated because they are felt to be necessary to maintaining our standard of living (Wilson et al., 1987).

When active strategies are part of an injury prevention plan, it is important to examine them to determine why people might choose not to use it and what might induce them to use it (Leventhal, Safer & Panagis, 1983).

Injury Prevention Models

There is seldom, if ever, a single cause for an injury. There are multiple factors, each of which are interconnected and interacting (Rothman, 1976). Crashes are best examined in terms of factors, which, if different, would have altered the probability of event occurrence or severity of the resulting injury. One model of injury occurrence involves the classic public health triangle: a susceptible host (the injured person), a predisposing environment, and an inciting agent (energy). The logical questions that arise are: Can the host be made less susceptible, the environment less predisposing, and the injury-causing agent controlled?

There are three broad time frames during which it is possible to prevent adverse outcomes from any injury-producing event. Injuries may be controlled by: 1) preventing events that may result in injury; 2) minimizing or preventing injury should an event with injury-producing potential occur; and, 3) decreasing

Table 1. Haddon Phase-Factor Matrix ("ATV Use as Example")

Phase	Host (Human)	Vector (Vehicle)	Physical Environment	Socio-Cultural Environment
Pre-Event	- Developmental stage - Experience - Training - Judgment - Alcohol	- Brake condition - Tire condition - Vehicle: Design, Modifications, Size, Maximum speed	- Uneven terrain - Night - Rain	- Acceptance of children riding adult-sized ATVs - Rider peer pressure - ATV advertising - No enforcement
Event	- Helmet - Gloves - Eye protection - Boots	- ATV weight - No ROPS - Nothing to protect from ejection off machine	- Trees, rocks in path	- No speed limits
Post-Event	- Physical condition	- Fuel system integrity - Celll phone	- Distance of emergency response	- Support for trauma systems and training of EMS personnel

the likelihood of death or permanent disability should an injury occur (Haddon, 1968; Haddon, 1970).

Perhaps the oldest and best model for examining the multiple causes of injury and the opportunities for prevention is the Haddon Matrix (Haddon, 1972). This model (Table 1) is based upon several tenets. First, the event leading to the injury should be distinguished from the injury itself. A crash of a sled into a tree is a separate event from the injury that may or may not result. Second, factors that increase the risk of an injury can either increase the likelihood that a particular event will occur (pre-event phase) or, once the event occurs, influence the probability or severity of injury (event phase). Third, factors that influence the long-term impact the injury will have on the victim are important (post-event phase). The time it takes for someone to recognize that an injury has occurred, the time it takes for help to be summoned, the time it takes for help to arrive, the quality of the on-site emergency care received, and the time it takes for the victim to arrive at a suitable emergency facility will all have a strong influence upon the consequences of an injury. The probability of surviving an injury with minimum consequences decreases with each passing minute after the injury occurs. This has particular meaning in rural settings where help may be far away.

Haddon also devised an exhaustive list of ten categories of prevention strategies (Table 2) to provide a conceptual basis for understanding the pathogenesis of injury in order to plan an injury control program. Obviously, some of Haddon's Ten Strategies are impossible or highly infeasible when applied to an injury problem. However, it is often helpful to use this list as a structured way to begin thinking about injury causes and potential prevention strategies. Table 2 is displayed with Haddon's own examples (Haddon, 1980; Haddon, 1970).

Table 2. Haddon's Ten Injury Prevention Strategies

General strategy	Illustrative examples
1. To prevent the creation of the hazard in the first place	Prevent production of plutonium, thalidomide, LSD
2. To reduce the amount of hazard brought into being	Reduce maximum speed of vehicles, lead content of paint, mining of asbestos
3. To prevent the release of the hazard that already exists	Pasteurizing milk, blocking old mine entrances
4. To modify the rate or spatial distribution of release of the hazard from its source	Brakes, shutoff valves
5. To separate, in time or space, the hazard from that which is to be protected	Walkways over or around hazards, evacuations, isolation of persons with communicable diseases
6. To separate the hazard from that which is to be protected by interposition of a material barrier	Surgeon's gloves, childproof drug, or poison-container closures
7. To modify relevant basic qualities of the hazard	Breakaway roadside poles, making crib slat spacing too narrow to strangle a child
8. To make that which is to be protected more resistant to damage from the hazard	Immunization, making structures more fire- and earthquake-resistant
9. To begin to counter the damage already done by the hazard	Rescuing the shipwrecked, extricating trapped miners
10. To stabilize, repair, and rehabilitate the object of the damage	Post-traumatic cosmetic surgery, physical rehabilitation, rebuilding after fires and earthquakes

SECTION 4
CONCLUDING COMMENTS AND RECOMMENDATIONS

CONCLUDING COMMENTS AND RECOMMENDATIONS

The review of the literature found no evaluations of risk-inherent recreation injury prevention programs or prevention programs that used a control group for comparison of injury occurrence or observed, lasting behavioral changes. Moreover, the authors found almost no programs that focused their prevention efforts on parents or other custodial adults working with children. In fact, the authors found very few intentional, research-based prevention programs in the entire field of risk-inherent activities. Developing such programs is evidently not a high priority.

However, through the process of conducting this review the authors found encouraging signs of effective prevention efforts that could have implications for planning, implementing, and evaluating injury prevention activities. For example, peer group norms are highly correlated with actual behavior. Parental influence and role modeling is also highly correlated to adolescent choices and behaviors. Mandatory training programs and laws appear, in some cases, to increase safe practices and thus reduce injury occurrence. Legislation can also be effective at increasing safe practices when it is part of a larger, more comprehensive strategy.

All these indicators of hope suggest that positive impacts can be made to reduce recreational injuries and deaths. The most promising area for future research involves assessing both parent and youth misperceptions of norms and various risk factors - an indication of the importance of correcting such misperceptions of norms as a risk reduction strategy.

METHODS FOR CHANGE

Behavioral approaches to injury control

In some cases, perhaps most, injuries cannot be controlled through passive environmental strategies alone. Successful injury control usually requires application of behavior change strategies at some point in the childhood injury prevention process (Peterson et al., 1987; Roberts, Fanurik & Layfield, 1987; Roberts & Layfield, 1987; Peterson et al., 1985). There is often a need to apply some level of influence to the children and adolescents at risk, their caregivers, legislators, and law enforcers. Using the example of seat belts in automobiles, government regulations that were the product of strong advocacy led to a requirement that seat belts be installed in all new cars. This didn't result in everyone using belts, so there were campaigns to improve the prevalence of their use. Advocates again worked with state legislators, with the result that 49 of the 50 states now have some form of law that requires automobile passengers to use seat belts.

Behaviorally oriented psychologists have described problematic behavior as falling into two categories - excess behavior and deficient behavior (Gelfand & Hartmann, 1984). Excess behavior occurs when unsafe behavior (driving a snowmobile too fast)

For example, peer group norms are highly correlated with actual behavior. Parental influence and role modeling is also highly correlated to adolescent choices and behaviors.

occurs so frequently as to produce many opportunities for injury. Deficient behaviors are when safe behavior (wearing seatbelts) occurs infrequently.

Some might be tempted to think the situation is hopeless because it is human nature for children and adolescents to take risks. It is not necessary to change "human nature" but rather to change human behavior, and there are many examples of successes in changing behavior regarding health and safety. For example, nowadays most people use seat belts. Moreover, the prevalence of drinking drivers has declined after advocates changed the image of drinking and driving from normal to criminal. Over the last several decades, smoking has become more associated with chemical dependency and other negative qualities than with glamour and success. A similar change in recreational injury rates could be accomplished if risk-taking behavior became more associated with immaturity and failure than with glamour and excitement (Evans, 1991).

Community-based interventions

Community-based interventions may provide a promising avenue to reduce child and adolescent injuries. By focusing upon altering behavior, promoting environmental change within the community, or passing and enforcing legislation, community-based interventions seek to change social norms about acceptable safety behaviors. There is evidence that community-based approaches can be effective at increasing some safety practices, such as bicycle helmet use among children and car safety seat use. However, other problems, such as adolescent motor vehicle injuries, seem to be less responsive to community approaches without other safety incentives like graduated licensing laws (Klassen, MacKay, Moher, Walker & Jones, 2000). Perhaps building the strength of already existing norms might prove to be most effective.

The literature review identified common elements of successful community-based approaches. First, the use of multiple strategies grounded in a theory of behavior change is critical. Second, to maximize success, interventions should be integrated into the community and approaches should be tailored to meet unique community needs. Third, community stakeholders should be included in the development of community-based strategies. This community involvement and ownership of the intervention increases the likelihood of modeling and positive peer pressure (i.e. norms), leading to more widespread adoption of a safety behavior (Klassen et al., 2000).

NEXT STEPS

Through this extensive review of risk-inherent recreational activities, the authors found that the prevention or safety field lacks the promise of a single magic bullet. Prevention of injuries in activities is a multi-faceted problem involving, at least, the individual characteristics of the child, parental attitudes, cultural norms, environmental design, and legislation and enforcement.

Much can be learned from other fields and their experts. Cross-disciplinary discussions need to continue among experts to relate and compare their findings, including the strengths and limitations of each type of program, and help each other improve them. In the end, the best approach will include a mix of strategies and methods.

In many areas (such as bicycle safety and drowning prevention), public health professionals have long recognized that multi-disciplinary efforts are likely to be more successful than any single type of effort alone (Schieber & Vegega, 2002).

Preventing injuries to children and adolescents will require a sustained multi-disciplinary effort on the part of manufacturers, policymakers, law enforcement officials, health and safety advocates, and parents. Further research will need to be done to identify factors that may influence parents and children to behave more responsibly. The effectiveness of prevention activities must be demonstrated through well-designed evaluation research studies.

Also important is the amount of attention that must be dedicated toward identifying and increasing those forces that already exist as norms, and that are pulling both parents and youth toward increased safety. Health and safety advocates, manufacturers, policymakers, and law enforcement officials are certainly capable of working together to meet these challenges. The task before us now is to translate these findings into action and encourage additional research to further our understanding.

The authors offer these comments and, in conclusion, the following recommendations.

RECOMMENDATIONS

1. STAY POSITIVE AND INCLUSIVE. A primary challenge to all of the various interest groups working on recreational safety issues is to stay positive and inclusive. Staying positive is a perspective based upon seeing the "glass as half-full." Being inclusive is a result of a stated value and intention associated with creating a spirit of teamwork among different interest groups. It is a result of identifying and working on common goals rather than focusing on differences. One message is

clear: too many children and adolescents are being injured and killed while recreating and immediate action is needed.

2. EMBRACE COMPLEXITY. Complex social problems demand comprehensive solutions. Practical solutions will not emerge from a short-sighted "one size fits all" approach, which oversimplifies the issue and results in polarizing key stakeholder groups at a time when identifying commonalities and sharing resources is needed. As with the prevention of other types of injuries to children, research clearly shows that the most effective prevention strategies involve multi-faceted, community-based approaches that include educational efforts aimed at children and parents, enforcement, and media campaigns.

3. MAINTAIN A BI-PRONGED PERSPECTIVE. The issues associated with youth recreational safety entail perspectives that are both general to the field of prevention and specific to recreation. All work and recommendations should address prevention from both of these frameworks. This bi-pronged approach should be maintained throughout future exploration of safety intervention strategies.

4. BUILD A BROAD COALITION. All effective social change strategies ultimately require the strength associated with building a broad coalition of support. The most effective solutions come from a joining of the various interests of a broad array of concerned stakeholders, including; parents, national youth organizations, researchers, the manufacturing industry, government agencies, consumer advocacy groups, and other key parties. The coalition format can go a long way towards ensuring that any potential policies or intervention strategies are supported and not undermined. Through such broad-based support, we can reverse the upward trend in injury occurrence while building partnerships between recreationists, prevention professionals, industry, and consumer advocates.

5. COORDINATE SYNERGISTIC STRATEGIES. A well-orchestrated effort is needed rather than the all-too-common cacophony of prevention approaches that are presented under the guise of a multi-faceted approach. Prevention programs are most successful when they are operated from a clear, consistent framework that allows the different strategies to enhance each other. Unfortunately, in the reality of practice, this research is often translated into trying everything - including competing theories. Such practices are not only ineffective, but also very costly. A well-designed targeted intervention should be developed, evaluated, and updated based upon data.

6. INCORPORATE TECHNOLOGICAL SOLUTIONS. Young people are very comfortable in technological formats. Technological strategies could impact perceptions, attitudes, behavior, and knowledge. Web-based interactive strategies for assessing attitudes and behaviors as well as for delivering interventions should be explored because they are fun and highly cost effective. Data can be gathered through the Web and important safety updates can be provided to both parents and young riders through interactive CD-ROMs.

7. CONDUCT AN EXPERIMENTAL PROJECT. A pilot project should be developed and tested which incorporates an experimental design involving treatment and control groups. The results and lessons learned from this project can then guide the development of a "best practice" model. Specific approaches such as the social norms framework could be employed so that researchers can assess exactly what is making a difference in changing attitudes and behaviors in the youth community. Training programs that use sophisticated evaluation and research methods should be employed. A science-based approach can positively impact the social culture and strengthen the resolve of partners based upon proven effectiveness.

8. INVOLVE PARENTS. One message is clear from the review of research in related fields of prevention: the solution to reducing youth death and injury must address the social culture of youth and parental recreation. Therefore, we must join parents and youth in a joint spirit of cooperation. This collaborative, intergenerational approach is a foundational framework from which all youth safety efforts must begin. The reality that parents influence kids' behaviors should be recognized so that they are integral parts of any training program. Youth need to hear their parents' clear expectations concerning their safety. In addition, parents must be viewed as a secondary target population who also need support, skills, and tools for communicating safe practices to their children. Parent norms affect youth norms and set the tone for the recreational culture. As the review has discovered, a sustained hands-on training program that involves parents by correcting misperceptions of norms can reduce injury and death.

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