



# Applying a Developmental Approach to Injury Prevention

James A. Mercy, David A. Sleet, and Lynda S. Doll

## ABSTRACT

*The epidemiology of unintentional injury and violence, including likely causes and individuals' abilities to respond to risks, are closely related to the stages of human development. The epidemiology and prevention of injury are also influenced by the social contexts (i.e., family, community, and socio-cultural) in which human development occurs. The purpose of this article is to describe injury risk and prevention strategies across the developmental stages of childhood and adolescence and associated social contexts. Viewing injury prevention from this perspective suggests that developmentally appropriate interventions conducted over several stages may be more likely to motivate and sustain injury prevention behavior change across a lifetime than a single intervention or a single policy change.*

Unintentional injuries and violence profoundly impact healthy physical and emotional development during childhood and adolescence. In every industrialized country, injury is the leading killer of children, accounting for almost 40% of all deaths among children ages one to 14 (United Nations Foundation, 2001). In the United States, about 20 children die every day from an injury, more than from all other diseases or conditions combined (Sleet, Schieber, & Dellinger, 2002). For each injury death to children less than 20 years of age, there are approximately 16 hospitalizations and 562 children treated and released from emergency departments (Centers for Disease Control and Prevention [CDC], 2001a). Injuries requiring medical attention or resulting in restricted activity affect more than 20 million people and cost \$17 billion annually for medical care (Danseco, Miller, & Spicer, 2000). Injuries also are one of the primary causes of death and disability to

children in the developing world (Krug, 1999; McQueen, McKenna, & Sleet, 2001).

Injuries can have serious long-term consequences for the healthy development of children and adults. For example, new scientific evidence shows that exposure to child maltreatment and other forms of violence during childhood is associated with risk factors and risk-taking behaviors later in life (e.g., depression, smoking, high-risk sexual behaviors, unintended pregnancy, and substance use) as well as some of the leading causes of death, disease, and disability (e.g., heart disease, cancer, suicide, and sexually transmitted diseases) (Felitti et al., 1998; Anda et al., 1999; Dietz et al., 1999; Hillis, Anda, Felitti, Nordenberg, & Marchbanks, 2000; Hillis, Anda, Felitti, & Marchbanks, 2001; Dube et al., 2001). It is unknown how many adults still suffer from injuries they received during childhood, but it is likely that childhood injuries can have lifelong impact on health and development

by causing permanent disabilities or long-term psychological damage (Sleet & Mercy, 2003; Zaff, et al., 2003). One follow-back survey of adults found that 62% of men and 26% of women reported at least one hospitalized injury since age 16, with 3.2% of these causing permanent physical disability (Barker, et al., 1996).

The purpose of this article is to describe injury risk and prevention strategies across the developmental stages of childhood and adolescence. We frame our discussion within an ecological model that emphasizes, for each developmental stage, the multiple levels of influence (family/peer, community,

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James A. Mercy, David A. Sleet, and Lynda S. Doll are with the National Center for Injury Prevention and Control (NCIPC), Centers for Disease Control and Prevention (CDC), Mailstop K68, 4770 Buford Highway, NE, Atlanta, GA 30341-3724. E-mail: JAM2@CDC.gov



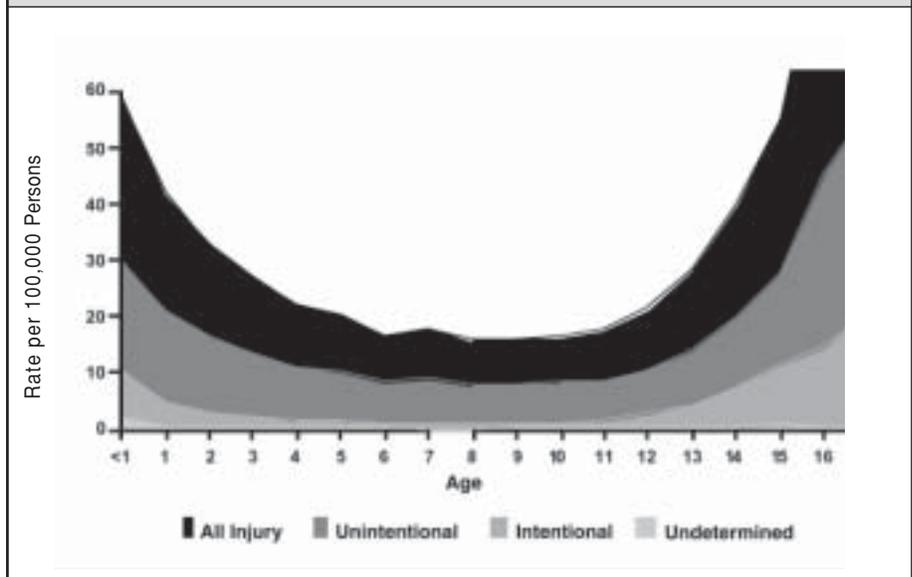
and social-cultural context) on both the causes and approaches for preventing injury risk. We emphasize social influences, though we also provide examples of physical settings (e.g., home, school) that are critical to injury prevention.

### INJURY, HUMAN DEVELOPMENT, AND ECOLOGY

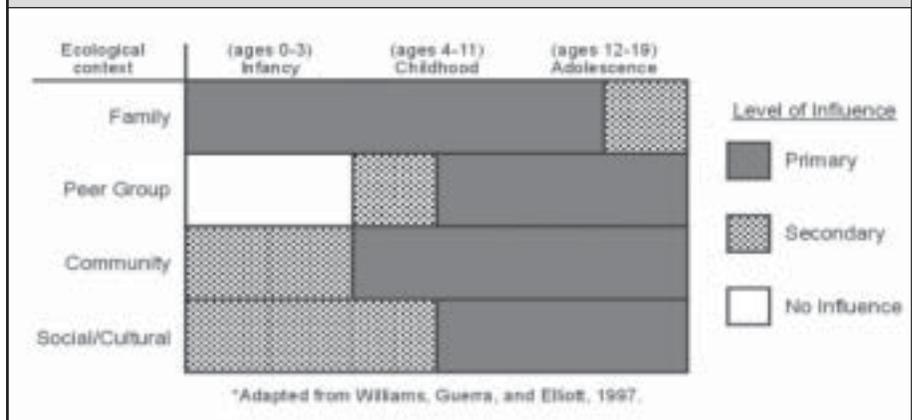
Changes in injury patterns, including likely causes and individuals' abilities to respond to risks, are closely related to developmental stages over the life course (Zuckerman & Duby, 1985; Dahlberg & Potter, 2001; Williams, Guerra, & Elliott, 1997). Exploration of the physical environment is an important developmental task during infancy and early childhood. Children gradually encounter more and different injury risks at the same time they are also developing the perceptual and cognitive abilities to adequately evaluate them. Parental supervision is critical during this period, especially given the limited cognitive skills and physical size of young children. As children mature, they gradually take more responsibility for self-protection from injury. Normal development is accompanied by greater opportunities for physical and social independence. Along with these changes opportunities to observe and engage in violent behavior also occur. Risk taking, a normal part of growing up, can enhance learning by providing children and adolescents with opportunities to test their limits and increase adaptation to their environment. However, these opportunities often are accompanied by increased rates of injuries and deaths.

Figure 1 shows death rates for major causes of injury from birth to age 17. Death rates are higher for unintentional than violence-related injuries at every age, and the u-shaped death rate curves by cause of death parallel one another. They show dramatically high injury death rates in young children, followed by a drop in middle childhood, then a sharp rise in late childhood and early adolescence that continues through late adolescence and early adulthood. The same u-shaped curve is

**Figure 1. Injury Fatality Rates (per 100,000) by Single Year of Age and Manner of Death, United States, 1998**



**Figure 2. Ecological Model of Life Course Development\* by level of Influence and Developmental Stage**



found in the distribution of nonfatal injuries by age (combining unintentional and violence-related causes), though the curve is not as pronounced as that for fatalities (CDC, 2001a).

The circumstances under which injuries occur change over the life course as well. During infancy and middle childhood, violence-related injuries primarily are caused by child maltreatment at the hand of parents or caretakers, but as children enter adolescence injuries from peer to peer violence and suicidal behavior predominate (Lung

& Daro, 1996; Dahlberg, 1998; CDC, 2001a). As children age and grow, developmental milestones help predict changes in injury risk, from those determined and controlled by the environment to those determined and controlled by individual behaviors. However, even for teens and adults, the environment plays an important part in overall risk potential, making the management of environmental risks important throughout the lifecycle.

Just as individual factors like physical size, cognitive ability, greater independence,



and risk taking are related to injury risk and prevention, so are the social contexts of children and adolescents. Social contexts (i.e., family/peers, community, social-cultural) change with development as do exposure to a variety of physical contexts (e.g., home, streets, neighborhoods, playgrounds, pools) and products (e.g., cribs, toys, bicycles, weapons) that may influence risk. According to the ecological model in Figure 2, from infancy through early adolescence, the family is the primary influence on safety. Also influential in childhood are peer influences and communities' actions, such as policies and structural changes. During infancy and early childhood the social and cultural context (e.g., social norms, state and national laws requiring safe behaviors) affects the safety of children primarily through its influence on parents and caretakers. Moving into and through adolescence, peers and the social/cultural context have even greater influence, although characteristics of the family and community remain essential to ensure safety.

### **LINKING INJURY PREVENTION WITH HUMAN DEVELOPMENT**

Table 1 presents a matrix of injury prevention strategies by developmental stage (i.e., infancy, childhood, adolescence) and by social context towards which the intervention is directed (i.e., family/peers, community, social-cultural). Some interventions influence injury risk across several developmental periods (e.g., parent training in the family or traffic calming in the community). Other interventions may be relevant in more than one physical setting and developmental stage (e.g., policies against bullying in schools and communities). The matrix reinforces the idea that what is ultimately needed to promote safety is a continuum of effective programs and services across the developmental spectrum that addresses salient ecological contexts.

### **INFANT AND TODDLER YEARS (AGES 0-3)**

The safety of infants and toddlers is dependent primarily upon two factors: an

appropriately safe home and community environment, and adequate parenting. Prevention of injuries to infants and toddlers can be achieved through a variety of means. These include modifying the home and community environment to increase safety, enhancing the child-rearing and supervision skills of new parents through home visitation and other strategies (Tertinger, Greene, & Lutzker, 1984; Hawkins, Von Cleve, & Catalano, 1991; Patterson, Capaldi, & Bank, 1991; Krugman, 1993; Olds, 1998; DiGuseppi, & Roberts, 2000; U.S. Department of Health and Human Services, 2001), improving safety in day care environments (Sacks et al., 1989), and adopting and/or enforcing laws that protect infants and toddlers from harm. Examples of effective laws include those that address pool fencing, infant and child safety seats, child resistant packaging to prevent poisoning, safe cribs to prevent strangulation, sleepwear regulations for burn prevention, and the safety of baby walkers (Sleet, Schieber, & Gilchrist, 2003; Grossman, 2000).

### **CHILDHOOD (AGES 4-11)**

During childhood the family remains the most influential social influence though peers, the community, and the broader social/cultural context gradually take on greater significance. Involvement by parents, teachers, and community members in supervision of children and in providing positive role models for safety behaviors and nonviolent social relationships is critical during this developmental stage (Peterson, Ewigman, & Kivlahan, 1993; Peterson & Roberts, 1992; Roberts & Peterson, 1984). As children grow older, however, they increasingly become involved in carrying out safety guidelines for their own self protection and thus initiating safe or risky behaviors that parents and other adults have taught or modeled (Schieber & Thompson, 1996). For example, at this stage the use of protective gear in sports and recreational activities (e.g., bicycle helmets, shin guards, and face masks) becomes increasingly important and some approaches for modifying individual child behaviors have been

found to be effective (Peterson, 1984; Jones, Kazdin, & Haney, 1981), as well as laws and regulations (Schieber, Gilchrist, & Sleet, 2000).

Although childhood is a period of relatively low injury risk compared to infancy and adolescence, behaviour patterns established during this stage can influence injury risk at later stages of life. Prevention programs at this stage not only focus on self-protection from injury, but also prevention of children's violent behaviour towards others. For example, early educational enrichment programs (e.g., Head Start) and social development programs that improve children's social skills with peers have been found to have both short and long-term effects on the prevention of violent behaviour (Richards & Dodge, 1982; Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikart, 1984; Lally, Mangione, & Honig, 1988; Schweinhart, Barnes & Weikart, 1993; Guerra & Williams, 1996; Kellermann, Fuqua-Whitley, Rivara, & Mercy, 1998; Hawkins, Catalano, Kosterman, Abbott, & Hill, 1999; U.S. Department of Health and Human Services, 2001).

### **ADOLESCENCE (AGES 12-19)**

Achieving safety from unintentional injuries for adolescents includes many of the same features, such as parental involvement and policy changes, as in earlier stages of life. Graduated licensing programs for teen drivers are a recent example. Graduated licensing systems are a way of managing driving experience and exposure of new teen drivers through driving restrictions that are gradually lifted with time and experience (National Safety Council, 2003). Parental involvement in administering and monitoring the teen "graduated licensing" provision of state laws has been shown to change teen driving behavior and injury risk on the road (Simons-Morton & Hartos, 2002). Injury risk in motor vehicle travel also can be reduced through laws, policies, and environmental modifications such as zero tolerance alcohol laws, minimum drinking age laws, lowering legal limits on blood alcohol levels to 0.08g/dL, and primary safety belt use



**Table 1. Prevention Strategies by Developmental Stage (Infancy Through Adolescence) and Ecological Context**

Ecological Context	Infant and Toddler Years (ages 0-3)	Childhood (ages 4-11)	Adolescence (ages 12-19)
Family	<ul style="list-style-type: none"> <li>▪ Provide home visitation services to high risk families</li> <li>▪ Train new parents in parenting skills</li> <li>▪ Increase access to prenatal and postnatal services</li> <li>▪ Avoid baby walkers</li> <li>▪ Use stair gates</li> <li>▪ Use approved child safety seats</li> <li>▪ Reduce hot water heater temperatures</li> </ul>	<ul style="list-style-type: none"> <li>▪ Provide parents with training in child-rearing skills</li> <li>▪ Use bicycle helmets</li> <li>▪ Use child safety seats, booster seats and seat belts</li> <li>▪ Monitor pedestrian crossing</li> <li>▪ Keep guns unloaded and locked</li> </ul>	<ul style="list-style-type: none"> <li>▪ Support home-school partnership programs to promote parental involvement</li> <li>▪ Provide parents with training in child-rearing skills</li> <li>▪ Provide therapeutic foster care for high-risk youth</li> <li>▪ Install and test smoke alarms on all floors</li> <li>▪ Wear safety belts</li> <li>▪ Enforce zero tolerance alcohol policies</li> <li>▪ Support graduated licensing programs with parent support provisions</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Remove hazards related to falls</li> <li>▪ Educate for dog bite prevention</li> <li>▪ Provide screens or grills on upstairs windows</li> <li>▪ Reduce access to poisons</li> <li>▪ Install working smoke alarms</li> <li>▪ Install 4-sided fencing on pools</li> </ul>		
Community	<ul style="list-style-type: none"> <li>▪ Inspect and modify school and daycare playground hazards</li> <li>▪ Conduct home hazard assessment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Provide social development training in anger management, social skills, and problem-solving</li> <li>▪ Provide preschool enrichment programs (e.g., Head Start)</li> <li>▪ Provide bullying prevention programs</li> <li>▪ Develop school policies to prevent injuries</li> <li>▪ Use protective equipment in sports</li> <li>▪ Institute traffic calming measures</li> <li>▪ Provide safe pedestrian and bike paths</li> <li>▪ Train children to dial 9-1-1 in an emergency</li> </ul>	<ul style="list-style-type: none"> <li>▪ Provide mentoring for high-risk youth</li> <li>▪ Provide education to promote healthy relationships and decrease dating violence</li> <li>▪ Provide social development training in anger management, social skills, and problem-solving</li> <li>▪ Develop and enforce school safety policies</li> <li>▪ Insist on using protective gear in sports</li> <li>▪ Create safe havens for children on high-risk routes to and from school</li> <li>▪ Provide after-school and recreational programs to extend adult supervision</li> <li>▪ Train health care professionals in identification and referral of high-risk youth</li> <li>▪ Separate bicyclists from motorists</li> </ul>
Social-Cultural	<ul style="list-style-type: none"> <li>▪ Adopt and enforce child safety seat laws</li> <li>▪ Provide adequate levels of funding for child protective services</li> <li>▪ Enforce product safety standards</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduce levels of media violence</li> <li>▪ Develop a "culture of safety"</li> <li>▪ Educate drivers to share the road</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deconcentrate lower-income housing</li> <li>▪ Reduce levels of media violence</li> <li>▪ Promote pro-social norms through public information campaigns</li> <li>▪ Provide educational incentives for at-risk, disadvantaged high school students</li> <li>▪ Enforce laws prohibiting illegal transfers of guns to youth</li> <li>▪ Support bicycle and motorcycle helmet laws</li> <li>▪ Support restrictions on access to alcohol</li> </ul>



laws (Shults, Elder, Sleet, et al., 2001; CDC, 2001b). Strategies that encourage individual behavior change become particularly salient during this developmental stage. Effective interventions have been developed for use in this population (Towner, Simpson, & Jarvis, 1996; Thornton et al., 2000) including techniques to increase use of safety belts (Streff & Geller, 1986), reduce youth violence (Ikeda & Dodge, 2001), modify bullying (Olweus, Limber, & Mihalic, 1999), change drivers' attitudes toward speeding (Parker, 2002), increase bicycle helmet use (Schneider, Ituarte & Stokols, 1993), and prevent school-associated unintentional injuries and violence (CDC, 2001c). Although safety (or risk reduction) devices and behaviors related to their use are likely to result in decreased injury, teenagers have among the lowest rates of behavioral safety compliance. Greater emphasis needs to be placed on obtaining and maintaining safety-related behaviors in adolescents. Interventions that focus on increasing use of safety devices by teens and those that induce or reward safe behaviors will also help. Fostering linkages with supportive community-based services such as schools, clinics, and health departments will be necessary to nurture safety-promoting behavior and social norms (McGinnis, Williams-Russo, & Knickman, 2002).

The social and cultural context in which adolescents reside also has important influences on their involvement in violent behaviour. For example, studies of efforts to reduce the concentration of poverty through rental voucher programs have found that these programs improve the safety of adolescents by reducing their involvement in and exposure to violence (CDC, 2002; Ludwig, Duncan, & Hirschfield, 2001). At the same time, however, as adolescents mature, more intensive personalized interventions may be necessary to reduce the chances of adolescents engaging in violent behaviour. For example, mentoring programs that match youth (particularly youth growing up in a single parent family or in adverse situations) with a non-familial caring adult, and therapy for

families experiencing high levels of conflict and behavioral problems have been found to be effective in reducing child behavior problems and violence (Mihalic & Grotzinger, 1997; Grossman & Garry, 1997; Hazelrigg, Cooper, & Borduin, 1987; Shadish, 1992).

## CONCLUSION

Throughout public health, there is a growing emphasis on implementing science-based intervention programs. Models and research on human development and social ecology describe the fluidity and overlapping nature of the various levels of influence on injury risk and safety over the life course (Williams, Guerra, & Elliott, 1997). They also inform efforts to tailor specific injury and violence prevention programs to the cognitive and physical skills of children and adolescents and to the social worlds in which they live.

These same models and research also can inform broader decision-making on the combination of prevention programs that are needed to reduce effectively the injury and violent behavior. These models suggest that developmentally appropriate interventions conducted over several stages may be more likely to motivate and sustain injury prevention behavior change across a lifetime than a single intervention or a single policy change. For example, sequential and complementary, developmentally appropriate interventions may be particularly important for assuring adherence to safety guidelines for injuries related to pedestrian safety, drowning, and sexual assault across developmental stages. Similarly, simultaneous interventions across multiple social contexts may be essential to reduce other risks (e.g., multi-level interventions to reduce teen drinking and driving). Recent research by Holder and colleagues (2000) supports this view, showing that multi-level interventions that simultaneously addressed social and structural contexts of alcohol use were associated with reductions in high alcohol consumption and alcohol-related injuries resulting from motor vehicle crashes and assaults.

Families, communities, schools, work-

places, and other social institutions are important partners in creating a "culture of safety" for children. Further, promoting safety in all of these settings across the stages of development will increase the chances for the healthy development of children and adolescents. Practitioners are encouraged to take every available opportunity to use evidence-based prevention strategies in applying these developmental approaches.

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