

Background for Community-Level Work on Physical Health and Safety in Adolescence: Reviewing the Literature on Contributing Factors

EXECUTIVE SUMMARY

By: Juliet L. Hatcher and Juliet Scarpa

Adolescents, as a group, are generally healthy; yet there are many opportunities to promote good physical health in adolescence. Two of the most important physical health concerns during adolescence are the high prevalence of health-compromising behaviors, which affect health during adolescence and beyond, and injuries—by far the leading cause of death in this age group.

In this report, we review the research literature that aims to identify factors that predict health and safety behavior patterns as well as injury risk, emphasizing research that relies on longitudinal data whenever possible. We also review a variety of evaluated programs designed to encourage health and safety habits and to prevent injury. Throughout, the discussion takes an ecological view of adolescent health and safety, exploring the role of individual, family, and peer characteristics as well as the broader context of neighborhood, society, and policy.

Promoting a Healthy Lifestyle

Many of the most common causes of morbidity and mortality in the United States are influenced by health behaviors, such as tobacco use, physical activity, and diet (Kann, et al., 2000). Because these behaviors appear to track from adolescence into adulthood (Kelder, Perry, Kleep, & Lytle, 1994), the promotion of good health behaviors in adolescence may have positive effects on future health behaviors and disease risks. In this section, we explore the antecedents of and program strategies for several health behaviors: tobacco use, physical activity, nutrition, sleep, and dental hygiene.

Tobacco Use

Importance, Prevalence and Trends

Tobacco use is considered the leading preventable cause of death in the United States (Centers for Disease Control and Prevention [CDC], 1989; McGinnis & Foege, 1993). Exposure to tobacco in various forms is associated with such serious illnesses as cardiovascular disease, cerebrovascular disease, chronic obstructive pulmonary disease, and various cancers (Baker, et al., 2000; CDC, 1994a; U.S. Department of Health and Human Services [DHHS], 1994). Adolescence is a critical time to address these health risks. Adolescents who smoke are more likely than their peers to become regular smokers as adults (Brook, Whiteman, Czeisler, & Shapiro, 1997; Chassin, Presson, Sherman, & Edwards, 1990; Kelder et al., 1994), and most adult smokers—about 4 of every 5—begin their smoking habit during adolescence (DHHS, 1994).

Despite these well-documented risks, tobacco use is strikingly common among adolescents. Nationally, in 1999, more than one-third of high-school students reported smoking cigarettes on

one or more of the 30 days preceding the survey, and 16.8% reported smoking cigarettes on at least 20 of the preceding 30 days (Kann et al., 2000). About 7 of 10 had ever tried a cigarette.

The prevalence of tobacco use varies across demographic groups. Older age, white race, lower socioeconomic status, and living in a single-parent family are all associated with a higher prevalence of smoking among adolescents (Blum, Beuhring, & Rinehart, 2000; Blum, Beuhring, Shew, et al., 2000; Kann et al., 2000; Lowry, Kann, Collins, & Kolbe, 1996; Norton, Lindrooth, & Ennett, 1998). However, these factors explain only a small portion of the observed differences in adolescent tobacco use (Blum, Beuhring, & Rinehart, 2000).

Antecedents of Tobacco Use

Individual Antecedents. Longitudinal studies have found that favorable attitudes towards smokers and smoking (Chassin, Presson, Sherman, & Edwards, 1991; Dinh, Sarason, Peterson, & Onstad, 1995; Engels, Knibbe, deVries, & Drop, 1998) and exaggerated perceptions of the prevalence of smoking (e.g., Chassin, et al., 1991) are associated with tobacco use among adolescents, as are poor school performance (Griffin, Botvin, Doyle, Diaz, & Epstein, 1999; Jackson, Henriksen, Dickinson, Messer, & Robertson, 1998; Wang, et al., 1999), depression (Patton, et al., 1998b; Wang, et al., 1999), conduct problems (Cohen, Richardson, & LaBree, 1994; Lynskey & Fergusson, 1995), and genetic factors (McGue, Elkins, & Iacono, 2000). Cross-sectional studies suggest that adolescents who work also may be at an increased risk for smoking (Resnick, et al., 1997).

Family Antecedents. Low parental monitoring and inconsistent discipline have been found to predict smoking among adolescents (Chassin, Presson, Todd, Rose, & Sherman, 1998; Cohen, et al., 1994; Jackson, et al., 1998), while parental anti-smoking attitudes (Chassin, et al., 1998; Griffin, et al., 1999) and a positive, supportive parent-child relationship (Chassin, et al., 1991; Chassin, et al., 1998; Cohen, et al., 1994) appear to protect against adolescent smoking. Importantly, adolescents whose parents smoke are more likely to smoke themselves (e.g., Jackson, et al., 1998; Patton, et al., 1998b, Wang, et al.); they are also less likely to quit smoking and more likely to relapse if they try to quit (Hansen, Collins, Johnson, & Graham, 1985; Patton, et al., 1998a).

Peer Antecedents. Adolescents are more likely to smoke if their friends do (e.g., Chassin, et al., 1991; Cohen, et al., 1994; Jackson, et al., 1998; Wang, et al., 1999). This association likely reflects a combination of influence (having friends who use tobacco may encourage an adolescent to use tobacco) and selection (adolescents may choose friends whose tobacco use behavior or propensity to use tobacco is similar to their own). Peers also serve as an important source of cigarettes (Robinson, Klesges, & Zbikowski, 1998).

Community Correlates. Research suggests that living in a more disadvantaged neighborhood is associated with a greater likelihood of being offered tobacco among young adolescents (Crum, Lillie-Blanton, & Anthony, 1996). Further study will be needed to determine whether being offered tobacco is actually a strong determinant of adolescent tobacco use.

Societal Antecedents and Correlates. The possible targeting of cigarette manufacturer

advertising to minors has been a hot topic of debate in recent years. Although it is difficult to isolate the relationship between media exposure and smoking behavior, there is a body of evidence suggestive of a link between tobacco promotion efforts and adolescent smoking (Pierce, Choi, Gilpin, Farkas, & Berry, 1998; Pierce & Gilpin, 1995; Pucci & Siegel, 1999).

Policy Antecedents and Correlates. Several studies report that interventions designed to prevent tobacco sales to minors can increase retailer compliance with the law, but have been largely unsuccessful in affecting adolescent smoking behavior (Altman, et al., 1999; Rigotti, et al., 1997; Stead & Lancaster, 2000). Other policy approaches appear more promising. Cross-sectional studies suggest that adolescent tobacco use may be sensitive to cigarette price (Chaloupka & Grossman, 1996; Chaloupka & Pacula, 1999) and that policies that restrict smoking on school and surrounding grounds are associated with a reduction in the amount that adolescent smokers smoke (Pentz, et al., 1989).

Programs to Prevent Tobacco Use

School-Based Programs. Multi-component, school-based programs that target the primary psychosocial factors related to adolescent tobacco use have enjoyed success where more traditional programs—that simply provide factual information about the dangers of tobacco or use fear-inducing strategies—have not (CDC, 1994a). The CDC has highlighted two such programs, Project Toward no Tobacco Use (TNT) and Life Skills Training (LST), in their “Programs that Work” series (<http://www.cdc.gov/nccdphp/dash/rtc/eval6.htm> and <http://www.cdc.gov/nccdphp/dash/rtc/eval7.htm>, accessed 12/14/2000); each has shown promising impacts on adolescent tobacco use in the context of randomized, controlled trials (Project TNT: Dent, et al., 1995; Sussman, et al., 1993. Life Skills Training: Botvin, Baker, Dusenbury, Botvin, & Diaz, 1995; Botvin, et al., 1989; Botvin, et al., 1992). However, a recently published evaluation of the Hutchinson Smoking Prevention Project—also a school-based smoking prevention program that targeted social influences—did not find any impact on adolescent smoking (Peterson, Kealey, Mann, Marek, & Sarason, 2000). Further research is needed to identify the program components that can explain the success of LST and Project TNT given the failure of this high-quality, long-term, social influences program.

Beyond School-Based Programs. A handful of studies have found that the augmentation of a school-based program with carefully constructed anti-tobacco media messages and other community activities enhances the impact on adolescent smoking behavior beyond that of the school-based program alone (Biglan, Ary, Smolkowski, Duncan, & Black, 2000; Worden, et al., 1996).

Physical Activity and Nutrition

Importance, Prevalence and Trends

Second only to tobacco use, insufficient physical activity and poor nutrition combine to make up the second leading preventable cause of death in the United States (McGinnis & Foege, 1993). This substantial impact reflects the shared influence of physical activity and dietary factors on such common morbidities as obesity, coronary heart disease, stroke, hypertension, diabetes, and

selected cancers (CDC, 1996a; Goran, Reynolds, & Lindquist, 1999; Ludwig, Peterson, & Gortmaker, 2001; McGinnis & Foege, 1993; Story & Neumark-Sztainer, 1999). Physical activity and nutrition also have shorter-term effects. For example, physical activity is associated with decreased anxiety and stress (Story & Neumark-Sztainer, 1999), and good nutrition is associated with a reduced risk of anemia and dental caries (Alvarez, 1995; CDC, 1996a; Story & Neumark-Sztainer, 1999; Szpunar, Eklund, & Burt, 1995). Physical activity and dietary behaviors track somewhat from adolescence to adulthood (Kelder, et al., 1994; Malina, 1996), suggesting that the establishment of positive physical activity and dietary behaviors in adolescence is likely to be important to adult health behaviors and health.

However, many adolescents are not active enough, and many are not consuming a healthy selection of foods. According to the 1996 National Longitudinal Study of Adolescent Health, one-third of 7th to 12th graders failed to meet the current public health recommendations of three or more sessions of continuous, moderate-to-vigorous physical activity per week (Gordon-Larsen, McMurray, & Popkin, 1999). Demographically, male gender (Gordon-Larsen, et al., 1999; Kann, et al., 2000; Ross, Dotson, Gilbert, & Katz, 1985), white race (Gordon-Larsen, et al., 1999; Kann, et al., 2000), and higher family incomes (Gordon-Larsen, McMurray, & Popkin, 2000) are associated with greater physical activity among adolescents. National surveys consistently indicate that physical activity declines precipitously with age, particularly among adolescent females (Gordon-Larsen, et al., 1999; Kann, et al., 2000).

The picture for nutrition is more complicated, as there are numerous dietary components that are vital to health. In general, national studies suggest that adolescents are consuming too much fat, sodium, and sugar and not enough fiber (Gleason & Sutor, 2001; Munoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997; Siega-Riz, Carson, & Popkin, 1998). Demographic variation in dietary intake is complex and depends on the specific nutrient or food type examined (Cavadini, et al., 2000; Gleason & Sutor, 2001; Lowry, et al., 1996; Munoz, et al., 1997; Siega-Riz, et al., 1998). One notable finding is that female adolescents have a particularly high prevalence of insufficient vitamin and mineral intake (Gleason & Sutor, 2001).

Antecedents and Correlates of Physical Activity and Good Nutrition

There have been only a handful of longitudinal, observational (i.e., non-intervention) studies designed to identify factors that predict physical activity and dietary patterns among adolescents. Thus, most of the findings discussed below are based on cross-sectional studies. Although cross-sectional studies are less informative than longitudinal studies, their findings can identify factors that merit attention in future well-designed, longitudinal studies. There is a great need for more rigorous research on the antecedents of physical activity and good nutrition among adolescents.

Physical Activity

Individual Antecedents and Correlates. Findings from two small longitudinal studies indicate that intention to exercise and, among adolescent girls, perceived ability to be physically active (self-efficacy) are associated with physical activity among adolescents (DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Reynolds, et al., 1990). Cross-sectional studies suggest that other factors deserving of further inquiry include: attitudes toward and enjoyment of

physical activity, achievement orientation, self-discipline, sedentary behavior and television viewing, time constraints, depression and mood (Allison, Dwyer, & Makin, 2000; Bungum & Vincent, 1997; DiLorenzo, et al., 1998; Sallis, Prochaska, & Taylor, 2000).

Correlates at Other Ecological Levels. Cross-sectional analyses indicate that the physical activity of adolescents is correlated with that of their siblings and parents, as well as with parental support and nurturing (Bungum & Vincent, 1997; DiLorenzo, et al., 1998; Rossow & Rise, 1994; Sallis, et al., 2000). In theory, the availability of safe, enjoyable opportunities to exercise, both in and out of school, may also affect physical activity among adolescents (e.g. Kohl & Hobbs, 1998; Ross, et al., 1985; Sallis, et al., 2000; Sallis, et al., 1992; Stillman, Truslow, & Woods, 2000).

Nutrition

Individual Correlates. One cross-sectional study has reported that adolescents who emphasize health considerations when choosing foods have a healthier diet than those who emphasize other considerations, like taste (Contento, Michela, & Goldberg, 1988). Additional cross-sectional analyses have found that adolescents who work and those who are not in school are less likely than their peers to consume a nutritious selection of foods (Siega-Riz, et al., 1998; Skinner, Salvetti, & Penfield, 1984).

Peer and Family Correlates. Although theory and findings for younger children suggest that peers likely have an influence on adolescent food intake, there has been little research to date on this topic (Birch & Fisher, 1998; Crocket & Sims, 1995). However, some studies have found a cross-sectional association between nutritional intake among adolescents and that of their parents (Astrom, 1998; Rossow & Rise, 1994). Moreover, adolescents in single-parent families are more likely than their peers to have an inconsistent meal pattern, which tends to be less healthy and nutrient-dense than are more consistent meal intakes (Siega-Riz, et al., 1998).

Neighborhood, Community, and Broader Environmental Correlates. In theory, the availability of healthy foods and ease of access to *unhealthy* foods—in school, in the community, and at home—may influence dietary intake among adolescents. Unhealthy food options are easily accessible in many schools, via vending machines, meals provided by fast food restaurants, or school stores (Stillman, et al., 2000; Story, Hayes, & Kalina, 1996; Wechsler, Brener, Kuester, & Miller, 2001). Federal policies that aim to restrict access to these unhealthy food options exist, but many researchers and others are urging for more stringent restrictions at the national level (Harnack, et al., 2000; Story, et al., 1996). Importantly, participation in the National School Lunch and Breakfast programs appears to be associated with a number of favorable dietary outcomes—including greater consumption of milk, fruits, and vegetables and a lower sugar intake—but also with higher fat intakes (Gleason & Sutor, 2001; Siega-Riz, et al., 1998). However, participation rates are low (Crockett & Simms, 1995).

Programs to Promote Physical Activity and Good Nutrition

School-Based Programs. The majority of programs to promote physical activity and a healthy diet have been school-based, and, while some have targeted adolescents, most have focused on younger children (Lytle & Achterberg, 1995; Marcus, et al., 2000; Story & Neumark-Sztainer, 1999). Many are multi-component programs that target physical activity and dietary behaviors together, sometimes in combination with smoking. In general, health education alone has not proved effective in changing behavior (Sallis, et al., 1992; White & Skinner, 1988), and programs that include behavioral components have met with more success. The Child and Adolescent Trial for Cardiovascular Health (CATCH)—a multi-component, school-based program involving health education, behavioral approaches, and school environmental modifications—is one such program that showed desirable impacts on physical activity and nutrition among young adolescents (Luepker, et al., 1996; Nader, et al., 1999). However, this and other program evaluations indicate that the maintenance of desired behavior changes over time is a continuing challenge.

Beyond School-Based Programs. While a few studies suggest that family- and community-based approaches may be promising (Epstein, Valoski, Wing, & McCurley, 1990; Kelder, Perry, & Klepp, 1993), our knowledge about such programs for adolescents is quite thin. Further research into the effectiveness of family- and community-based programs in promoting physical activity and good nutrition among adolescents is needed.

Sleep

Importance, Prevalence and Trends

Although researchers do not fully understand the functions of sleep, it is clear that sleep is a vital necessity. Insufficient sleep has been associated with an increased risk of motor vehicle accidents (Pack, et al., 1995), behavioral and emotional problems (Dahl, 1999; Leotta, Carskadon, Acebo, Seifer, & Quinn, 1997; Wolfson & Carskadon, 1998; Wolfson, et al., 1995), oversleeping for class (Wolfson & Carskadon, 1998), tiredness during school (Wolfson & Carskadon, 1998), and difficulty in performing complex tasks and in working toward goals (Dahl, 1999).

Data from the National Longitudinal Study of Adolescent Health suggest that just over one-quarter of 12- to 17-year-olds report that they do not get enough sleep (DHHS, 1999). Demographically, adolescent females are more likely than males to report insufficient sleep (DHHS, 1999), and adolescents tend to get less sleep and to have later bedtimes and more erratic sleep schedules as they age (Allen, 1991; Carskadon, 1990; Dahl, 1998; DHHS, 1999; Wolfson & Carskadon, 1998).

Antecedents and Correlates of Sleep Habits

Researchers generally consider adolescent sleep deprivation the result of a clash between an increased need for sleep and the time constraints imposed by employment, activities, homework, social involvement, and early school start times (Dahl, 1998; Wolfson & Carskadon, 1998).

Nearly all of the research regarding correlates of sleep behaviors in adolescents has been cross-sectional or based on only a handful of subjects.

Individual Antecedents and Correlates. One large, longitudinal study indicates that female gender, rebelliousness, depression, and smoking predict sleep problems among adolescents and young adults (Patten, Choi, Gillin, & Pierce, 2000). Cross-sectional studies suggest that advanced pubertal development (Carskadon, Vieira, & Acebo, 1993) and working 20 or more hours per week (Carskadon, Mancuso, & Rosekind, 1989) are associated with insufficient sleep. Emotional arousal, stress, pain, and stimulants (like coffee) are also thought to interfere with sleep in people of all ages (Dahl, 1998).

Family Correlates. Adolescents living in single-father families are more likely than those in single-mother or two-parent families to report insufficient sleep (DHHS, 1999). Moreover, as children age to adolescence, parents become less involved in setting bedtimes but more involved in getting their child to wake up in the morning (Carskadon, 1990). These findings—and the fact that most sleep occurs in a family home—indicate that longitudinal studies should evaluate elements of the family context as potential determinants of adolescent sleep behavior.

Broader Environmental Correlates. Recently, there has been a particular interest in the proposed relationship between adolescent sleepiness and school start times, which generally get earlier as adolescents progress through school (Allen, 1991; Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998). Minneapolis public schools have initiated changes in school start times in response to concerns about adolescent sleepiness; initial findings suggest that such changes have both positive and negative consequences (Kubow, Wahlstrom, & Bernis, 1999).

Program Strategies. To our knowledge, no rigorous evaluations of program strategies to improve adolescent sleep habits have yet been published in the mainstream literature.

Dental Health Behaviors

Importance, Prevalence and Trends

Dental caries is one of the most common diseases among adolescents and children in the U.S. today. More than three-quarters of 17 year-olds have at least one cavity or filling (DHHS, 2000b) and about one in five adolescents has at least one untreated caries lesion or active tooth infection (McKay, Fingerhut, & Duran, 2000). Untreated dental caries have negative consequences, including pain—which can interfere with diet, sleep, learning, and other daily functions—and increased likelihood of periodontal disease and tooth loss (Albandar, Buischi, & Axellson, 1995; DHHS, 2000b). Good dental health behaviors, such as tooth brushing, flossing, fluoride use, and seeking professional care, can reduce the risk of these dental afflictions (DHHS, 2000b; Ismail & Sohn, 2001; Nowjack-Raymer, Drury, & Selwitz, 1996).

According to the Health Behavior in School-Aged Children (HBSC) study, about 75 to 80 percent of girls ages 11, 13, and 15 brush their teeth more than once per day, compared with about 65 percent of boys (Vereecken & Maes, 2000). The limited available data suggest that flossing is much less common (Chen & Rubinson, 1982). As for professional care, nationally in

1997, 64 percent of poor adolescents and 80 percent of near-poor and non-poor adolescents had visited the dentist in the past year (MacKay, et al., 2000).

Antecedents and Correlates of Dental Health Behaviors

There is a wide gap in the research literature concerning the antecedents of personal dental health behaviors, such as toothbrushing and flossing, among adolescents. The limited available research suggests that adolescent girls have better dental health behaviors than adolescent boys and that dental health behaviors among mothers may influence those of their adolescent children (Astrom, 1998). Potentially important barriers to utilization of professional care include dental anxiety (Bedi, Sutcliffe, Donnan, Barret, & McConnachie, 1992; Milgrom, Vignehsa, & Weinstein, 1992) and low socioeconomic status (MacKay, et al., 2000). Further research is needed to identify the antecedents, at all ecological levels, of adolescent dental hygiene and use of professional care.

Programs to Promote Healthy Dental Behaviors

Few evaluated programs have aimed to promote self-sufficient dental health behaviors, such as brushing and flossing, among adolescents. The limited literature suggests that programs that include behavioral components—such as training in personal dental hygiene and self-evaluation of dental health and hygiene—along with the provision of dental health information may be effective (e.g., Axelsson, Buischi, Barbosa, Karlsson, & Prado, 1994; Buischi, Karlsson, & Prado, 1994; Walsh, 1985, DHHS, 2000b); however, more rigorous research is needed to support this claim. Programs to bring fluoride to communities are among the most successful efforts to date to prevent dental caries (DHHS, 2000b). An increased focus on personal dental behaviors, also important to caries risk, is warranted.

Conclusions/Recommendations

In reviewing the literature on adolescent health behaviors, we have identified the following recommendations for communities:*

- *Communities should take a multi-faceted approach to promoting positive health behaviors.* Adolescent health behaviors are complex. Individual factors, peer and family effects, and the broader community and environmental context likely all interact to shape the health behaviors of adolescents. Programs that address adolescent health behaviors on multiple levels are likely to be the most effective.
- *Programs should not be solely informational but should include psychosocial and behavioral components.* Programs that simply convey health information are usually not sufficient to effect behavior change. Those that target psychosocial determinants of health behaviors and those that include behavioral components tend to meet with more success.
- *Health behavior promotion efforts need to reach and be meaningful to adolescents in low-income families.* In general, adolescents in low-income families are more likely than their peers to display specific health-compromising behaviors and to practice multiple unhealthy

* Please see the final section of this summary for recommendations for future research.

behaviors (Lowry, et al., 1996).

- *Programs should address maintenance of health behavior change over time.* Across health behaviors, maintenance of desirable behavior changes over time remains a critical challenge. Booster sessions, and the utilization of settings for behavior promotion that can be extended or translated into future life stages, may help.

Preventing Injury, Promoting a Safe Lifestyle

In this section, we focus on unintentional injuries: those that result from seemingly accidental causes—including many motor vehicle crashes, bicycle crashes, sports mishaps, work hazards, burns and falls—rather than acts of violence.[§] We explore the antecedents of unintentional injury in general, as well as injuries associated with motor vehicle and bicycle crashes and hazards at work. These three injury types do not, by any means, encompass all unintentional injuries, which can occur in a wide variety of settings, such as in the home, on sports teams, and during water activities. However, the specific examples included here should provide an in-depth picture of what the research literature shows with regard to three important causes of unintentional injuries among adolescents, as well as with regard to unintentional injuries overall.

Importance and Prevalence

Nationally, in 1998, injury deaths comprised more than half of all deaths among 10- to 14-year-olds and, staggeringly, nearly four of every five deaths among adolescents ages 15 to 19 (g., Alexander, Ensminger, Somerfield, Kim, & Johnson, 1992; Scheidt, et al., 1995).

[§] Please see the Knight report on mental health and disorders (Zaff & Calkins, 2001) for information on suicide and the recent Surgeon General's report on violence among youth (DHHS, 2001) for information on violence.

* Unintentional injuries account for the bulk of adolescent injury deaths, including more than half of all injury deaths among adolescent males and three-quarters of those among females (MacKay, et al., 2000). Fatal injuries, in causing early and often preventable death, have an immeasurable impact.

Nonfatal injuries are also common. National estimates suggest that, over the course of one year, about seven percent of 10- to 13-year-olds and 11.5 percent of 14- to 17-year-olds experience a serious injury that requires hospitalization, missed school, or stitches or other surgery (Scheidt, et al., 1995). The consequences of such injuries vary with injury severity, from minimal disruption of daily activities at one extreme to extended or even life-long disability at the other.

Antecedents of Adolescent Injury

Antecedents and Correlates of Unintentional Injuries as a Group

Individual Antecedents and Correlates. Studies have consistently found that adolescent males are more likely than their female peers to experience an injury[†] and that injury rates increase with age during adolescence (MacKay, et al., 2000; Scheidt, et al., 1995). Longitudinal studies also indicate that use of alcohol or marijuana, aggressive behavior in childhood, and a general inclination to risk-taking behavior are predictors of adolescent injury, as are employment and participation in sports (Alexander, et al., 1992; Cobb, Cairns, Miles, & Cairns, 1995; LaPorte & Dearwater, n.d.).

Antecedents and Correlates Beyond the Individual Level. The research literature regarding antecedents of unintentional injuries beyond the individual level is sparse; however, studies of specific injury types begin to fill this gap. The limited available research suggests that childhood injuries vary seasonally, with the largest fraction occurring in summer (Kane, Mickalide, & Paul, 2001). Findings regarding socioeconomic status and injury risk have been mixed (Anderson, et al., 1994; Williams, Corrie, Wright, Elton, & Beattie, 1996).

Antecedents and Correlates of Motor Vehicle Injuries and Related Outcomes

Motor vehicle-related injuries are the most common cause of unintentional and total injury deaths among adolescents (MacKay, et al., 2000). Importantly, much of the current knowledge about factors associated with motor vehicle injuries and related outcomes, discussed below, derives from cross-sectional studies. Future rigorous, longitudinal studies will add meaningfully to the field.

Individual Antecedents and Correlates. During adolescence, the prevalence of motor vehicle-related injuries rises with age and is higher among males than females (MacKay, et al., 2000; Scheidt, et al., 1995). Several behaviors, including reckless driving, driving at night, driving

* Author's calculation based on national death count data obtained via CDC WONDER, retrieved on January 23, 2001, from the World Wide Web: <http://wonder.cdc.gov/>.

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after drinking, not wearing a seatbelt, and general risk-taking are associated with an elevated risk of motor vehicle crashes (MVC) and injuries (CDC, 1994b; Jelalian, Alday, Spirito, Rasile, & Nobile, 2000; National Highway Traffic Safety Administration [NHTSA], 1984; Williams, 1985; Zador, Krawchuck, & Voas, 2000). Notably, adolescent males are less likely than their female peers to wear seatbelts (Kann, et al., 2000; Maron, et al., 1986) and more likely to drink and drive and to drive at night (Grosvenor, et al., 1999; Kann, et al., 2000; Klepp & Perry, 1990; Williams, 1985). Various beliefs about the dangers and benefits of risky behavior and the availability of alternatives to risky behavior are also associated with drinking and driving, reckless driving, and seatbelt use (Gerard, Gibbons, Benthin, & Hessling, 1996; Grube & Voas, 1996; Grosvenor, Toomey, & Wagenaar, 1999; Klepp & Perry, 1990; Klepp, Perry, & Jacobs, 1991; Shin, Hong, & Waldron, 1999).

Family and Peer Antecedents and Correlates. The research literature suggests that having peers as passengers may raise an adolescent driver’s risk of being in an MVC (Preusser, Ferguson, & Williams, 1998). Moreover, more favorable peer and parental attitudes toward drinking are associated with an increased risk of MVCs among adolescents (Shope, Waller, & Lang, 1996). Cross-sectional studies further suggest that adolescents whose parents and friends use seatbelts are more likely to use seatbelts themselves (Maron, et al., 1986; Shin, et al., 1999).

Community and Neighborhood Antecedents and Correlates. Few studies have evaluated antecedents of motor vehicle crashes, injuries, and related behaviors at the neighborhood and community levels. Some analyses suggest that students in inner-city schools and adolescents of lower socioeconomic status are less likely than their peers to wear seatbelts (Maron, et al., 1986; Shin, et al., 1999). Other factors that warrant research attention include community norms and local road conditions.

Antecedents and Correlates of Bicycle Injuries and Related Outcomes

The following discussion reflects the fact that the bulk of the literature on factors associated with bicycle injuries and related outcomes are cross-sectional, and most focus on bicycle helmet use.

Individual Antecedents and Correlates. Numerous studies suggest that wearing a helmet decreases the risk of head injury in a bicycle crash (Maimaris, Summers, Browning, & Palmer, 1994; Thompson, Rivara, & Thompson, 1996; Thomas, et al., 1994). However, according to the 1999 YRBS, 85% of high school students who had ridden a bicycle in the previous year reported rarely or never wearing a bicycle helmet (Kann, et al., 2000). Cross-sectional studies suggest that adolescents who have a helmet, believe that helmets increase safety, and are less concerned about helmet discomfort or negative peer reactions are more likely than their peers to wear a helmet (Gielen, et al., 1994; Liller, Morissette, Noland, & McDermott, 1998).

Antecedents and Correlates Beyond the Individual Level. Cross-sectional analyses have found that adolescents whose parents, siblings, or friends wear bicycle helmets are more likely to use helmets themselves (Cryer, et al., 1998; Harlos, et al., 1999; Liller, et al., 1998). There is also suggestive evidence that helmet use may be more common in urban than rural areas and in higher income than lower income areas (Harlos, et al., 1999).

Beyond Bicycle Helmets: A Need for Further Research. While bicycle helmets are a vitally important safety device, there is a gap in the literature regarding other factors that may affect bicycle injuries among adolescents. Factors deserving of research attention include alcohol use, risk-taking while riding, and the influence of road conditions and bicycle paths or lanes.

Correlates of Occupational Injuries

There is a growing interest in occupational injuries among adolescents, and a handful of cross-sectional studies have begun to pave the way for research in this area. These studies have highlighted some potentially important factors associated with adolescent injuries at work, including: male gender, work in food service settings, substance use, exposure to physical hazards, larger workloads, and lesser supervision (Frone, 1998; Evensen, Schulman, Runyan, Zakocs, & Dunn, 2000; Layne, et al., 1994). In theory, other factors, such as risk-taking, physical strength, sleep habits and sleepiness, job safety training, and enforcement of the Fair Labor Standards Act may also influence the safety of adolescents at work (Runyan & Zakocs, 2000).

Programs to Prevent Injury and Promote Safety Habits

Programs Targeting Motor Vehicle Crashes and Related Outcomes

Driver Education. The research literature suggests that the critical influence of driver education lies in its effect on age at licensure. Offering driver education as a route to early licensure that otherwise would not be available appears to expedite early licensure, increase the number of adolescent drivers on the road, and so lead to a rise in the overall rate of MVCs (Lund, Williams, & Zador, 1986; Robertson, 1980; Robertson & Zador, 1978; Vernick, et al., 1999). On the other hand, imposing driver education as a *new* requirement for licensure at an age when adolescents previously could procure a license without driver education may discourage early licensure and lead to a drop in the MVC rate (Ulmer, Pruesser, Ferguson, & Williams, 1999).

Graduated Driver Licensing and Curfew Laws. A number of studies provide suggestive evidence that delaying full licensure among adolescents (Ulmer, Preusser, Williams, Ferguson, & Farmer, 2000) and placing restrictions on driving at night (Preusser, Williams, Zador, & Bloomberg, 1984; Preusser, Zador, & Williams, 1993) may decrease the risk of MVCs among adolescent drivers. However, a recent review of this literature concluded that further study is needed to fully evaluate this claim (Foss & Evenson, 1999).

Programs and Policies to Prevent Drinking and Driving. Some school-based programs to prevent drinking and driving and/or riding with a drunk driver have met with success (Sheehan, et al., 1996; Shope, Elliot, Raghunathan, & Waller, 2001). These programs have aimed to increase awareness of the risks associated with drinking and driving and to prepare adolescents with ways to deal with drinking and driving situations. Community organizing programs, in which communities initiate a variety of activities to prevent drinking and driving—such as mass media campaigns, awareness days, and law enforcement changes—have also shown promising results (Hingson, et al., 1996; Wagenaar, Murray, & Toomey, 2000). However, more research is

needed to identify which component(s) of these programs are effective. Finally, at the policy level, a number of non-randomized studies indicate that lowering the legal blood alcohol concentration for young drivers may reduce motor vehicle-related fatalities (Hingson, Heeren, & Winter, 1994; Shults, et al., 2001; Zwerling & Jones, 1999).

Programs to Promote Seatbelt Use. Few programs to promote adolescent seatbelt use have been evaluated in the literature. The research does suggest, however, that seatbelt laws may encourage seatbelt use and reduce the rate of motor vehicle-related fatalities (Dinh-Zarr, et al., 2001; Houston, Richardson, & Neeley, 1996).

Programs to Promote Bicycle Helmet Use

Multi-component helmet promotion programs, including such elements as educational curricula, helmet giveaways or coupons, awareness campaigns, and helmet use legislation have shown promising results for children and young adolescents (Abularrage, DeLuca, & Abularrage, 1997; CDC, 1995; Moore & Adair, 1990; Rivara, Thompson, Patterson, & Thompson, 1998). Pure helmet giveaway programs have met with more variable results (Logan, et al., 1998; Rivara, et al., 1998). There is a need for research on helmet promotion among older adolescents and on other strategies for enhancing bicycle safety in the adolescent population.

Programs to Prevent Occupational Injury

There is a dearth of literature regarding promotion of safety in the workplace for adolescents. The single published evaluation of an occupational safety program for adolescents suggests that introducing less hazardous equipment and implementing worker training in on-the-job safety may be useful approaches (Banco, Lapidus, Monopoli, & Zavoiski, 1997). Future studies should evaluate strategies to reduce exposure to hazards at work, enhance safety knowledge and awareness among adolescent workers, discourage on-the-job substance use, increase supervision, and enforce worker protection laws.

Conclusions/Recommendations

In reviewing the literature on adolescent injury, we have identified the following recommendations for communities:

- *In aiming to prevent injury, programs should address behavior.* Behaviors are critically important to adolescent injury. Research supports the intuitive notion that risky behaviors increase injury risk, while good safety habits decrease this risk. Alcohol use, in particular, is a common risk factor for several types of injury, including but not limited to motor vehicle-related injury (e.g., Lang, et al., 1996; Zador, et al., 2000), drowning (Wintemute, Kraus, Teret, & Wright, 1987), and injury at work (Frone, 1998).
- *Communities should ensure that injury prevention efforts reach adolescent males.* Males have a greater risk of unintentional injury than do females. This disparity likely reflects, at least in part, a gender difference in the practice of risky and safe behaviors.
- *Injury prevention programs should be multi-faceted.* Injury risk and the behaviors that

influence this risk reflect influences at multiple levels. Individual factors, peer and family effects, and the broader community and environmental context likely all interact to determine risky and safe behavior patterns and injury risk among adolescents.

Recommendations for Future Research

In general, we know more about why health behaviors and safety habits are important than about what predicts or determines these behaviors—or what can be done to promote them among adolescents. The following are some suggestions for future research:

- *More studies need to focus specifically on adolescents.* Often, there is more information on the antecedents of and strategies to promote health and safety habits among younger children or adults than among adolescents. While we can make some tentative inferences from literature on other age groups, hypotheses and program strategies need to be tested among adolescents to provide information that is more clearly applicable to this unique developmental stage.
- *More high-quality longitudinal and experimental research is needed to identify antecedents of health and safety habits and effective program strategies.* For many of the outcomes examined here, the majority of the available research is cross-sectional. Longitudinal and experimental studies will provide more informative results.
- *Future studies should address antecedents and program strategies at multiple ecological levels.* Generally, the research on health behaviors and safety habits among adolescents is not distributed across ecological levels. In many cases, there is a particular need for research on community-level antecedents and program approaches.
- *More long-term program evaluations are needed.* As noted above, the maintenance of desired behavior changes over time is an ongoing challenge. Program evaluations should follow study participants over the long-term in order to assess the program's capacity to effect sustainable behavior change.