Epidemiologic Approaches to Injury and Violence

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This volume of Epidemiologic Reviews features 13 articles covering a variety of injury problems and research topics. In this commentary, the authors highlight the remarkable achievements in injury control and the important role the Haddon Matrix has played in understanding injury causation and developing preventive strategies; comment on the individual articles included in this volume in the broad categories of research methods, childhood injury, motor-vehicle-related injury, alcohol-related injury, intentional injury, and occupational injury; and outline research gaps and future directions in injury epidemiology and prevention.

This volume of Epidemiologic Reviews celebrates a period of growth in the science of injury control. The papers demonstrate the great variety of injury problems now being tackled and underscore the progress made in applying epidemiologic methods to the control of injury. Of the 10 great public health achievements of the 20th century and the first decade of this century, identified by the Centers for Disease Control and Prevention (1, 2), 2 are directly related to injury. First, deaths and injuries from motor vehicle crashes, the leading cause of lost years of productive life in the United States and much of the rest of the world, have yielded to remarkable improvements in vehicle and road design; second, occupational safety has advanced through appropriate regulations and increased protection of workers from the hazards of their work environment. In addition, progress in the health of women and infants, while dependent upon far more than injury prevention and control, has benefited greatly from attention to child safety at home and on the road, as well as the more recent focus on prevention of violence against women.

Reasons for the progress in reducing injuries include the recognition of energy, especially mechanical energy, as the etiologic agent for most injuries. This knowledge underlies much of the research effort to prevent injury and reduce its effects, especially through emphasis on passive (automatic) protection, which obviates the need for each individual to recognize hazards and respond appropriately. The past 5 decades have witnessed far greater emphasis on “harm reduction” through technological and environmental approaches instead of behavioral modifications. Finally, development and evaluation of emergency medical services, trauma systems, and injury rehabilitation have moved us even closer to preventing unnecessary death and disability.

Underlying the remarkable progress in injury prevention and control is the famed Haddon Matrix, an innovative conceptual framework growing out of the classic epidemiologic triad of agent, host, and environment (3). The Haddon Matrix divides the 3 elements in the epidemiologic triad temporally into 3 phases—pre-event, event, and post-event—to form a 3-by-3 table. The pre-event phase includes all the factors likely to prevent a crash or other injury-producing event from occurring; event-phase factors such as helmets and air bags operate during the crash, fall, or other event to reduce the severity of injury; and post-event factors, including acute care and rehabilitation, determine whether an injured person survives and is restored to health. The Haddon Matrix has served as the theoretical basis of epidemiologic approaches to understanding injury causation and control strategies.

The 13 papers in this volume begin with 2 that are applicable to all realms of injury control: classification of injury and measuring the burden of injury. They are followed by groups of papers on injury to children, motor-vehicle-related injury, alcohol-related injury, intentional injury, and occupational injury.

Classification—something epidemiologists thrive on—is especially challenging with regard to injuries, with their great variety of causes, intents, circumstances, and contributing factors. In the lead article, McKenzie et al. (4) present the history of the International Classification of Diseases. The 11th edition, currently being developed, includes the first major structural revision of the injury codes in 60 years and should be useful in myriad settings. The authors explain the
rationale for major changes and emphasize that the improved coding of external causes will contribute to better approaches to reducing injury morbidity and mortality.

Polinder and her international team of authors (5) reviewed studies that have addressed measurement of the burden of injury in populations. The result is a presentation of the methods of measuring injury burden and the limitations and problems encountered therein. Too often, we describe the importance of a health problem only in terms of the numbers or rates of deaths due to one cause or another. The burden of any health problem, however, reflects mortality, disability, and quality of life. Moreover, the burden on a population is greatly influenced by when, in the lifespan, a person dies or can no longer live a productive life. The true burden of injury is revealed when the relative youth of its victims is considered. The many ways of measuring the injury burden are described in this article, and their respective advantages and shortcomings are detailed (5).

Two papers focus on prevention of injuries to children. Cooper et al. (6) applied network meta-analysis to the evaluation of interventions designed to increase possession of working smoke alarms. This evaluation may be the first application of network meta-analysis to a home injury problem; the review not only illustrates the technique but also shows its value in comparing injury prevention programs with multiple components and teasing out the effects of the individual components.

Pedestrian injury is a serious threat to children, one often ignored. Using the Bayesian regression method, DiMaggio and Li (7) assessed the epidemiologic evidence for the association of built environments with the risk of pedestrian injury. They found that roadway characteristics, such as the presence of parked vehicles and lack of barriers to residential areas, have been consistently linked to a significantly increased risk of pedestrian injury and that interventions regarding these environmental hazards have been particularly effective in reducing pedestrian injuries in children (7). We hope this review will encourage further application of effective designs, such as sidewalks and single-lane roundabouts, in urban planning and construction of residential communities.

Motor-vehicle-related injury is the subject of 3 additional papers. Vernick et al. (8) reviewed 17 studies that have addressed vehicle incompatibility, a problem resulting from the wide range of sizes, strengths, and weights of vehicles on our highways. The large numbers of sport-utility vehicles now on the roads and the current impetus to reduce the size and weight of cars combine to make this a pressing problem. The authors discuss the effectiveness of various design approaches in reducing injury to occupants of the smaller vehicle.

Drug-impaired driving has become a serious concern in the United States and many other countries. Marijuana is the most commonly detected drug other than alcohol. The meta-analysis by Li et al. (9) was based on 9 epidemiologic studies assessing the relation between marijuana use and crash risk, conducted in different geographic regions and driver populations and using different research designs. They found that use of marijuana by drivers doubled the risk of crash involvement and that there existed a dose-response relation between marijuana use and crash risk (9).

Native Americans and Alaska Natives have especially high rates of death and injury related to motor vehicle crashes. The review by Pollack et al. (10) found the strongest support for interventions related to alcohol use, restraint use, and pedestrian deaths. To attack the problem, the use of partnerships and a combination of strategies showed special promise.

Two other papers explore the important relation between alcohol and injury (11, 12). Both indicate the need for more rigorous research. The review by Keyes et al. (11) of racial differences in alcohol-attributable injuries further illustrates the disproportionate importance of alcohol in injuries to Native American populations. Asian populations, known for having the lowest injury rates, showed the least association between alcohol and injury. A notable finding is the much greater alcohol-attributable injury mortality among blacks and Hispanics relative to their reported alcohol consumption, an important area for further exploration.

Rothman et al. (12) reviewed 29 studies to assess the strength of epidemiologic evidence for the association between alcohol use and dating violence in adolescents. While most of the studies reviewed reported a positive association between alcohol use and dating violence perpetration, the authors found that the pertinent literature is overwhelmingly based on cross-sectional surveys, thus severely hampering their ability to infer causality and estimate the attributable risk of different drinking behaviors to youth dating violence. This particular research area may benefit from innovative epidemiologic designs, such as temporally matched case-control and case-crossover studies, which have proven extremely effective in understanding the role of alcohol in motor-vehicle-related injury and other injuries (13).

Intentional injury is the subject of two papers in addition to the one on dating violence. Sentenac et al. (14) examined 60 studies related to peer victimization of school-aged children with disabilities or chronic conditions. The association was evident in North America and Europe, but few prevention efforts specifically considered ways to reduce bullying and other forms of victimization aimed at chronically ill or disabled children.

The complex epidemiology of suicide, as revealed by Chen et al. (15), is further complicated in Asia by the size and diversity of the region and the 9 countries discussed. Socio-cultural factors play an important role in the age- and gender-specific differences among countries. Recent trends such as the increase in charcoal-burning suicide in several countries and the decrease in suicide from pesticide ingestion in China’s rural areas provide incentives for evaluation of preventive strategies.

Occupational hazards vary immensely, as shown by the papers on psychological trauma to relief workers (16) and injury to older construction workers (17). Connorton et al. (16) focused their review on mental health consequences in humanitarian relief workers, an understudied occupational group known to be at exceptionally high risk of both unintentional and intentional injuries. The authors are commended for highlighting the magnitude of psychological trauma experienced by relief workers. Despite the limited data available, it is evident that exposure to trauma among relief workers is extremely prevalent and that 8%–43% of these workers may develop posttraumatic stress disorder (16). Moreover, postmission debriefing, the intervention most widely adopted by nongovernmental organizations...
and other employers of relief workers, does not seem to have any measurable benefit (16). These findings underscore the heightened risk of physical injury and psychological trauma facing relief workers as well as the urgency to develop effective interventions to protect the safety and well-being of this occupational group.

The economic downturn has created an incentive for older workers to work for more years than they otherwise might. Workplaces, however, have rarely adjusted to their needs, as pointed out in the review by Schwatka et al. (17), who urge that the safety needs of older workers, especially those in the construction industry, be considered in designing jobs. In the case of road design, changes to protect inebriated drivers, such as “wrong way” signs near expressway ramps, also protect elderly drivers, teenagers, and other high-risk drivers as well as the average driver. Similarly, designing the workplace so the less fit will survive uninjured will also protect the average nondisabled worker.

Several important injury areas are not represented in this volume. Among them, poisoning is notable not only for its very high death rate (approaching the rate of motor-vehicle-related death) but also for the recent increase in unintentional overdose deaths from opioid analgesics, often prescribed for pain relief. Falls and drowning each claim thousands of lives each year, and efforts to prevent them deserve further evaluation. Homicide threatens people of all ages. So do wars, ethnic strife, and terrorism. The continuing aging of the global population and the rapid urbanization in much of the developing world represent special challenges to injury control professionals; these demographic and socioeconomic transformations may adversely impact the epidemiology of injury by substantially increasing the number of people most vulnerable to injury and by exacerbating existing and creating new injury hazards. Meeting these challenges should be the mission of injury epidemiologists in the years to come.

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REFERENCES