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# Evidence-Based Practice in Primary Prevention of Spinal Cord Injury

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A spinal cord injury (SCI) not only causes paralysis, but also has long-term impact on physical and mental health. There are between 236,000 to 327,000 individuals living with the consequences of SCI in the United States, and the economic burden on the individuals sustaining the injury, their support network, and society as a whole is significant. The consequences of SCI require that health care professionals begin thinking about primary prevention. Efforts are often focused on care and cure, but evidence-based prevention should have a greater role. Primary prevention efforts can offer significant cost benefits, and efforts to change behavior and improve safety can and should be emphasized. Primary prevention can be applied to various etiologies of injury, including motor vehicle crashes, sports injuries, and firearm misuse, with a clear goal of eliminating unnecessary injury and its life-changing impact. **Key words:** *epidemiology, prevention, spinal cord injuries*

Spinal cord injury (SCI) not only causes paralysis, but also has long-term impact on physical and mental health. As of 2012, estimates show 236,000 to 327,000 people living with an SCI in the United States, with the average age of injury at 41 years.<sup>1</sup> Postinjury inpatient rehabilitation is used to teach new and adaptive skills. SCI rehabilitation efforts include therapeutic instruction and interventions to ameliorate alterations in body function and structure and activity impairments and to enhance participation in established life roles.<sup>2</sup>

After the initial hospitalization and inpatient rehabilitation, there is often a lengthy period of emotional and physical readjustment during which individuals must learn a new way of life. In addition to the physical changes, the emotional impact of the injury is experienced by the persons with SCI and their family and loved ones. Divorce rates during the first 3 years after an SCI are about 2% higher than in the general population.<sup>3</sup> The lack of independent transportation may result in social isolation. Additionally, in a sample size of 947 community-dwelling individuals with an SCI, 23% reported having major depression.<sup>4</sup>

In addition to the physical and psychological effects, a traumatic injury increases the economic burden on the person who sustains an SCI and

potentially his or her entire support network. Changes in employment or educational goals may contribute to this burden. Depending on the severity, SCI can cost an injured individual \$334,000 to \$1 million the first year after injury. Costs in each subsequent year range from \$41,000 to \$178,000.<sup>1</sup>

Efforts have focused primarily on treating the effects of SCI versus preventing the injury. Primary prevention is defined as the “care that consists of measures taken to prevent diseases or injuries rather than curing them or treating their symptoms.”<sup>5</sup> Currently, there are not as many policies to encourage prevention as there are to promote the latest and best treatment options. Recent efforts to change this priority include the creation of the American Spinal Cord Injury Association (ASIA) Prevention Committee. This committee was created to be a collaborative partner with other national and international groups in the prevention of SCI and its resulting complications through education, advances in engineering, research, and legislation. Additionally,

comprehensive registries help identify the most prevalent causes of SCI. Researchers can use this information to establish appropriate primary prevention programs.<sup>6</sup> This article will focus on the importance of primary prevention and will detail etiology-specific evidence-based SCI prevention tips.

### **Types of Prevention**

Public health and preventive medicine literature define 3 types of prevention: primary, secondary, and tertiary. The aim of primary prevention is to stop a disease or disability from occurring. Secondary prevention is identifying and stopping an asymptomatic disease or disability. Tertiary prevention is eradicating a disease or disability when symptoms are already evident.<sup>7</sup> For this article, the focus will be on defining and explaining evidence-based primary prevention efforts. One way to prevent SCIs is through education, including teaching behavior modification and parenting strategies. Engineering and equipment innovations can also play a vital role in primary prevention. For example, air bags and improved car seats and seat belts have reduced the incidence of motor vehicle-related SCIs.<sup>8</sup> Awareness of etiology-driven evidence-based primary prevention techniques is important to help avoid SCIs.

### **Views on Prevention**

The focus of the medical community has been on treating those already injured from the viewpoint of “helping the worst first.”<sup>7</sup> In July 2012, the House Appropriations Committee specifically proposed to eliminate funding for the Prevention and Public Health Fund and reduce funds for the Centers for Disease Control and Prevention (CDC) and the Centers for Medicare and Medicaid Innovation. The Centers for Medicare and Medicaid Innovation provide a pioneering connection between the health care system and prevention efforts. These funding cuts indicate that the federal government does not consider prevention efforts to be as vital as rehabilitation or research.<sup>9</sup>

Prevention is also overlooked in physician training programs and in physician compensation.

Faust and Menzel report that preventive medicine and public health residencies are not funded by Medicare or Medicaid. Additionally, physicians who specialize in prevention are on average compensated at a general rate of 15% less than the next comparable specialty.<sup>7</sup>

In opposition to this view, a poll of 950 adults nationwide indicated that 73% of people supported prevention efforts, specifically those that targeted preventive health for children and families.<sup>10</sup>

### **Cost-Effectiveness of Primary Prevention**

The Prevention Institute reports that prevention programs are extremely cost-effective; nearly \$3 billion dollars in health care costs could be saved in 2 years by a \$10 investment per person in prevention programs. That savings jumps to \$16 billion dollars in 5 years and close to \$18 billion within 10 to 20 years.<sup>11</sup> Community-based prevention programs are a cheaper alternative compared to emergency care to save a patient’s life.<sup>12</sup> One cost-beneficial prevention program is California’s Tobacco Control Program; it cost \$1.8 billion to establish but resulted in \$86 billion in savings.<sup>13</sup> The Christopher Reeve Foundation, a leading organization in prevention and treatment in SCI, has projected that the United States could save an estimated \$400 billion dollars by providing SCI-based preventive and therapeutic interventions.<sup>14</sup>

### **Etiology-Based Prevention Tips**

According to the American Trauma Society, the best way to deal with injuries is to prevent them, either actively or passively.<sup>15</sup> Actively working to change behaviors to improve safety can decrease the chance of experiencing an SCI. The leading causes of SCI are motor vehicle crashes (MVCs), falls, violence, and sports.<sup>1</sup> There are efforts being made to identify measures and implement prevention programs to reduce the chance that someone will experience an SCI secondary to one of these etiologies. Programs vary in their message, but they all have the common goal of preventing an SCI from ever taking place.

### Motor vehicle crashes

The leading etiology of SCI is MVC at 39.2%.<sup>1</sup> Safety tips such as always wearing a seat belt or utilizing an air bag, obeying the speed limit, paying attention, and following rules of the road are vitally important to the primary prevention of an SCI.<sup>16</sup> Rules that are imperative for children in a motor vehicle are the use of safety seats and proper restraints. The car seat should never have been used in a previous MVC and it should be installed correctly.<sup>16</sup> For older children, the Academy of Pediatrics suggests that a booster-style seat be used until the child is 8 years old or taller than 4 ft, 9 in. Additionally, the Academy states that children should ride in the backseat of the vehicle until they are over the age of 12.<sup>17</sup>

Distracted driving has become a huge epidemic with the rise of cell phone use. Some states have made it illegal to use a handheld device while driving. Even the use of a hands-free device is considered unsafe.<sup>18</sup> A driver who must focus on driving while talking on the phone has a reduced response time, regardless of whether he or she is using a hands-free device.<sup>19</sup> National and international studies have also found that drivers who use a cell phone while driving are at 4 times greater risk of having an MVC than those who do not.<sup>20,21</sup> Prevention tips regarding cell phone use include the recommendation of limited use while driving. Additionally, the enforcement of hands-free laws and resulting punishments and fines aimed at prohibiting cell phone usage while driving are crucial.<sup>18</sup>

A crucial component of primary prevention of MVCs is the eradication of driving under the influence of drugs or alcohol. Drunk driving kills over 10,000 people per year,<sup>22</sup> with 25% to 35% of non-fatal MVCs resulting in traumatic injuries.<sup>23</sup> Drivers also need to be informed about how prescription medications can impact their ability to operate a motor vehicle.<sup>16</sup>

### Falls

The second leading cause of SCI is falls (28.3%).<sup>1</sup> For people over the age of 65, falls are the number one cause of SCI.<sup>24</sup> Primary prevention techniques

to avoid a fall include holding onto a handrail while climbing stairs and keeping the floor free from debris and hazards. Spills should be cleaned up quickly, and no rugs or non-skid rugs should be used in the home. Electrical cords should be kept out of walkways, and all areas should be well lit. To reach high spaces within a home, individuals should use a sturdy step stool instead of climbing on countertops or chairs. Grab bars in bathrooms and showers are recommended to help prevent slipping on wet surfaces. For children, it is important to use window latches and safety gates so they do not have access to areas where they could sustain a fall and be injured.<sup>16,24</sup>

### Firearm-related injuries

Incidents involving firearms are the third leading cause of SCI (14.6%).<sup>1</sup> Prevention of these injuries involves safe and responsible gun use. It should always be assumed that a firearm is loaded to ensure careful handling. For primary prevention of a gunshot injury, the firearm should only be pointed at an intended target, and the trigger should only be touched when the firearm is ready to be used. All firearms should be secured in a locked location away from children, and bullets should be stored separately from the firearms. Prevention includes educating children and teenagers about the dangers of guns and teaching them how to solve arguments without violence.<sup>16,24</sup>

### Team sport-related injuries

Sports-related SCIs have received a lot of media attention. Because high profile athletes have sustained SCIs in recent years, many people have become more aware of techniques for preventing sports injuries. Sports-related SCIs typically affect people under the age of 29 years, which is younger than the national average for this injury.<sup>24</sup> Basic prevention starts with ensuring that players of matched skill levels play one another. Organizing sports teams and games based on maturity level and size of opponents can be crucial to avoiding injury. Appropriate and adequate protective gear is also vital to protect athletes from SCIs;

damaged equipment should never be used. Fields and playgrounds where sporting events are played should be well maintained and lit to prevent injuries.<sup>16,24</sup>

### **Water-related injuries**

Diving into a shallow body water, whether it is a swimming pool, river, or lake, can cause a high-level SCI, resulting in quadriplegia and/or traumatic brain injury. Water-related injuries occur in a younger demographic and typically in the summer months. Of the estimated 850 SCIs caused by diving each year, 300 occurred in a private swimming pool. Almost half of these injuries occurred during a party. Additionally, results of a 1998 study indicated that alcohol use was involved in 49% of 196 persons interviewed who had been injured in a swimming pool incident. It is evident that abstention from alcohol use while swimming/diving is a major primary preventive measure against SCI.

Another primary prevention technique that can be used to prevent SCI in swimming pools is the use of clearly marked depths. Research has shown that of the SCIs resulting from diving headfirst into a swimming pool, 75% occurred in a pool with no depth indicator.<sup>25</sup> Ninety-five percent of people receiving an SCI from a swimming incident dove into water less than 8 ft deep.<sup>25</sup> A primary prevention technique for these injuries is to clearly mark the depth around swimming pools. Depth indicators can be purchased from a pool supply store. Designated diving areas for people should be obvious as well.

Other important primary prevention tips for diving and swimming include never pushing or shoving another person into a swimming pool or body of water, making sure there is a lifeguard or someone trained in water safety, and securing the pool with fencing and a gate when it is not being used.<sup>16,24</sup>

### **Recreational sports-related injuries**

Proper use of a helmet while bicycling, skateboarding, and roller skating is an important SCI primary prevention technique. The helmet must be the appropriate size for the person using

it and it must fit properly. The helmet must be secured with the chin strap buckled to prevent an injury.<sup>24</sup> In the United States, helmets must pass US Consumer Product Safety Commission (CPSC) standards and have the CPSC sticker displayed inside the helmet and obvious to consumers. These standards, issued in 1999, stipulate that helmets will provide sufficient head protection and chin straps will be of high quality material to ensure that the helmet will not come off in a crash, collision, or fall. For children up to age 5, it is required that helmets provide additional protection and coverage to protect the more fragile areas of a child's skull.<sup>26</sup>

### **Trampoline-related injuries**

Trampoline use is a frequent cause of SCIs. This etiology affects a younger population, with two-thirds of injuries reported in children between the ages of 6 and 14 years and 15% of injuries reported in children under the age of 6 years. The essential primary prevention tip for trampoline usage is competent supervision. Netting constructed around the trampoline has been shown to reduce the number of falls, but it should not be used as a substitute for supervision. The trampoline should be placed on ground level to prevent falls off the side and the area should be well-lit. Acrobatic maneuvers should be done only under the supervision of a trained professional or with the use of specialized equipment, such as a harness, and the trampolines should not be overcrowded.<sup>27</sup>

### **Prevention Program Evaluation**

A challenge for any prevention program is evaluating the long-term effectiveness and overall outcomes. The National Center for Injury Prevention and Control provides an easy-to-read resource to help program developers.<sup>28</sup> This guide can serve as a reference when program coordinators consider how to evaluate the program content, including the effectiveness of materials and the logistical aspects of implementation.

Program evaluation is used to determine whether the content is accurate and appropriate for the target audience; to improve content and guide program modifications; to justify future

funding and expand programs; and to add to the body of literature regarding injury prevention.

Based on the National Center's guide, a *process evaluation* is used to determine whether the content is reaching the target audience. *Impact evaluations* examine the more immediate changes that result from the program, such as short-term behavior modification or knowledge or attitude changes. *Outcomes measurements* are designed to measure the ultimate goal of reducing mortality and morbidity. This presents the greatest challenge for injury prevention researchers and educators. Incidence and prevalence data of morbidity and mortality, even within a small population, may not be directly relevant to the specific program. Therefore, outcomes related to behaviors that may result in these injuries may be the most attainable measurement. For programs that cover multiple years, these data can be more effective in demonstrating long-term change. Either way, it is critical to gather data prior to beginning the program so that specific outcomes may be then compared.<sup>28</sup>

Several examples in the literature demonstrate the utilization of these evaluation techniques. A larger scale education program described in the literature combined questionnaires and short-term observational programs to evaluate the effectiveness of Think First prevention programs across various school environments.<sup>29</sup> The questionnaire and direct observations did not seem overly difficult, although limitations related to their overall population made it difficult to draw conclusions related to behavioral modification. A more recent study of the effectiveness of

video education in reducing injuries that occur during hockey used several strategies: testing, data acquisition, and direct observation. The researchers included a control group, which added to the rigor of the study.<sup>30</sup> It appears more feasible to utilize program evaluation strategies such as direct observation and control groups when considering smaller samples sizes or when targeting very specific behaviors.

## Conclusion

Primary prevention is often not the first element that comes to mind in regard to treatment of an SCI, however it may be the most important. Society often focuses on prevention of secondary complications or on finding a cure, rather than putting into practice ways to eradicate the occurrence of SCIs. Primary prevention of SCI requires the cooperation and education of members of the community and health care professionals. Countless prevention programs exist across the world with agencies and committees working to eliminate SCI and its life-changing effects.

## Acknowledgments

Portions of this material were presented at the American Spinal Injury Association's 38th Annual Scientific Meeting in Denver, Colorado in April 2012. We acknowledge ASIA and specifically the members of the ASIA Prevention Committee for their commitment to prevention and their desire to bring prevention activities to the forefront.

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