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Reduction of Traumatic Brain Injury Through Helmet Education and Legislation

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Traumatic Brain Injury (TBI) is a leading cause of many of debilitating injuries and even death. These injuries often occur in common athletic activities, such as bicycling, snow skiing, snowboarding, football, and skateboarding. TBI resulting from each of these activities can be reduced by the proper use of certified helmets. Surveys have been conducted with college-age students, neurosurgeons, and the general population, and the results show that many believe in the efficacy of helmets as a means of protection. However, cognitive dissonance is displayed in the limited helmet use reported in these samples. Among the reasons researchers have found for this disparity include personal vanity and the lack of education. Moreover, those who purchase helmets often select non-certified products. After considering the efficacy of helmet use in the prevention of TBI, I offer suggestions for legislative policy and public education that could produce reduce the incidence of TBI.

The human body is not made to move at high speeds. We drive cars, ride bikes, and participate in fast-paced contact sports, each of which poses a danger. However, proper precautions can be taken in order to optimize safety in the event of a damaging accident.

Cause and Effects of TBI

Damage produced by impacts to the head may cause a Traumatic Brain Injury (TBI). This occurs when the skull accelerates at a high velocity and is suddenly decelerated by a surface, such as asphalt, and the bone stops moving, but the brain, which is floating in cerebrospinal fluid, keeps moving. The brain will bounce against the walls of the skull, causing a concussion or bleeding if the brain (called a contusion) or both (Ryszard, 2011), as well as brain-tissue cuts and tearing (Corbo & Tripathi, 2004). Although our skulls are made to protect the brain, possibilities still exist for head trauma and TBI, especially when we participate in potentially dangerous activities.

TBI often results in deleterious consequences. Mild TBI may cause loss of consciousness, headaches, disorientation, nausea, vomiting, mood swings, blurred vision, or feelings of depression. A moderate-to-severe TBI could cause an extended loss of consciousness, slurred speech, convulsions or seizures, loss of coordination, memory loss, fluids draining from nose or ears, impairments of brain function, or even death (Mayo Clinic Staff, 2012). The brain is the command center of the body. A concussion or more serious damage can cause problems not just in cognition but also in body functioning for months and even years (Kowlakowsky-Hayner,

Murphy, & Carmine, 2012). Some of these problems worsen with age. The quality of life for an individual who survives TBI often is greatly diminished.

Wearing a Helmet Increases Safety

Most helmets are designed so that, upon impact, the foam shell crushes, allowing the head to decelerate at a slower speed and thus reduces the force of impact between the skull and brain (Bicycle Helmet Safety Institute, 2010). A study of 1,710 cases of bicycle crashes showed that helmet use reduced risk of TBI by 45% (McDermott, Lane, Brazenor, & Debner, 1993). Head injury is the leading cause of death in snow sports, but helmet use may reduce head injury by up to 60% (Ackery, Hagel, Prowidenza, & Tator, 2007). Increased helmet use leads to decreased TBI, though other factors play a role.

Some researchers (e.g., Curnow, 2006) believe that it isn't the helmet itself that reduces injury but instead the cautious behaviors of the kind of person who would wear a helmet. Perhaps people who wear helmets are cautious and are less risk-taking, which leads to less injury, including TBI. However, other researchers (e.g., Hagel, 2006) have pointed out that, when proper experimental controls are used, the results show that people who wear helmets do not exhibit less risk-taking behavior than those who don't.

Prevalence of TBI

The Centers for Disease Control and Prevention (2013) has estimated that, in the United States alone, 1.7 million people suffer from TBI each year, and 52,000 of them die as a result of their injuries. This figure corresponds to 30.5% of all injury-related deaths in

the U.S. Shaughnessy (2009) reported roughly 300,000 sports-related injuries each year. In which they were primarily bicycle related, with football second, baseball third, and skateboarding fourth.

TBI is a worldwide problem, with many other countries reporting similar statistics. A German report cited approximately 23,000 TBI-related bike injuries in one year. A German poll of two million people reported that only 5% wore helmets while bicycling (Jung, Zweckberger, Schick, & Unterberg, 2010). A Canadian study showed that there was one fatality every week due to cycling accidents and that they are among the leading causes of death in young adults (Persaud, Coleman, Zwolakowski, Lauwers, & Cass, 2012).

Kakefuda (2009) examined the attitude of college students towards helmets and the incidence of use. The results showed that, although many students were aware that helmets increase safety, the majority of them neglected to wear helmets. Similarly, the percentage of people who actually use helmets during athletic activities is disturbingly low. In the German survey cited earlier (Jung et al., 2010) only 5% of respondents reported they wore helmets. Among the reasons for this neglect are personal vanity and ignorance.

Vanity

Kakefuda's (2009) study was conducted at Colorado State University, where the author surveyed 315 students who acknowledged knowing the importance of helmets, but only 37% of them actually wore helmets in recreational activities, and only 9% wore helmets for bike travel. Respondents reported three main reasons for not

wearing helmets: worry that helmets could mess up their hair, helmets were uncomfortable, and helmets were inconvenient to carry around. These were students investing an average of almost $23,000 a year in their education (see Appendix), but they seemed to care more about their hairstyle than preserving their head.

Ignorance

Leathem and Body (1998) studied a group of adolescents with the purpose of determining how knowledgeable they were on the subject of TBI. The authors found that those who had sustained a head injury of some sort were much more aware of the risks and consequences than those who had not. Adolescents often do not know the risks they are taking until it is too late, and they have suffered an injury. This ignorance may lead to apathy, unsafe practices, and injury.

Effective Preventive Education and Legislative Initiatives

Despite the strong evidence for the benefits of helmet use, many people still refuse to use them. For this reason, measures should be taken to assist people in better understanding proper protective measures and adopting them in order to prevent injuries.

Education and Exposure

As previously mentioned, research has shown that a person usually becomes cognizant of the risks of TBI after an injury occurs, not before (Leathem & Body, 1998). The risks of failing to use a helmet should become common knowledge, though how best to achieve this goal is uncertain.

Educational initiatives have tried to teach children and adolescents about the benefits of helmet use. Studies of one program showed that, initially only 50% of children were persuaded to use helmets. The program was in effect for six years, but helmet use never exceeded 60% (Lee & Mann, 2003). In addition, despite their knowledge about the brain and its vulnerability to damage, only 49.7% of neurosurgeons surveyed by Jung et al. (2010) wore helmets, just slightly more than the 44.5% of the general public who wear helmets.

Education informs people about the dangers going with a helmet, but it needs to be mixed with an emotional factor in order to be more successful. Jung et al. (2010) asserted that people are more likely to wear a helmet if it viewed as attractive, comfortable, or necessary. When helmets are "cool" or desirable, more people may wear them. The use of emotional components in educational programs coincides with Kakefuda's (2009) finding that college students who wore helmets did so because they felt it important to do so.

Legislative Initiatives

When facts and emotions aren't enough to persuade someone to wear a helmet, laws can be enacted to enforce helmet use. This has proven to be successful in reducing TBI. When helmet laws were passed in Australia, the use of helmets increased from 31% to 78%, and the incidence of injury was reduced by 48% (Persaud et al., 2002). A study in California showed that laws mandating the use of helmets for bicyclists under the age of 17 decreased the incidence of TBI by 18.2% (Lee, Schofer, & Koppelman, 2005). In 1999 only 16

states in the U.S. had laws enforcing helmet use for children and adolescents. These states reported 20% fewer deaths from bicycle-motor vehicle accidents than the other 34 states (Meehan, Lee, Fischer, & Mannix, 2013).

A study in Israel (Ginsberg & Don, 1994) showed that, whereas a helmet usually costs about $50, the cost of medical care of TBL is remarkably higher. If obligatory helmet-use laws were had been enacted, the potential savings over five years could be as much as $43.3 million, in addition to emotional and physical benefits. A similar U.S. study estimated that the fees for TBI totaled $76.5 billion in just one year (Finkelstein, Corso, & Miller, 2006). Although people don't usually like laws telling them what to do, the benefits of mandatory helmet-use laws are hard to ignore. When certified football helmets were made mandatory by the Nations Operating Committee on Standards for Athletic Equipment (NOCSAE), the occurrence of TBI decreased dramatically, and incidents of TBI related death dropped by 74% (Savica, Parisi, Wold, Josephs, & Ahlskog, 2012). A recent article published at Brigham Young University (Hollingshead, 2013) reported a new type of foam that is being inserted into football helmets. Special sensors transmit impact energy and other information directly to the coach and personal trainers, thus assisting them in knowing when to take an athlete out of the game.

Laws shouldn't just cover more activities but also a wider range of ages. Currently, most laws mandate helmet use for those aged 16 and under (Meehan et al., 2013). However, 43% of persons hospitalized with TBI were 20 years and older.

Non-Certified Helmets

Mandating the use of helmets isn't enough if the helmets themselves are not effective in protecting the skull and brain. Bicycle helmets are mandated by law to meet the Consumer Product Safety Commission (CPSC) standard. This is a test in which a 5-kg weight is dropped from a height of 1.2 meters (Bicycle Helmet Safety Institute, 2010), thus simulating a human head falling from mounted-bicycle-riding height. If the helmet prevents an impact of less than 300 g of force, it is considered safe. An impact above 300 g has been shown to cause head injury e (S-1 Helmets, 2013).

As previously mentioned, skateboarding is the fourth most-common cause of TBI (Shaughnessy, 2009), yet there is no regulation for skateboard-helmet safety standards. Many skateboard helmets are manufactured to pass the American Society for Testing and Materials (ASTM) test. In this test, the helmet undergoes a 3-foot drop or a 7 mph impact multiple times (ASTM Standard, 2003). However, the test does not effectively measure the effect of an actual fall, which would frequently be from a height of more than three feet. Also, although many regulatory agency and manufacturer studies have examined bike helmets, there is a further need for peer-reviewed research that demonstrates the comparative dangers of soft-foam, or non-certified, helmets, which are frequently purchased because of convenience and comfort.

Discussion

TBI is a pervasive global health issue. It results in injury to and the death of hundreds of thousands of people each year as well as the expenditure of billions of dollars. Steps need to be taken to re-

duce this tragic cost. Helmets are one means for reducing TBI. Increased helmet use can be achieved through preventative education and legislation mandating the use of helmets.

There is presently a dearth of empirical research focusing on sports such as skateboarding, which results in poorly informed consumers, as well as companies that sell unsafe products. Further research on helmet safety standards will help manufacturers to create affordable but effective helmets. With confidence in helmet protectiveness, widespread knowledge of TBI risks, and an emotional impetus to use helmets, their use may well increase, thereby reducing the risk of TBI.

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Appendix

Cost of Attendance for the 2013-14 Academic Year

Source: Colorado State University (2013)

The following reflects the average cost of attendance for a full-time student during the nine- month academic year. These are estimated expenses. Tuition and fees are direct costs while all other expenses will vary based on living arrangements, major, marital status and lifestyle. Charges for Technology, Special Course Fees and Differential Tuition, and loan fees (if you are a Direct Loan borrower) are not included in these estimates. On-campus room and board will raise your costs depending on your specific residence hall and the meal plan you select.

Expenses for Undergraduate Resident

	off campus	on campus
Tuition & General Fees	$9,266	$9,266
Housing & Meals	$8,982	$10,504
Books & Supplies	$1,126	$1,126
Transportation	$674	$674
Other Educational Costs	$1,314	$1,314
Total	**$21,362**	**$22,884**

http://registrar.colostate.edu/students/tuitionfees/index.aspx