

Comprehensive Review of the ThinkFirst Injury Prevention Programs: A 30-Year Success Story for Organized Neurosurgery

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Traumatic brain and spinal cord injuries are major public health issues causing significant death and long-term disability in the United States, with higher incidences in young and older adults. The ThinkFirst National Injury Prevention Foundation is a nonprofit organization focused on injury prevention education and awareness for people of all ages, with a particular focus on educating children, teens, and young adults. ThinkFirst chapters have evaluated the effectiveness of the ThinkFirst programs in both children and teens by demonstrating significant improvement in knowledge regarding high-risk behaviors postintervention. Here, we review the available literature studying the efficacy of the ThinkFirst National Injury Prevention Foundation programs, outline current ThinkFirst activity, and discuss future directions of the program. This review discusses the efforts of a number of ThinkFirst chapters in terms of research, legislation, and public communication. It showcases the success of ThinkFirst interventions and suggests future directions which can help improve national injury prevention efforts.

KEY WORDS: Traumatic injury, Injury prevention, Brain injury, Spinal cord injury

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In the United States (US), traumatic injuries are the leading causes of death and disability for ages 1 to 44, with brain and spinal cord injuries (SCI) among the most devastating.¹ The Centers for Disease Control and Prevention (CDC) estimates that of the 1.7 million people who suffer a traumatic brain injury (TBI) each year, 52 000 die, 275 000 are hospitalized, and 1.36 million are treated and released from emergency departments.² In addition, TBI is a contributing factor to a third of injury-related deaths in the US. The leading causes of TBIs that resulted in emergency department visits, hospitalizations or death are falls, strikes or blows to the head from or against an object, and motor vehicle-related injuries.³ The estimated direct

and indirect costs of TBIs are approximately \$76.5 billion.⁴

As a result of a TBI, approximately 5.3 million Americans require lifelong or long-term assistance for daily activities.⁵ The number of people suffering the long-term consequences of a TBI is disproportionately higher for children, young adults, and those living in rural areas. In 2008, the estimated number of youth from ages 0 to 19 years living with long-term TBI-related disabilities was 145 000.^{2,6}

In addition to TBIs, SCIs are another devastating traumatic injury, with lifelong consequences, that are often preventable. Each year approximately 12 500 new cases of SCI occur, primarily affecting people between the ages of 16 and 30.⁷ The estimated cost of SCI in the US is \$7.7 billion per year.⁸ The main causes of SCI since 2010 are motor vehicle crashes, falls, violence, and sports-related injuries.⁷ Sports-related injuries have, in part, diminished due to increased prevention and awareness of SCI resulting from sports.

The staggering number of people affected by TBIs and SCIs each year, coupled with huge societal cost of the injury, makes these

ABBREVIATIONS: US, United States; SCI, spinal cord injury; TBI, traumatic brain injury; CDC, Centers for Disease Control and Prevention; AANS, American Association of Neurological Surgeons; CNS, Congress of Neurological Surgeons; HBM, Health Belief Model; TFFK, ThinkFirst For Kids; TFFT, ThinkFirst for Teens; SES, socioeconomic status; VIP, Voices for Injury Prevention

TABLE. Annual Operating Costs of the ThinkFirst Oregon Chapter

	Annual cost (\$)
Salary (2.0 Full-time equivalent)	81 000
Benefits	36 000
Mileage/travel	5000
Materials/curricula/fees	10 000
Safety supplies	9 000
Fall prevention materials and fees	6 000
Total	150 000

use educational presentations and curricula to help students understand basic anatomy of the brain and spinal cord, the importance of the brain and spinal cord, how a TBI or SCI could affect their life permanently, and how simple actions or behaviors can reduce their risk for injury, such as wearing a seat belt or driving without the distraction of a cell phone.

Program Costs

The ThinkFirst National Injury Prevention Foundation is funded primarily by sponsorship and grants, as well as revenue earned from conferences and special events. Additional proceeds are earned through membership dues, contributions, and product sales (full revenue reports are released annually and can be found on the ThinkFirst National Injury Prevention Foundation's website: <http://thinkfirst.org/annual-reports>). The costs associated with each individual ThinkFirst chapter vary depending on the location and extent of the program. The initial chapter fee is \$1500, with \$300 annual dues. International chapters are on a graded fee schedule based on their country's WHO status, ranging from \$500 to \$1500. All materials are included in the initial training fees, with additional supplies ordered as needed. Depending on the level of activity, a budget for a single ThinkFirst chapter can range from several thousand dollars to upwards of \$100 000 or more depending on the salaries and associated benefits of the chapter director, the travel costs and honoraria associated with VIP speakers, and any other personnel support. For example, the total operating costs of the ThinkFirst Oregon chapter is approximately \$150 000 per year which includes salary for staff members, benefit costs for staff, travel support and reimbursement, costs of materials and curricula, safety items, and supplies for fall prevention seminars (Table). This particular chapter is funded by a combination of government and philanthropic grants, departmental support, and revenue from helmet sales (which is solely used for purchasing more helmets). In addition, ThinkFirst Oregon relies heavily on the assistance of volunteers who donate approximately 800 h of time on outreach efforts, and whose in-kind hours are used to match grant support. At this level of funding, ThinkFirst Oregon reaches approximately 50000 people annually, which equates to cost per person of around \$3.00. It must be noted that this is just one example of costs associated with operating a chapter. Further, for both the ThinkFirst National Injury Prevention Foundation

and the individual ThinkFirst chapters, grant and other financial support is not automatically guaranteed each year which can lead to wide variances in the annual budget for any given chapter.

Program Evaluation

Over the past 30 years, there have been a number of studies examining the efficacy of the various ThinkFirst programs (ie, TFFK, ThinkFirst for Teens (TFFT), etc) at different sites throughout the US. Research studies on ThinkFirst programs have provided a key source of data used by the Foundation to determine program revisions, guide program development, and improve chapter training approaches. It is important to note that studies conducted over the years reflect findings on a particular year's version of a program intervention, with methods that may be unique to the specific chapter that conducted the study. However, the inclusive nature of the Foundation has led to open communication and feedback between the chapters and national office resulting in frequent modifications to the programs as more data have become available. There have been 5 teen videos produced and several renditions of the PowerPoint presentation, just in the teen and youth programs. Presentation delivery may also be affected by the use or nonuse of standardized presentation scripts, and the experience and effectiveness of the presenter, which is not generally noted in the studies. Along with evaluations, chapter feedback has played an important role in program development and presenter training. This section describes the intervention and evaluation methods used in each of the studies conducted on ThinkFirst and shows how those results were used, or could be used, to enhance outcomes of ThinkFirst interventions.

TFFT was the first injury prevention program developed by ThinkFirst, and its validity was first studied in 1996. The Oregon Head and Spinal Cord Injury Prevention Program study, one of the earliest studies of a ThinkFirst program, evaluated the effectiveness of a TFFT educational assembly. The study focused on high school students and demonstrated a statistically significant increase in knowledge postassembly.¹¹ The authors suggested that to elicit a change in behavior, a continuous or intermittent reinforcement was required. After measuring its effectiveness in high school students, another study was designed to test whether the TFFT program would have the same beneficial effect on middle school students.¹² The results suggested that the program was appropriate and beneficial for middle school students, with all of the students in one school and the girls at another school experiencing a significant increase in knowledge.

The effectiveness of the TFFK curriculum has been evaluated through various research efforts at diverse ThinkFirst chapter locations. ThinkFirst launched the TFFK injury prevention curriculum in 1996 for primary students, grades 1 through 3. Based on the principles of applied learning, as well as behavioral theories that establish that an idea delivered repetitively over time increases understanding, knowledge retention, and sustained behavior, the curriculum consisted of multiple interventions given

over a six-week period.¹³ These interventions provided information on (1) general knowledge about the structure and function of the brain and spinal cord, (2) motor vehicle and pedestrian safety, (3) bicycle safety, (4) conflict resolution and the dangers of weapons, (5) water safety and, (6) playground, recreation, and sport safety.¹⁴

Several studies have supported the effectiveness of TTFK. Gresham et al used a randomized approach to demonstrate that TFFK significantly increased knowledge about safe behaviors, and decreased self-reported high-risk behaviors in students in first through third grades.¹³ After controlling for pretest, gender, socioeconomic status (SES), and race/ethnicity, the authors found that the TFFK curriculum was a significant predictor of increased test score from pretest to posttest. In addition, the authors report that African American and Hispanic students in second and third grades saw the greatest improvement in test scores. This study was the first to report a decrease in self-reported, high-risk behavior as a result of the TFFK program.

In the same manner, a 3-phase nonrandom experimental study conducted by ThinkFirst Oregon sought to evaluate the efficacy of the TFFK curriculum with children in first through third grades.¹⁴ A significant ($P < 0.01$) increase in knowledge of injury prevention was observed in all three grades for the schools that received the TFFK curricula vs control schools that received no curricula. This suggested that exposing children to a six-week school-based program is an effective approach for promoting injury prevention among students in first through third grades. Greene et al also found a significant correlation between SES and change in knowledge, with the greatest improvement in post-intervention knowledge having occurred in lower SES schools.

ThinkFirst is truly a national and international program, and therefore must be sensitive to local environments. Knowledge base and cultural norms differ by geography, and therefore modifications of the program may be necessary to gain maximal effect. In 2005, an article by Rosenberg et al reported that national and international ThinkFirst chapters were tailoring injury prevention approaches to the needs of their communities.¹⁰ This article also mentioned a 3-year longitudinal study which demonstrated that implementing the TFFK curriculum as the child progresses through school leads to an increase in knowledge, a decrease in self-reported risk behavior, and a retention of knowledge over the three-year period.¹⁰ Rosenberg et al also emphasized the need for federal and private financial assistance and support to ensure injury prevention efforts are sustained. The evidence of positive outcomes from ThinkFirst injury prevention programs would suggest justification for local and national support for these programs.

In another study, the Level I Trauma Center in Cambria County, Pennsylvania, documented that the incidence of pediatric TBI and SCI coming to their facility was 5 times higher than the state average. In order to address this issue, the trauma center set out to establish an educational brain and SCI prevention program for children. The study implemented the TFFK 6-week injury prevention curriculum for first through third-grade students in

Cambria County.¹⁵ Three years of data were collected for a total of 6644 matched pretests and posttests. Results from the study showed a 21% increase in knowledge of safety issues in first graders, 15% increase in second graders, and 11% increase in third graders. Overall, there was a 10% decrease in self-reported risky behaviors in first graders followed by second and third graders. Most importantly, the study reported that preliminary data from their Level I Trauma Center revealed a decrease in pediatric head and neck injuries. In 2001, 73% of pediatric trauma patients admitted had a head and/or back injury, whereas in 2003 the pediatric trauma patients that sustained such injuries decreased to 51%. This study demonstrates the importance of injury prevention and provides evidence that implementing injury prevention programs can have great public health impact.

Several studies have also sought to evaluate the effectiveness of the TFFT program implemented in high schools. In 2007, TFFT was assessed in 3 suburban Chicago high schools and its effectiveness was evaluated by the pretest and posttest approach.⁹ A 3-month posttest was collected after the initial intervention in subset of subjects to assess retention of knowledge. Results demonstrated an increase in knowledge of behaviors associated with potential for injury and the importance of making safer choices. The qualitative posttest given 3 months after the intervention showed the lasting positive impact of this intervention. In conjunction with the TFFT curriculum, speakers who sustained a TBI or SCI, referred to as VIP speakers, were utilized. Of the students tested, 67% stated that they were most influenced by hearing VIPs speak, suggesting that additional emphasis should be given to the impact VIP speakers have on students as a Think-First intervention, as they appear to play a critical role for injury prevention to become more tangible to students.

A study conducted in Saskatchewan, Canada, demonstrated that the ThinkFirst Canada curriculum was effective at enhancing knowledge and behavior associated with injury prevention in 1257 students in sixth and seventh grade.¹⁶ There was also an increase in self-reported use of protective sporting equipment after the intervention.¹⁶

Contrary to this common trend, 2 peer-reviewed articles reported that their ThinkFirst interventions failed to elicit significant changes in knowledge; however, several limitations to these studies have been observed.^{17,18} A study published in 1995 assessed the impact of the ThinkFirst Head and Spinal Cord Injury Prevention Program in 11- to 15-year-old students showed suboptimal impact.¹⁷ However, one of the limitations identified by the authors was that only one school served as control, and the questionnaires had to be shortened to cover only selected items. The authors acknowledged that the adaptation of the questionnaire could have introduced bias.¹⁷ Similarly, a recently published article set-out to determine whether a short educational intervention led to improvements in self-reported understanding of safety measures and behaviors in teenagers.¹⁸ The study implemented a web-based pretest (distributed to 177 students before the intervention) and a posttest (distributed to 191 students 3 months after the intervention). The questions in the pre- and

posttest were not assessed for content clarity and face validity, which is a limitation acknowledged by the authors.¹⁸ Furthermore, the questions used were different from the questions provided by the TFFT curriculum, which may have been a source of bias that affected the results obtained.

In summary, multiple studies have shown the effectiveness of ThinkFirst's programs, while others have suggested the need for modifications to the program, which have been continuously enacted based on feedback from the studies. Both short- and long-term research studies are very important in elucidating the strengths and weaknesses of existing ThinkFirst programs, as well as providing key information on how to improve these programs and shape future programs.

While several of the published studies provided some insight on how social and environmental factors may impact the effectiveness of the ThinkFirst program (such as differences in increased knowledge depending upon SES), not all of the studies presented examine this issue. When possible, future studies should include metrics to measure these differences.

One of the challenges in measuring the efficacy of the ThinkFirst program, and injury prevention programs in general, is the lack of measurable hard effects. As such, the most reasonable way of measuring the effectiveness of the program is by using retention of, or increase in knowledge as the primary measured outcome.

An additional challenge of testing the efficacy of the ThinkFirst program is the inherent variation in presentation delivery including the use or nonuse of standardized presentation scripts, the experience level of the presenter and the public speaking effectiveness of the volunteers, which is not generally noted in the studies. While this lack of consistency may be viewed as a weakness of the program, it also has its strengths. Each presenter is not only able to modify the curricula in a way that they feel maximizes conveying the message to their audience, but is also able to include their personal experiences, whether it be as a trauma nurse, physician, or injury prevention specialist, etc. in their presentation.

ROLE OF THINKFIRST IN LEGISLATION AND COMMUNICATION

Additional goals of the ThinkFirst National Injury Prevention Foundation are to utilize the media to promote injury prevention efforts in the community, and advocate for local and state legislation to reduce traumatic injuries. Several state chapters of ThinkFirst have been involved in local and state government, and have seen success in these realms. Since 1990, ThinkFirst Oregon has provided public education, distribution of information, and testimony at legislative hearings in order to endorse various state legislation associated with safe practices and injury prevention including safety belt use, bicycle helmet mandates, pick-up truck passenger safety, all-terrain vehicle safety, and antigun legislation. ThinkFirst Missouri has also been active in advocacy work through lobbying and testifying at the state capital

to successfully reduce the legal blood-alcohol content to 0.08 and maintain the current motorcycle helmet law. More recently, this chapter partnered with the Missouri Coalition for Roadway Safety to educate and encourage legislative leaders to pass a primary seatbelt law and adopt an all-driver texting ban. For over a decade, this particular chapter has partnered with a statewide public information and education safety campaign to promote their injury prevention programs. This ongoing partnership has demonstrated the impact and effectiveness of ThinkFirst programs and aided in the acquisition of further support at the state and national levels.

FUTURE PROJECTS

Research has shown that children and adolescents are continuously engaging in new and innovative forms of social media, benefiting them by enhancing communication, social connection, and even technical skills.¹⁹ Koestner et al suggest that it may be valuable to use social media to disseminate traumatic injury awareness and prevention information to this population.¹⁸ The internet provides an avenue of great potential for injury prevention efforts and its application should continue to be explored by ThinkFirst chapters. Currently, the ThinkFirst National Injury Prevention Foundation and several state chapters utilize websites, Facebook, Twitter, YouTube, and other social media outlets to post injury prevention information and messaging. The ThinkFirst Foundation has recognized the importance of assessing how to best utilize social media in injury prevention efforts in an effective manner, and has committee members dedicated to this area.

The ThinkFirst Foundation is continually aiming to expand its audience with the goal of targeting injury prevention throughout the lifespan. With a modest beginning that aimed interventions at teenage audiences, the program now includes materials that target young children, middle- and high school students, young adults, and older adults. ThinkFirst launched a new program called "ThinkFirst to Prevent Falls" which is focused on reducing falls in older adults (ages 65 years and older); a major source of death and disability in this age group. In addition, ThinkFirst For Your Baby is currently under development, which will be aimed at educating parents on injury prevention in infants and toddlers. There is great importance in reducing TBIs and SCIs throughout the lifetime, and the ThinkFirst Foundation strives to reach audiences by tailoring its interventions to the target populations.

The impact the VIP speakers have on the efficacy of the ThinkFirst For Teens Program should be further investigated. The VIPs are usually young adults with a TBI or SCI who speak to the students about their life prior to the injury, the choices that led to the injury, how it could have been avoided, and how their life has changed as a result of the injury. In 2007, a study by Gerhardstein was one of the few that emphasized the significance of the VIPs on intervention efforts.⁹ The study shows that a vast majority of the students stated they were most influenced to be safe by hearing from the VIP speaker. It is of great importance

to continue to assess the impact of VIPs on the acquisition and retention of knowledge and change in attitudes and behaviors derived from a ThinkFirst presentation in order to maximize efficiency and effectiveness of the program. Future studies aimed to take a randomized controlled trial approach to see the effect of including a VIP speaker in a ThinkFirst presentation are being explored.

There is very little published data estimating the cost–benefit ratio associated with injury prevention interventions. While Rosenberg et al emphasized the importance of federal and private support to continue improving injury prevention efforts, the direct costs associated with the ThinkFirst programs have not been well documented.¹⁰ Therefore, future studies should assess the estimated program costs to both examine the cost–benefit of the program, and assist fundraising efforts.

While it is extremely important to carry out research studies testing the efficacy of ThinkFirst programs, and injury prevention in general, it should be noted that the resources to do so are extremely limited. Most ThinkFirst chapters are supported by small grants from private and government sources or industry sources. However, the majority of funds are dedicated to support injury prevention outreach, and any additional funding goes toward expanding the reach of the programs, leaving little to no funds for research projects. The ThinkFirst Foundation has recently partnered with the AANS and CNS to encourage physicians to submit abstracts on injury prevention by establishing two annual injury prevention research awards.

CONCLUSION

The ThinkFirst National Injury Prevention Foundation programs offer multilevel evidence-based educational programs that have reached millions of children and teens nationally and internationally, have had great influence in public policy initiatives, and continue to expand in order to reach those most vulnerable to traumatic injuries. Each year, ThinkFirst chapters provide thousands of educational presentations to schools, businesses, organizations, conferences, and community events with the goal of traumatic injury prevention. However, to continue making an impact on injury prevention, the Foundation must have increased financial support for their activities. A review of the ThinkFirst programs demonstrates that injury prevention is as worthy of an endeavor as smoking cessation programs and campaigns to encourage the use of seat belts, both of which have been adequately supported and have proven to be effective in the US.¹⁰ It is undeniable that the detrimental effects of TBIs and SCIs, including the catastrophic societal cost of care, the long-term loss of wages, and the fact that traumatic injuries continue to be the leading cause of death among the ages of 1 through 44, support the notion that injury prevention programs such as ThinkFirst should become a state and federal priority. The future of injury prevention efforts will rely on local chapters that devote their time to develop and constantly improve ThinkFirst interventions. Furthermore, it is these ThinkFirst chapters, and the

communities that support their efforts, that will help prevent future generations from suffering the far-reaching and long-term detrimental effects of TBIs and SCIs.

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