DEVELOPING A BICYCLE HELMET PROGRAM FOR AN URBAN PEDIATRIC EMERGENCY DEPARTMENT

by

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SIGNED: __James Thomas Mulholland__________________

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DEDICATION

This DNP Project is dedicated to all those children, and the kids at heart, who love the freedom of self-powered pedaling. May you always have the wind at your back, your tires full of air, and your craniums protected.

To my two favorite cyclists, Grace and Mattie, may you always chase your dreams, never shy away from hard work, and always enjoy the journey.

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ABSTRACT

Introduction and Rationale: Bicycle riding is popular among the pediatric population, but with popularity comes a significant increase in morbidity and mortality. Cycling injuries occur in one-fifth of children aged 15 years and younger. Most life-threatening injuries among bicycle riders occur when the head is involved in bodily injury. Traumatic brain injury (TBI) related to bicycle accidents accounts for three-fourths of deaths. Despite the risk, many bicycle riders go without wearing helmets, largely due to lack of ownership.

Purpose and Objective: The purpose of this Doctor of Nursing Practice (DNP) project was to develop and implement a pilot bicycle helmet program for a pediatric population, ages 5-13, from a pediatric emergency department (PED) perspective. The project objective was to increase bicycle helmet use among participants' children by providing the child with a free bicycle helmet, and also providing the parent with education specifically related to the importance of bicycle helmet safety. The project was driven through the Health Belief Model, and utilized the Teachable Moment of a PED encounter to influence risk-reducing behavior.

Methods: This DNP project utilized a quasi-experimental, one group, pre- and post-test design. Participants were recruited from an urban PED, and identified at triage as being involved in a bicycle accident. Eligible children were fitted for a free bicycle helmet, and the parent was provided with an educational session coupled with a handout for home. A one-month follow-up phone call was conducted to assess bicycle helmet use and education retainment following the intervention.

Results: All participants reported an increase in bicycle helmet use by their children. This study was able to show statistical significance related to bicycle helmet use, thus the null hypothesis

was fairly confidently rejected. However, there were only five participants in this study, which makes generalization of results to a larger population difficult.

Conclusions: This study showed that a bicycle helmet program is feasible in a PED, and could increase bicycle helmet use in a pediatric population. A DNP is an excellent candidate to run such a program as it focuses on positively impacting injury-prevention and dissemination of good practice for a larger community.

CHAPTER 1: BACKGROUND AND SIGNIFICANCE OF THE PROBLEM

Introduction

The purpose of this Doctor of Nursing Practice (DNP) project was to develop and implement a pilot bicycle helmet program for a pediatric population, ages 5-13, from a pediatric emergency department (PED) perspective. This chapter will provide a background of bicycle-related injuries, injury sequelae, financial burden of traumatic brain injury, benefits of helmet use, and barriers to helmet use in pediatrics. The chapter will also discuss the purpose and specific aims of this DNP project, a definition of terms to be used throughout the paper, and the project's significance to advanced practice nursing and the role of a DNP.

Background

Bicycle riding is popular during childhood. Mehan, Gardner, Smith, and McKenzie (2009) reported that greater than 70% of children age 5-14 years ride bicycles in the United States. However, the popularity comes with a significant increase in morbidity and mortality. For children, riding a bicycle is a major source of trauma in the United States (U.S.) (Bergenstal, Davis, Sikora, Paulson, & Whiteman, 2012). According to the Centers for Disease Control and Prevention (CDC) (2011), bicycle crashes are the leading cause of nonfatal emergency department visits for children younger than 19 years during a recreational activity. Bicycle-related injuries occur in over 300,000 children annually, and a large number require hospital admission (Mehan et al., 2009). Cycling injuries occur in one-fifth of children aged 15 years and younger (McLaughlin & Glang, 2010).

Bicycle-Related Injuries

Injuries to cyclists are mostly due to the result of accidental falls, inattention, road conditions, and traffic collisions with another cyclist or motor vehicle (Junior et al., 2012). Cyclists are at risk for serious injury upon impact (Junior et al., 2012). Bicycle riders find themselves in a disadvantage during accidents because of their lack of available safety equipment comparable to motor vehicle passengers, such as air bags, roll-cages, and seat belts (Junior et al., 2012). The three main anatomical sites most injured during a bicycle accident are the upper limbs, lower limbs, and head (Amoros, Chiron, Thelot, & Laumon, 2011; Bambach, Mitchell, Grzebeita, & Olivier, 2013; Juhra et al., 2012; Santos et al., 2010; Kiss, Poto, Pinter, & Sarkozy, 2010). Head injuries related to bicycle injuries can cause both acute and lifelong disability requiring lengthy, expensive treatment, loss of independence, and loss of income potential (Kayani, Homan, Yun, & Zhu, 2009; National Highway Traffic Safety Administration [NHTSA], 2008). NHTSA (2008) estimated the annual cost of bicycle-related injuries including deaths to be $8 billion for all ages.

In a five year period from 2000-2005, children less than 15 years of age accounted for 19% of all bicycle deaths (Helmkamp, Aitken, & Lawrence, 2009). Rivara and Johnston (2013) found children under the age of 15 years had the highest rate of injury per mile ridden. Siman-Tov, Jaffe, and Peleg (2012) conducted a retrospective review of trauma centers, which produced a sample of 5529 injured cyclists, and found children had a higher prevalence of head, face, or neck injuries compared to adults.

Serious facial and dental injuries are also prevalent in bicycle accidents. Santos et al. (2010) studied 542 patients suffering accidental dental trauma, and found bicycle accidents to be the most common cause, accounting for such injury in 26.94% (n=146) of patients. The authors discovered that only three of these patients were actually wearing a helmet (Santos et al., 2010). Junior et al. (2012) examined facial injuries and traumas in patients involved in motorcycle and bicycle accidents. Of the 923 patients, 556 were involved in a bicycle accident, and 250 of those patients suffered a facial injury ranging from facial fractures to soft tissue injuries. Interestingly, only 6% of cyclists wore a helmet when the accident occurred (Junior et al., 2012).

Traumatic brain injury. Most life-threatening injuries among bicycle riders occur when the head is involved in bodily injury (Amoros et al., 2011; Kennedy, 2008). Traumatic brain injury (TBI) related to bicycle accidents accounted for approximately one-third of emergency department (ED) injuries, two-thirds of hospital admissions, and three-fourths of deaths annually (Rivara & Johnston, 2013). There is an increased risk of death as a result of TBI associated with not wearing a helmet during a cycling accident (Persaud, Coleman, Zwolakowski, Lauwers, & Cass, 2012).

The resulting pathophysiology of head injuries is classified as *primary injury*, from direct mechanical force, and *secondary injury*, from delayed effects (Schunk & Schutzman, 2012; Walker et al., 2009). Primary injuries include skull fracture, intracranial hemorrhage, cerebral contusions, and diffuse axonal shearing resulting in loss of consciousness, disorientation, slurred speech, delayed question answering, amnesia, lethargy, headache, nausea, dizziness, and vomiting (Bergenstal et al., 2012; Giza et al., 2013; Schunk & Schutzman, 2012; Wing & James, 2013; Youngblut, Caicedo, & Brooten, 2013). A pediatric skull is able to absorb more force without a fracture due to the fact that it is more compliant than an adult skull, however, the chance for shearing forces between the skull and underlying vessels increases (Wing & James, 2013). The pediatric brain is also at greater risk for more acceleration-deceleration injuries than adults because it is less dense (Wing & James, 2013). Secondary injuries result from continued damage to neuronal cells most likely due to increased intracranial pressure, hypoxia, hypoperfusion resulting in cerebral edema, infarction, herniation, and hypotension causing cerebral blood flow changes, metabolism changes, neurologic dysfunction, cardiopulmonary deterioration, and death (Richmond & Rogol, 2014; Schunk & Schutzman, 2012; Wachter, Gundling, Oertel, Stracke, & Boker, 2009; Wing & James, 2013). Gardner, Poehling, Miller, Tooze, and Petty (2013) found that 29% of pediatric trauma patients that suffered an isolated head injury presented with severe shock without hemorrhagic injury. These children presented with poor perfusion, elevated blood lactate levels, and hypotension (Gardner et al., 2013).

Stuss and Anderson (2004) discuss the potential devastating effects of frontal lobe damage during the childhood years. Damage to this area can result in deficits in the development of maturing skills, and decreased arousal and sensory awareness (Stuss & Anderson, 2004). Neurological, behavioral, and school problems were reported by parents of children and adolescents following even a mild TBI (Bergenstal et al., 2012; Hooper et al., 2004; Tonks et al., 2009). Postconcussion syndrome can last up to a few months after initial concussion, and includes symptoms such as headache, dizziness, fatigue, impairment in concentration, and neuropsychiatric symptoms (Bergenstal et al., 2012; Schunk & Schutzman, 2012; Wing & James, 2013). Head injuries can also result in long-term symptoms such as poor attention, poor memory, impaired language skills, impaired communicative skill, and difficulty in social situations (Tonks et al., 2009). Timonen et al. (2002) found a two-fold increase of mental health disorders in adults who suffered a brain injury as a child.

All subjects reviewed by Gerlach et al. (2009) involved in a bicycle accident had an associated skull fracture, and 40% had a brain contusion. Skull fractures and intracranial injuries are more prevalent in ages 13-19 years (Bambach et al., 2013). Occipital bone fractures, mandibular condyle dislocations, aneurysm of the superficial temporal artery, as well as orbital floor fractures have been seen as a result of bicycle accidents (Nicolotti, Poglio, Grivetto, & Benech, 2014; Oberman, Setabutr, & Goldenberg, 2014; Veen, Poelman, & IJpma, 2014).

Financial burden of TBI. Short-term costs associated with a TBI include emergency department (ED) visit charges, follow-up, and additional hospital charges (Kayani et al., 2009). If injury is severe enough to require long-term care, costs could include skilled nursing care, rehabilitation, or hospice (Kayani et al., 2009). Acute hospitalization cost due to TBI-related injuries were estimated above $1 billion in the United States in the year 2000 (Schneier, Shields, Hostetler, Xiang, & Smith, 2006). Those same costs were estimated around $2.5 billion in 2006 (Shi et al., 2009).

Benefits of Bicycle Helmet Use

A bicycle helmet is the main safety measure for protection in an accident for cyclists, and one of the most effective measures for preventing injuries (Amoros, Chiron, Martin, Thelot, & Laumon, 2012; Dellinger & Kresnow, 2010; Junior et al., 2012; Kaplan & Prato, 2013; McIntosh, Lai, & Schilter, 2013; NHTSA, 2008). The NHTSA (2008) estimates 39,000 - 45,000 head injuries would be prevented annually if all children ages 4-15 years wore a bicycle helmet. They estimate 18,000 - 55,000 scalp and facial injuries would be prevented annually with universal bicycle helmet use (NHTSA, 2008). Universal bicycle helmet use by children, ages 14 and under, would prevent 382,000 - 529,000 bicycle-related injuries and 212 - 294 deaths annually (Children's Safety Network [CSN], 2009).

Concussion, skull fracture, and intracranial hemorrhage are more likely in children not wearing helmets (Bergenstal et al., 2012). Helmets produced for bicycle riders are designed to completely or partially absorb an impact to the head (Amoros et al., 2012; McNally & Rosenberg, 2013; Meadows-Oliver, 2007). McNally and Whitehead (2013) used computer simulations to create different variations of cyclists, bicycles, and vehicles to produce common accidents seen in real life. The authors based injury severity using the Abbreviated Injury Scale (AIS) with injury levels ranging from 1 (minor) to 6 (un-survivable) (Association for Advancement of Automatic Medicine, 2008). The study produced 36 different crash simulations where direct head impact occurred in 21 of these crashes (McNally & Whitehead, 2013). Overall, helmet wearing was found to significantly reduce severe (AIS>3) head injury mean risk from 40% to 24%, and reduce injury severity by an average of 1.5 AIS points. Additionally, helmeted riders benefited from the elimination of head injury from accidents that would have resulted in an AIS ≤ 2 head injury of an un-helmeted individual. Helmet wearing was found to be protective against neck injuries, and to prevent fatality in one-third of simulations (McNally & Whitehead, 2013). Bergenstal et al. (2012) found the only two individuals who died in their study were not wearing a helmet at the time of the crash. Dellinger & Kresnow (2010) found a 29% reduction in risk for fatal head injury when wearing a helmet, as well as at least a 45% reduction in risk for head injury all together. Similar studies, found a decreased risk of head injury of any severity, especially serious head injuries when a helmet is used (Amoros et al., 2012; Juhra et al., 2012; McNally & Rosenberg, 2013). Bambach et al. (2013) reported helmet use significantly reduced head injury up to 74% compared to non-helmeted individuals. Additionally, they found a 78% reduction in risk for skull fracture, a 72% reduction in intracranial injuries, a 74% reduction in concussions, and an 80% reduction in open head wounds by wearing a helmet during a bicycle accident (Bambach et al., 2013).

Skull injury and brain injury risk can be related to linear head accelerations (Cripton, Dressler, Stuart, Dennison, & Richards, 2014; McIntosh et al., 2013). Bicycle helmets reduce linear head accelerations across varying heights of falls, producing a reduction in the risk of head injury (Cripton et al., 2014; Mattei et al., 2012; Miyamoto & Inoue, 2010; McIntosh et al., 2013). By using drop tests, Mattei et al. (2012) concluded that by wearing a helmet a child riding a bicycle at a speed of 30 miles per hour (mph) during an accident would reduce the force of head impact to the equivalent of an accident at 7 mph. McIntosh et al. (2013) used similar tests and found that at least a concussion would be suffered in each of the 37 non-helmet tests, with a 30% greater chance of suffering a serious head injury compared to the helmeted test. There is a debate that helmets used by cyclists do little to ensure facial protection by design (Junior et al., 2012). However, Dellinger and Kresnow (2010) found bicycle helmets provide a 27% reduction in the risk of facial injuries, which corresponds with a previous study by McDermott, Lane, Brazenor, and Debney (1993) that found a 28% reduction.

Underutilization of Helmets

Despite the overwhelming data related to bicycle helmet safety, a large number of bicycle riders go without helmets (NHTSA, 2008). An estimated 55% of children do not always wear a helmet (Bambach et al., 2013; Dellinger & Kresnow, 2010; Dennis, Potter, Ramsay, & Zarychanski, 2010). Estimated rates of bicycle helmet use among school-aged children in the

United States ranges from 12% to 37% (Kakefuda, Henry, & Stallones, 2009; Ross, Ross, Rahman, & Cataldo, 2010). Castle, Burke, Arbogast, and Upperman (2012) obtained helmet data on 1,684 emergency department patients injured from a bicycle-related accident where helmet use was known, and only 206 of those patients were wearing a helmet. Amoros et al. (2012) reported that out of a total of 2,990 children aged 14 years and younger injured in a cycling accident, only 365 (12%) were wearing a helmet. Davison et al. (2013) interviewed 19,410 Canadian students, and only 26% reported wearing a bicycle helmet every time they rode a bicycle in a 12-month period. Kiss et al. (2010) interviewed 378 children under the age of 18 years involved in a bicycle accident, and only 8% were actually wearing one at the time of the accident. Brand et al. (2013) and Wang et al. (2009) found less than 7.6% of individuals involved in bicycle-related accidents wore a helmet. Only 15% of the youth demographic 17 years old and younger in the Brand et al. (2013) study wore a helmet at the time of the accident.

The NHTSA (2008) estimates society saves $30 in indirect medical and other costs for every $1 spent on bicycle helmets. The CSN (2009) estimates that every $10 bike helmet will generate a $570 benefit to the public, and if 85% of all children wore a bicycle helmet in a one-year period the lifetime medical cost savings would be $197 - $256 million.

Barriers to Helmet Use

Lack of helmet use has been identified, largely, as a lack of helmet ownership due to both cost and availability (Baeseman & Corden, 2014; Grenier et al., 2013; Pierce, Palombaro, & Black, 2014; Ross et al., 2010; Secginli et al., 2013). Only 8.6% of a sample of 1180 children ages 8 - 16 years reported owning a bicycle helmet (Secqinli, Cosansu, & Nahcivan, 2013). Kiss et al. (2010) found that only 36% of children in their study owned a bicycle helmet.

Negative peer pressure has been linked to a lack of helmet use, even when ownership is not an issue (Baeseman & Corden, 2014; Finnoff, Laskowski, Altman, & Diehl, 2001; Ross et al., 2010; Secginli et al., 2013). Parental practice is a cause for lack of helmet use when a child's parent does not wear a helmet while riding (Baeseman & Corden, 2014; Finnoff et al., 2001; Ross, Brinson, & Ross, 2014; Secginli et al., 2013). Lack of helmet legislation and enforcement causes a lack of helmet adherence when compared to areas with stricter laws in place (Baeseman & Corden, 2014; Grenier et al., 2013; Ross et al., 2010). Helmet use is also attributed to a lack of knowledge pertaining to the protective effects of helmet use related to head injury resulting from an accident (Finnoff et al., 2001; Ross et al., 2010). Finnoff et al. (2001) found that a common reason for lack of helmet use was the children and adolescents surveyed did not believe they were going to crash.

Significance to Advanced Practice Nursing

Health promotion and injury prevention are essential tenets of clinical practice for the advance practice nurse (APN) and the DNP (American Association of Colleges of Nursing [AACN], 2006; National Association of Pediatric Nurse Practitioners [NAPNAP], 2008). This type of education has typically fallen on the shoulders of the primary care provider (PCP) during well-child visits (Melzer-Lange, Zonfrillo, & Gittelman, 2013). However, Gittelman and Durbin (2005) discuss how injury prevention education often takes place in Pediatric Emergency Departments (PEDs), and the pediatric emergency medicine physicians are not adequately trained or qualified to provide anticipatory guidance. As APNs and DNPs fill more specialty roles in clinical areas such as a PED, in addition to PCP roles, they have been equipped with an educational foundation focusing on anticipatory guidance and health promotion using evidence-based research (AACN, 2006).

A DNP is educated to focus on broad community improvement and not only on the direct care of an individual (AACN, 2006). Large improvements in health have occurred from interventions at the population level (Rivara & Johnston, 2013). Prevention of TBI through use of helmets addresses an important public health problem (Rivara & Johnston, 2013). Additionally, emergency providers and other DNPs should support legislation having positive effect on injury prevention such as mandatory helmet laws (Coffman, 2003; Mace et al., 2001; Rezendes, 2006). It is important for APNs to identify children at the highest risk for injury (NAPNAP, 2008). Low socioeconomic families use EDs and urgent care for medical management, likely not receiving appropriate injury-prevention, and are at increased risk for serious injury (Melzer-Lange et al., 2013). Ultimately, DNPs play a huge part in the international community of injury-prevention, and can assist by disseminating good practice based on evidence (Toroyan, 2009).

Purpose and Specific Aims

The purpose of this DNP project was to develop and implement a bicycle helmet program in a Pediatric Emergency Department (PED) of an urban community hospital. The program provided free bicycle helmets to children, ages 5 - 13 years, and bicycle helmet education to their parents/guardians when the child presented with a bicycle-related injury and an observed need for a helmet. The program was informed through the Health Belief Model, Social-Ecologic Framework, and Teachable Moment in order to achieve a change in behavior.

The specific aims of this project were to:

1. Increase bicycle helmet use among the participants' children.
2. Increase parental knowledge about the importance of bicycle helmet use.

It was hypothesized that by providing free bicycle helmets and increasing parental knowledge of the importance of bicycle helmet use through a Teachable Moment would result in an increase in bicycle helmet use among participants' children.

Definitions

Pediatric Emergency Department

For the purpose of this project, a pediatric emergency department (PED) is defined as a specific department within a hospital that provides medical and advanced nursing care to individuals from birth through their twenty-first year of life.

Parent

For the purpose of this project, the term parent includes biological parents, step-parents, and legal or temporary guardians as appointed by a courtroom.

Traumatic Brain Injury

A traumatic brain injury (TBI) is an injury to the head caused by a blunt trauma, which causes acceleration and deceleration forces of the brain that is associated with one or more of the following symptoms: decreased level of consciousness, amnesia, neurologic or neuropsychological abnormalities, skull fracture, intracranial lesions, or head injury listed as cause of death on the death certificate (CDC, 1999). For the purpose of this project, penetrating trauma was excluded from the definition because it is much less common and unlikely to occur during a bicycle crash (Schunk & Schutzman, 2012).

Summary

Head injuries are prevalent amongst pediatric bicycle riders. TBI accounts for the most serious injuries associated with bicycle crashes and lack of helmet use. TBI can be most costly both physically and monetarily. This chapter has demonstrated that bicycle helmet use is a proven safety measure for protection, and for preventing head injuries. However, bicycle helmets are not being worn by riders. A major barrier to helmet use is simply lack of ownership. This project planned to remedy a lack of ownership by supplying free helmets with additional education to ultimately increase helmet use and knowledge related to the importance of helmet use. This chapter also discussed how the goals of this project align with the role of a DNP as it focuses on a public health issue and injury-prevention on a community level.

CHAPTER 2: CONCEPTUAL FRAMEWORK AND A REVIEW OF THE LITERATURE

Introduction

This PED bicycle helmet program focused on injury-prevention through influencing risk-reducing behavior. This chapter will discuss how the Health Belief Model (Hochbaum, 1958), teachable moment, and the Social-Ecological Framework (Baeseman & Corden, 2014) provided the foundation for injury-prevention and adopting risk-reducing behavior relevant to the PED bicycle helmet program. This chapter will also focus on the current literature relevant to the success of similar helmet programs.

Conceptual Framework

Health Belief Model

The Health Belief Model (HBM) focuses on how an individual constructs their health behavior, and how health-related action or change is likely to occur (Janz & Becker, 1984; Melzer-Lange et al., 2013; Rosenstock, Strecher, & Becker, 1988). For a health-related behavior to change, people must feel threatened by the current behavior, believe a change in behavior will produce a beneficial outcome, and view implementation as low cost (Rosenstock et al., 1988). HBM centers around four tenets; perceived severity, perceived susceptibility, perceived benefits, and perceived barriers (Janz & Becker, 1984; Melzer-Lange et al., 2013; Rosenstock et al., 1988). Both perceived susceptibility and perceived severity lead to an individual's perceived overall threat of continuing with their current health behavior (Janz & Becker, 1984). The perceived benefit and perceived barrier help shape an individual's idea of a perceived outcome of a change in health behavior (Janz & Becker, 1984). Figure 1 illustrates the constructs of HBM.

Perceived susceptibility. Perceived susceptibility focuses on one's belief of how vulnerable they feel contracting an illness or condition (Janz & Becker, 1984; Rosenstock et al., 1988). Individuals will vary within their subjective perception of personal vulnerability (Janz & Becker, 1984). In terms of bicycle helmet use addressed by this project, a parent's perceived susceptibility would include how likely they feel their child would be to suffer a head injury while on a bicycle.

Perceived severity. Perceived severity involves an individual's judgment as to seriousness of an illness or condition (Janz & Becker, 1984; Rosenstock et al., 1988). Severity includes medical consequences such as death and pain, and social ramifications such as effect of work, family, and social life (Janz & Becker, 1984). Perceived severity related to bicycle helmet use would include a parent's perception of what level of debilitation due to a traumatic brain injury is acceptable to their child, and to what extent an injury would impair their physical, social, or occupational functioning.

Perceived benefit. The perceived benefit is the idea of how likely the new behavior will reduce the health risk (Janz & Becker, 1984; Rosenstock et al., 1988). Feelings of susceptibility and severity are not enough to change behavior, a person must actually believe a feasible course of action will produce effective results (Janz & Becker, 1984). For children and parents to view bicycle helmets as beneficial they must have knowledge of the likelihood in which a helmet protects the head and brain during an accident or fall.

Perceived barrier. Perceived barriers are thoughts of what can potentially hinder the behavior implementation (Janz & Becker, 1984; Rosenstock et al., 1988). Some barriers include cost, side effects, pain, inconvenience, lack of ease, time constraints (Janz & Becker, 1984). As discussed above, potential barriers to helmet use include lack of helmet access, helmet cost, and peer influence.

Lajunen and Rasanen (2004) applied HBM constructs using bicycle helmet safety examples. The authors found that helmet wearers reported higher perceived severity of injury, higher perceived benefits, higher perceived susceptibility, and fewer perceived barriers than non-helmet wearers (Ross et al., 2010). This project uses this model specifically to target parents, through education, and the perceived threats and perceived outcomes related to encouraging and enforcing their child's helmet use. This model is useful in an ED since nurses and providers are likely to screen and discuss perceived risk for injury, and discuss future injury-prevention ideas (Melzer-Lange et al., 2013).

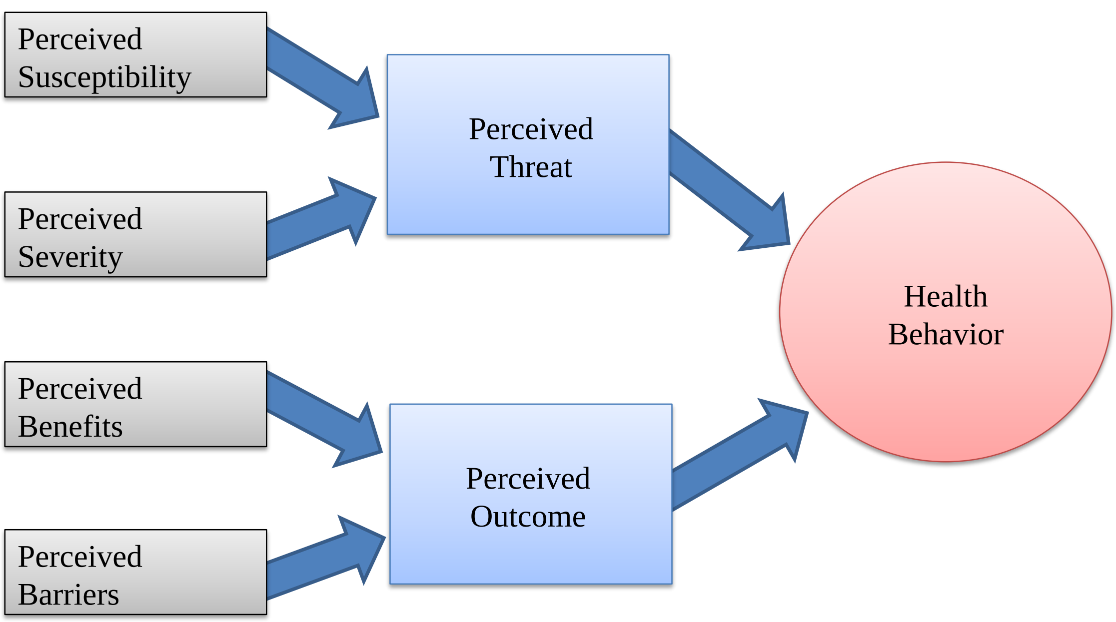

FIGURE 1. The Health Belief Model as it Influences Health Behavior.

Teachable Moment

The term, Teachable Moment (TM), describes an event such as an illness or injury that is thought to motivate individuals to change their health behavior, and adopt a more risk-reducing behavior (McBride, Emmons, & Lipkus, 2003). Timing interventions at the time of one of these events is thought to increase the effectiveness of the intervention (McBride et al., 2003). TM can be linked to the HBM since the event that occurs most likely increases the perception of susceptibility and strengthens the belief of benefits surrounding the new behavior (McBride et al., 2003; Posner, Hawkins, Garcia-Espana, & Durbin, 2004). An encounter at a PED may serve as a TM, and encourage families to adopt new health behavior (Gittleman, Pmoerantz, Ho, Hornung, & McClanahan, 2012; Melzer-Lange et al., 2013; Posner et al., 2004). Specifically for this program, using the TM of an injury due to a bicycle accident in the PED to provide education and a free bicycle helmet enforces the fact that injury can happen, and bicycle helmets have a positive protective effect. Figure 2 illustrates how, in relation to the HBM, an individual's health behavior towards bicycle helmet use can be influenced by the teachable moment of injury and PED encounter resulting in increased helmet use.

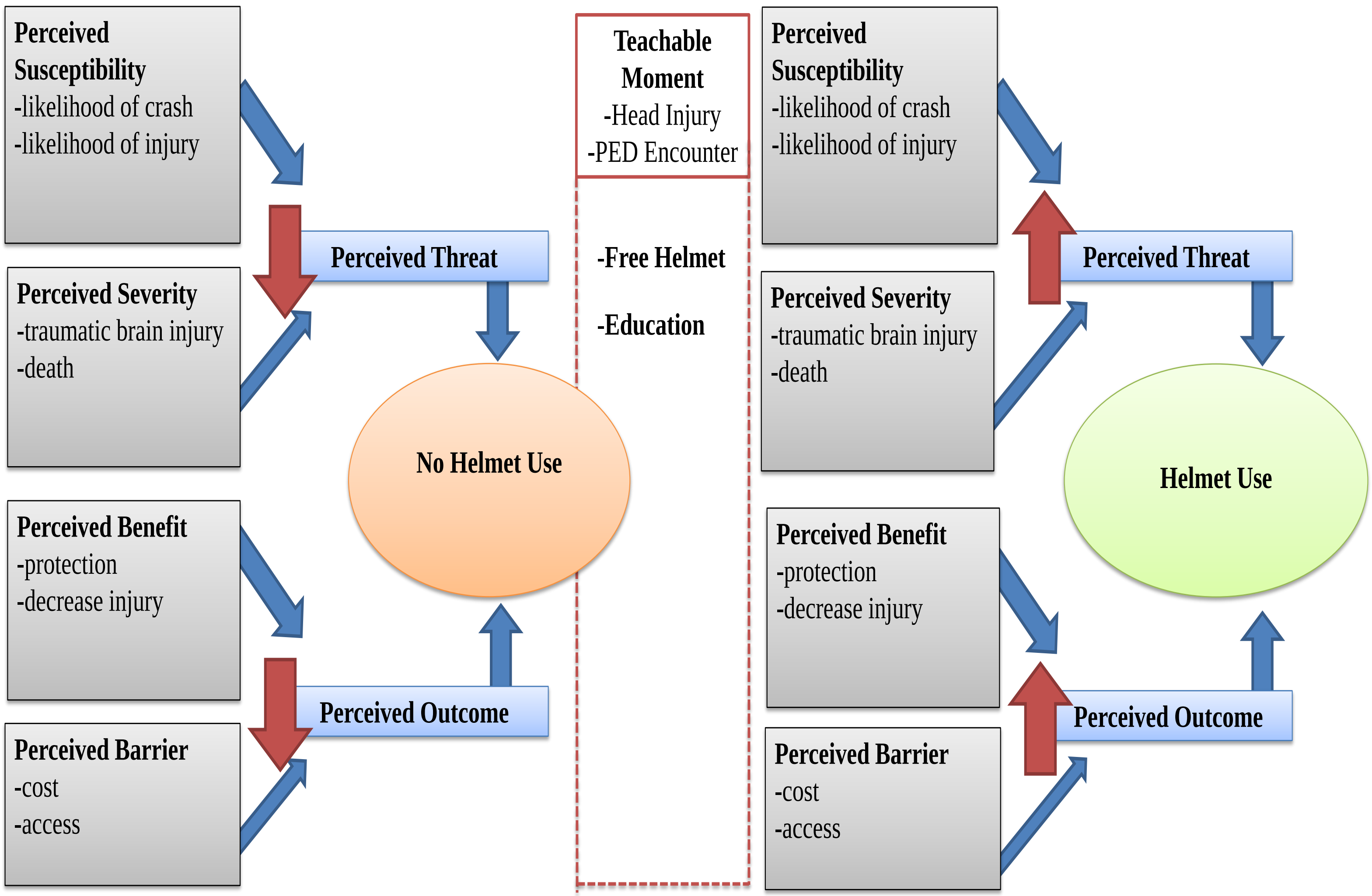

FIGURE 2. Model for Increased Bicycle Helmet Use Using HBM and TM.

Social-Ecological Framework

Baeseman and Corden (2014) developed a model for improving bicycle helmet use by children, which has been used to guide this bicycle helmet program. The model includes four levels: individual, relationships, community, and societal (Figure 3). The individual level includes the helmet ownership status of the child while the relationship level includes parental modeling of helmet behavior and peer influences that may affect helmet compliance. The community level includes both community and school programs, and access to affordable or free helmets. The societal level focuses on local, statewide, and national legislature and helmet law enforcement (Baeseman & Corden, 2014). This DNP project implemented a program that focused primarily on the community level by providing a program that increases access to bicycle helmets to children served in a larger geographical area. As children are discharged back into their communities following a similar intervention they are able to model correct injury-preventative behavior by wearing a bicycle helmet (Gittelman & Durbin, 2005).

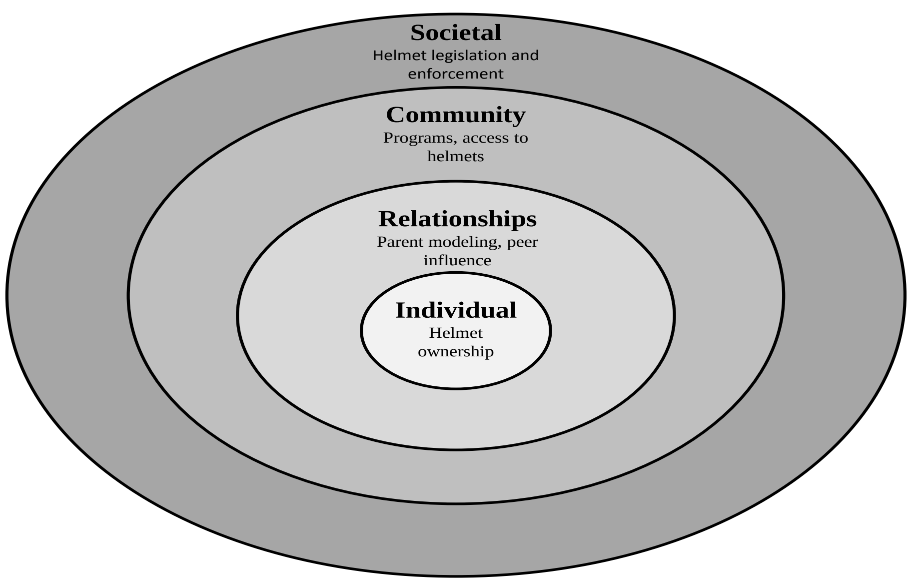

FIGURE 3. Social-Ecological Model for Increasing Pediatric Bicycle Helmet Use. (Adapted from Baeseman & Corden, 2014.)

Literature Review

The scientific literature producing evidence in regards to the effectiveness of bicycle helmets reducing consequences of head injuries is extensive in both adult and pediatric populations. A literature review of bicycle helmet programs was conducted using the PubMed and CINAHL search engines, and the search terms *bicycle, helmet, children, safety programs, emergency department, head trauma*. The search resulted in 240 articles written in the past five years. While numerous articles included important information and data regarding bicycle helmet use, non-use, and head injuries related to bicycle accidents as discussed in the previous chapter, a total of 12 were relevant for this review of existing helmet programs. Additional resources, although dated, were also discovered during the literature review that proved to be useful.

Bicycle Helmet Programs

The National Association of Pediatric Nurse Practitioners (NAPNAP) (2008), American Academy of Pediatrics (AAP) (2001), Centers for Disease Control and Prevention (CDC) (1995), and the American College of Emergency Physicians (ACEP) (2011) have released position statements encouraging interventions to increase bicycle helmet use by all riders. Twenty-one states in the United States, and other countries rely on legislature in hopes to increase bicycle helmet use among the pediatric population (Dennis et al., 2010; Insurance Institute for Highway Safety [IIHS], 2015; Karkhaneh, Rowe, Saunders, Voaklaner, & Hagel, 2013, 2011a,b). According to the IIHS (2015), the state of New York requires helmet use for children ages 1-13 years, and no child under the age of one year is allowed to be on a bicycle. Karkhaneh et al. (2013, 2011a,b) found an increase in child and adolescent helmet compliance after helmet legislation was introduced in Alberta, Canada. In the United States, states with laws pertaining to helmet use demonstrate a 13 - 20% decrease in death and injuries from bicycle-related accidents when compared to states without such laws (Markowitz & Chatterji, 2013; Meehan, Lee, Fischer, & Mannix, 2013).

Review of interventions to promote bicycle helmet wearing by school-aged children found the majority of interventions are community-based, school-based, or healthcare-based (Coffman, 2003; Owen, Kendrick, Mulvaney, Coleman, & Royal, 2011). Health-care based programs are typically conducted through a primary care office, hospital inpatient setting, or emergency department. These interventions typically include, to some degree, education, free helmets, or subsidized helmets, or a combination (Owen et al., 2011). Interventions that include education and a free helmet were found to be more effective than interventions of education only or education plus subsidized helmets (Owen et al., 2011). The New Jersey Bike School program provided an educational program targeting 8- to 12-year-olds, and used both on and off the bicycle lessons while providing free helmets and fittings for children who did not own one or their helmet failed inspection (Lachapelle, Noland, & Von Hagen, 2013). There was an increase in pre- to post-test correct answers related to helmet knowledge, however, they were not statistically significant (Lachapelle et al., 2013). McLaughlin and Glang (2010) used a computer-based intervention in a two-session classroom setting that provided education with video, animation, and peer-to-peer modeling of appropriate safety issues on a bicycle. They did not supply helmets, but found the students in the intervention group were more likely to correct erroneous helmet placement examples compared to the control group. Students in the intervention group also had a significantly greater increase in post-test scores pertaining to safety information such as safe places to ride, hand signals, and potential hazards (McLaughlin & Glang, 2010).

The Georgia Health Sciences University Children's Medical Center conducted a program that provided in-patients ages 5 - 18 years that were not hospitalized for a bicycle-related issue with education materials and a free bicycle helmet, and found increased helmet wearing at a three-month follow-up (Barnes, Maria, Caldwell, & Hopkins, 2013). Bishai, Qureshi, Cantu, and Parks (2003) found a similar increase in helmet wearing among 5- to 15-year-olds when education and a free bicycle helmet were provided. The population was not specific to children presenting with bicycle-related injuries, but was conducted from an ED and included a written contract between child and provider (Bishai et al., 2003). Broward General Medical Center uses a Safety Helmet Discharge Plan for ED and hospital inpatients where a trauma case manager or pediatric nurse provide age-appropriate educational materials, a free helmet, and follow-up phone calls after discharge for children injured in a bicycle incident (Puranik, Long, & Coffman, 1998). The program was developed after a study revealed that out of 211 children injured in bicycle-related accidents only 1.4% were wearing a helmet, however they did not publish data on how successful the program is in increasing helmet use (Puranik et al., 1998). A Swedish study focused on one district that utilized legislation, increased helmet law enforcement, and provided children from 1- to 3-years-old a *helmet prescription* for a subsidized helmet at their health care clinic (Ekman & Ekman, 2012). The study found a 99% reduction in bicycle helmet-related hospitalizations over the 23-year study period (Ekman & Ekman, 2012).

Summary

This chapter outlined the conceptual framework driving behavior change, which is instrumental to increase the use of bicycle helmets. It was critical for this helmet program to address all four tenets of the HBM through education and providing a free helmet. The TM of a PED visit for a bicycle-related injury is a most appropriate arena to encourage behavior change or reward positive behavior. By performing this program through the community level of the socio-ecologic model, a DNP’s best attributes are utilized to reach a larger population as discussed in the previous chapter. This chapter also provided an extensive review of literature pertaining to the development of bicycle helmet programs, and supporting further development of like-minded programs to increase helmet use.

CHAPTER 3: METHODOLOGY

Introduction

The purpose of this chapter is to discuss the methods that were used for this study. The chapter will discuss the sample of participants, and the setting in which the program was implemented. The chapter will also discuss the specific eligibility and exclusion criteria. Additionally, the chapter will discuss the study design and the procedures conducted to achieve the aims of free helmet distribution, and knowledge dissemination. Finally, the chapter will discuss the specific questionnaires used to collect data, and type of data analysis used to interpret findings.

Human Subject Protection

This DNP project was reviewed and approved by the University of Arizona's Human Subject Protection Program, and Rochester Regional Health System's Clinical Investigation Committee and Department of Nursing Research and Evidence-Based Practice. The University of Arizona ceded IRB oversight to Rochester Regional Health System. Once approval was granted, informed consent was obtained prior to participation. Full disclosure was provided to the participants, and by signing the consent form, they demonstrated they understood the terms and conditions of their participation. No data was collected prior to a participant signing the consent form. Personal information such as name, date of birth, and phone number was obtained and retained for no more than six weeks after initial interview, after which it was destroyed.

Study Design

This exploratory project used a quasi-experimental, one group, pre- and post-test design to determine helmet use and parental bicycle helmet safety knowledge before and after the intervention of education and helmet distribution. The independent variable was the provision of a free bicycle helmet and parental educational material. The dependent variable was helmet use and parental knowledge, measured by parental report. The main outcome measures resulting from pre- and post-test comparison determined the effectiveness of the education provided, and subsequent helmet use. As previously discussed, it was hypothesized that by providing a free bicycle helmet and increasing parental knowledge of the importance of bicycle helmet use through a teachable moment would result in an increase in bicycle helmet use among the participants' children.

Sample and Setting

The sample was recruited from a Pediatric Emergency Department (PED) of an urban, community hospital in Rochester, NY. The PED is a stand-alone, non-trauma center for pediatrics within a larger adult hospital. The PED is a 17-bed unit, capable of expanding to 21-beds at full capacity, and serves individuals ages 0 to 21 years. Parents were the direct participants in this study. To be eligible to participate in the program, parents must have accompanied their child to the PED. Their child must have been 5 - 13 years old. Programs aiming to increase helmet use found interventions focused on younger children were more effective than those tailored to older children and young adults (Owen et al., 2011). Additional eligibility criteria required the parent's child to have been involved in a bicycle accident, and did not require admission to the hospital due to their injuries. The PED uses the Emergency Severity Index (ESI), a numeric acuity system, at triage ranging from ESI 1-5, with ESI 1 being the most acute (Gilboy, Tanabe, Travers, & Rosenau, 2011). For parents to be eligible their child must have been triaged as an ESI 3, 4, or 5, and medically cleared by a provider. Prevention education is difficult to provide when injuries are severe, and require a higher level of care (Melzer-Lange et al., 2013). Finally, the child must have either not owned a helmet or was wearing a helmet that impacted a blunt object at the time of the accident. The AAP recommends any helmet involved in a crash or damaged in some other way should be replaced (AAP, 2001). Parents needed to be able to speak, write, and read English. Individuals were excluded if they did not accompany their child to the PED or the child already owned a helmet and was not wearing it during the bicycle accident. Children triaged as an ESI 1 or 2, require admission for their injuries, or were involved in another type of accident not involving a bicycle such as a scooter or skateboard, etc., were also excluded. Parents who were unable to speak or read English were excluded.

Recruitment and Eligibility Screening

An a priori sample size was calculated using G Power 2 to compare the means across the intervention using a paired t-test model with an effect size of 0.6, an alpha of 0.05, and a power of 0.8. The resulting recommended sample size to determine a statistically significant difference of helmet use was 25 individuals.

Potentially eligible participants were identified at triage as having accompanied their child who was involved in a bicycle accident. The child must have been triaged as an acuity 3, 4, or 5. Prior to approach for study enrollment, the child was seen by a physician or advanced practice provider, and provided with necessary evaluation and standard of care. After their initial medical screen and provision of any necessary care, the parent was introduced to the study. The primary investigator (PI) asked the parent the following questions to determine eligibility: “Does your child own a helmet?” and “Was your child wearing the helmet at the time of the accident/crash?” If the parent’s answer was *yes* to the former question, and *no* to the latter question then the family was not eligible. If criteria was met, the parent's informed consent was obtained. Once parent eligibility criteria was determined, and consent signed, the PI administered the remainder of the pre-test to determine helmet usage, bicycle helmet safety knowledge, and additional demographic and contact information for the follow-up phone interview to administer the post-test (Appendix A).

Instrumentation

Demographic Questionnaire

A questionnaire designed to gather information related to the participants' demographics was administered. The questionnaire consisted of 12 questions. Questions included name of child and parent, date of birth of child, age and gender for child and parent, race of child and parent, and parental household income, education level, marital status, contact phone number, and best time of day to call for follow-up (Appendix A). The questionnaire was presented after consent, and prior to the pre-test.

Pre-test and Post-test

The pre- and post-test used for this project was adapted from Elwell, Kulp, and McCue (2014). The pre-test consisted of 11 multiple-choice questions (Appendix A). The first six questions assessed helmet use. The next five questions assessed parental knowledge of bicycle helmet safety. Questions geared toward knowledge assessment were also constructed in accordance to the tenets of the HBM such as susceptibility, severity, benefits, and barriers. The post-test varied only slightly in the first six questions as they focused on the free helmet provided during the initial encounter. The remaining five questions were identical to the pre-test in order to evaluate parental knowledge of bicycle helmet safety. The pre-test was given prior to the administration of the educational handout, and prior to providing the free helmet. The post-test was administered at one-month following the pre-test via telephone.

Data Collection Methods

After completion of the pre-test, the parent was provided with a one-on-one educational session given by the PI, which included a handout related to bicycle helmet safety, and took approximately five minutes to discuss (Appendix B). The educational session and handout focused on relevant bicycle accident statistics, associated risks, current laws, importance of helmet use, and when a helmet needs to be replaced. The HBM was the framework for the educational handout. The child was not the target of the educational session, but may have benefited from secondary education while in the room and was be able to ask questions. Written educational materials based on theory are effective at increasing knowledge, and improving the effectiveness of education (Hoffman & Worrall, 2004; Perry et al., 2012; Whittingham, Ruiter, Castermans, Huibert, & Kok, 2008). Written material is easy to deliver, portable, economical to produce, and the learner is able to re-visit as needed (Hoffman & Worrall, 2004). Additionally, health education material should be written between a 5th and 6th grade reading level (CDC, 2009). Text should include common words, active voice, a conversational style, and include the pronoun *you* to engage the learner (CDC, 2009; Hoffman & Worrall, 2004). The Flesch-Kincaid Readability Test from Microsoft Word 2007 was used to calculate reading level and readability of this educational handout (CDC, 2009). The Flesch-Kincaid Grade Level was 5.1. The Flesch Reading Ease was 76.2, based on a scale from 0-100 where a score of 100 is the least complex to read. Passive voice was used in only 7% of sentences.

Upon completion of the educational session, the child then signed a Contract of Commitment to wear a bicycle helmet when riding a bike, and took the contract home as a reminder (Appendix C). Once the Contract of Commitment was signed the PI obtained the correctly sized helmet based on proper fitting instructions (Appendix D). Bicycle helmets must be properly worn in order to provide full protection (Hagel, Lee, Karkhaneh, Voaklander, & Rowe, 2010; Lee, Hagel, Karkaneh, & Rowe, 2009). The helmet was for the child to keep free of charge. Free or inexpensive helmets in addition to education is most effective at increasing use (Baeseman & Corden, 2014; Barnes et al., 2013; Gittleman, Pomerantz, & Frey, 2009; Melzer-Lange et al., 2013; Pierce et al., 2013; Rivera & Johnston, 2013). The helmets met current standards as put forth by the Consumer Product Safety Commission (CPSC) (1998). The CPSC is the federal entity that issues mandatory safety standards for bicycle helmets (CPSC, 1998). Bicycle helmets were supplied by donation from the TWIG Association, and stored in the PED storage room. After the child was fitted with the helmet, the parents were required to sign a Waiver of Responsibility consistent per hospital protocols (Appendix E). Signed Waiver of Responsibility forms were given to Gina Lord, Pediatric Health Educator for Rochester General Hospital, and kept in a locked file according to hospital policy. The family then continued to follow their PED plan of care leading up to discharge.

The PI conducted a one-month follow-up phone call from the date of their PED encounter, initial helmet fitting, and helmet distribution to administer the post-test. The PI contacted the child's parent at the phone number provided on the demographic questionnaire during the time of day designated by the parent. In the event that the phone call was unsuccessful due to unavailability, the author conducted four more attempts over a two-week period. If follow-up phone calls were unsuccessful after the two weeks the participant would have been assumed to have withdrawn from the study, and their contact and identifying information was to be destroyed. However, this was not necessary as all participants were reached for the follow-up phone call. A successful follow-up call included assessment if the child still owned the helmet given to them in the PED, and the status of their current helmet use (Appendix A). Additionally, the call included a post-test identical to the pre-test to re-examine parental knowledge of bicycle helmet safety (Appendix A). All data, including demographic information and pre- and post-tests, were initially collected on a paper copy. The pre- and post-tests were coded in numerical order starting at 1, unique to the participant, and kept in separate folders to ensure proper data congruence. Upon completion of a successful follow-up phone call the contact and identifying information for the child and parent were destroyed. The answers to the demographic information and pre- and post-tests were used for data analysis.

Data Analysis Plan

Post-test scores at a one-month follow-up after the intervention of an educational handout and the provision of a free bicycle helmet were compared to the pre-test scores to examine the effect of the intervention. This project looked only at a treatment group, and did not include a control group. The number of participants was low. Descriptive statistics of demographic information were produced, but were not convincing enough to generalize to a larger population based on their diversity. A comparison of the pre- and post-test scores were utilized to determine if supplying a free bicycle helmet coupled with educational material produced an effective change in bicycle helmet use. McNemar's test was used, specifically on questions 3, 8, and 11 (Appendix A) to determine if the null hypothesis can be rejected.

Summary

This chapter discussed the methodology used for this DNP project. Parental participation was assessed based on specific eligibility and exclusion criteria. Eligible children were properly fitted for and provided a free bicycle helmet. Their parents were given an educational handout after initial assessment of their bicycle helmet safety knowledge. A follow-up phone call was used to complete data collection. Assessment of bicycle helmet use and parental knowledge was analyzed to provide the information necessary to deem this project effective in increasing bicycle helmet use.

CHAPTER 4: RESULTS

Sample

This study was conducted during the second half of August 2015 through the first half of September 2015. A total of 12 children between the age 5 years and 13 years presented to the Pediatric Emergency Department (PED) with a chief complaint involving a bicycle-related injury. Of the 12 children, only five (four males, one female; mean age 9.2 years) met all eligibility criteria, and their parents were approached to participate in this study. All five participants' (parents) were female, with an age range of 30-42 years (mean 34.4) (Appendix F). Of the 12 children, six children were excluded because they already owned a bicycle helmet, but were not wearing it at the time of the bicycle accident. One child was triaged as an ESI 2, and therefore was excluded. All five eligible parents (five females) agreed to participate. All five participants completed both the pre- and post-tests.

Data Analysis

The results of responses to the pre-test and post-test revealed a difference in answers to the following three questions: question 3, question 8, and question 11 (Appendix A). The McNemar's test was performed on these three questions to determine the difference between the individual responses for the pre- and post-test. The McNemar test is an adaptation of a chi-square used to compare pre- and post-test change within one group using dichotomous variables. As shown in Table 1, the McNemar's test demonstrated statistical significance in the differences of responses between the pre- and post-test to questions 3 and 11 using a *priori alpha* of 0.05.

TABLE 1. *McNemar's Test Results for Question 3, Question 8, and Question 11 of Pre- and Post-test.*

Question 3. When your child rides a bike, they wear a helmet always, sometimes, never?

	Post-test				
Pre-test	Never	Yes	Total		
Never	0	5	5	Statistic	5.0000
Yes	0	0	0	DF	1
Total	0	5	5	p-value	0.0253

Question 8. While riding a bicycle, how often is your child at risk for a serious head injury?

	Post-test				
Pre-test	Correct	Incorrect	Total		
Correct	4	0	4	Statistic	1.0000
Incorrect	1	0	1	DF	1
Total	5	0	5	p-value	0.3173

Question 11. The state of New York has a law in place requiring helmet use by children. Do you know the age range that are required to wear a helmet according to the law?

	Post-test				
Pre-test	Never	Yes	Total		
Never	0	5	5	Statistic	5.0000
Yes	0	0	0	DF	1
Total	0	5	5	p-value	0.0253

Note. In Question 3, the positive responses of *Always* and *Sometimes* have been combined as a *Yes* response such that the comparison is dichotomous.

Rejection of the Null Hypothesis

The hypothesis of this study focused on increasing helmet use and increasing parental bicycle helmet knowledge, which was reflected in the difference in responses of questions 3, 8, and 11 or the pre- and post-test. Question 3 became the focus as the most important outcome of this study because it specifically addresses the increase of helmet use. The thought being that if parental knowledge increases, but does not result in an increase in helmet use, then the protective benefits of the helmet will not be achieved. Since the p value of 0.0253 was less than the alpha value of 0.05, the chances of replicating this result given the null hypothesis that this intervention does nothing to change bike helmet wearing patterns is true, is about 2.5%, and thus the null hypothesis is rejected.

Sample Size Calculation

Although it is statistically unlikely that this intervention does not work, there is still a pretty low level of evidence that it does work due to the low number of participants. The low number of participants makes the results difficult to generalize to a larger population. As illustrated in Table 2, a calculation was conducted to determine a sample size of 11 participants would most likely provide increased generalizability to a larger population. Again, question 3 was used for this analysis, but in attempt to remain conservative with the estimation, the response of *Sometimes* was counted as a negative response.

TABLE 2. *Sample Size Calculation for McNemar Test*.

Probability of Type I Error (α) = 0.05
Power (1 - β) = 0.8
Proportion switching from + to - = 0.0
Proportion switching from - to + = 0.6
Sample size required = 11

Note. Calculation based on response results from question 3.

CHAPTER 5: DISCUSSION

Despite the inability to show a large sample size, a statistically significant change does demonstrate potential that the interventions of supplying a free bicycle helmet and providing parental education could be effective in increasing helmet use among children. All participants of this study reported an increase in helmet use by their child at the one-month follow-up. All participants also demonstrated an increase in overall bicycle helmet knowledge score from the pre-test to the one-month follow-up post-test. These two results are encouraging in that they suggest that a bicycle helmet program in a PED could increase bicycle helmet use in the community. As a DNP working in pediatrics, injury prevention, specifically bicycle helmet safety, is a very important part of my practice. I plan to continue this work, and progress to full implementation of a bicycle helmet program in the PED where I currently practice.

While not originally designed as such, this study resulted in an effective feasibility study. Feasibility studies are used to determine if an intervention is appropriate to be tested further, and if the idea may be relevant and sustainable by looking at acceptability, implementation, and practicality (Bowen et al., 2009). Overall, the interventions were received well by the parents and children involved. The testing, educational material, and helmet fitting took approximately ten minutes to complete, and did not appear to negatively impact departmental patient flow or delay care. The general consensus from the attending physicians and other advanced practice providers was positive. Many feasibility studies use convenience samples resulting in intermediate outcomes, and limited statistical power (Bowen et al., 2009). The outcomes from this study did show an increase in helmet use and parental education in a limited number of participants, which leads me to believe this is a beneficial study to continue during the next bicycle riding season.

Based on the limited results of the study it is difficult to report for certain if the Health Belief Model (HBM) and Teachable Moment (TM) are appropriate foundations for this type of intervention. However, because all participants showed an increase in educational scores and helmet usage by their children it is encouraging that with a larger sample it could be demonstrated that HBM and TM are important foundational models for developing a similar program in a PED.

Significance of Results to Advanced Practice Nursing

A Doctor of Nursing Practice (DNP) is equipped with the educational focus on health promotion and anticipatory guidance (AACN, 2006). Many DNPs are filling specialty roles in addition to providing primary care. In many areas, such as a PED, a DNP has an opportunity to fill a gap as a trained and qualified provider of health promotion and anticipatory guidance (Gittleman & Durbin, 2006). This project reinforces the importance of delivering health-promotion interventions in a specialty area that is looked to as a predominant symptomatic treatment environment. This project shows that a bicycle helmet program can potentially be conducted successfully from a PED without disruption of the department's regular function.

A DNP is taught to be proficient in direct patient care, but to also focus on a broad community scale. This project focused on families in an urban, underserved population that has a higher risk for injury, and may rely on a PED as their primary modality of healthcare. This project also focused on increasing helmet use through the provision of a free bicycle helmet, and parental education. While the parent and child may have received the primary benefit of this intervention, it is hoped that they return to their community and serve as models of proper injury prevention to their peers, and encourage them to adopt similar behaviors. Hopefully, the continuation of this study can produce statistically significant results that can be disseminated to other PEDs, or EDs that see high pediatric volumes, and similar bicycle helmet programs can be initiated at those institutions.

Strengths and Limitations

A strength of this quasi-experimental, one-group study is the use of a pre- and post-test design. The use of a pre-test helps to strengthen the probability that the participant's increase in knowledge scores was due to the educational session and handout provided. Although not statistically significant, the study showed an increase in bicycle helmet knowledge and an increase in risk-reducing behavior among participants' children. From a feasibility standpoint, this study showed that this type of intervention could be efficiently conducted in a PED with encouraging results.

This study had several limiting factors. First, the sample size was small, and unable to produce statistically significant results easily generalized to larger populations. The limited bicycle season in the state of New York most likely was a factor in the small sample size. It should be noted that there was a rather difficult and lengthy process to gain IRB approval for this study. The process was hindered by a lack of important communication coupled with a first-time PI lacking the knowledge of the most important questions. Verbal approval was obtained from the PED in May 2015 without mention of hospital IRB procedures. The hospital IRB requirements were not communicated until after the submission of materials for the University of Arizona's approval process. The University of Arizona IRB application was withdrawn, and the type of application was changed to ceded oversight. After approval was granted from both sites, the study was still kept on hold for two weeks in order for written department approval to be obtained. This pushed the start of the study into the end of August 2015, near the time children returned to school. Also, as the PI, I was the only individual involved in enrolling participants. While the PED staff did an excellent job of informing me of potential participants, there may have been some individuals that were missed if I was not in the department at the time of their arrival. Second, the participants represented a convenience sample from a single PED in Rochester, NY. These two limitations decrease the ability to generalize results to a larger population. Third, the instruments used as the pre-test and post-test were not validated or tested for reliability.

Future Implications

All participants completed both the pre-test and post-test, all reported an increase in helmet use by their child, and demonstrated an increase in bicycle helmet knowledge. The study results are encouraging, and the continuation of these types of interventions could be effective. Numerous factors could increase generalizability by increasing the number of participants. The continuation of this study, and similar programs, should be conducted for more summer months especially in colder climates when bicycle riding is limited for most children. Other staff members including other providers, nurses, and patient care technicians should be included in order to increase chances of recruitment, provide the proper education, and properly fit helmets. To conduct such a program in a PED that does not already have a similar program will involve a change in the department's culture, and this can most likely be facilitated by including other staff members. Staff would have to be trained on how to properly fit bicycle helmets, and kept informed of any new recommendations or changes in helmet laws or regulations. It was considered to send out a monthly email reporting any of these changes, and also an update of how many bicycle helmets were given to patients from the previous month to keep staff engaged.

Continued evaluation should also be considered for future programs. During peak bicycle riding weather there may be a high volume of participants that qualify for the interventions. One might consider an electronic survey or mailed survey as a follow-up to improve the efficiency of the study during the follow-up period. However, it should be considered that this population may not have readily available access to the internet. The vision for this project is for the provision of bicycle helmets and education to be in the normal day-to-day operations of this PED, and even expand to children involved in other activities where helmets are beneficial such as riding scooters or skating. Additional ideas for program evaluation could include collecting data related to the number of helmets given out, recording whether or not staff members are handing out bicycle helmets on their own, evaluating staff observations of the value of the program, and randomized parental follow-up related to helmet use and educational retainment. Additional considerations include the procurement of funding for bicycle helmets. The PED in which this study was conducted has access to a large number of donated helmets from a philanthropic association.

Attention should be brought to other factors to consider in the future. Since one of the barriers to helmet use is cost, it would be interesting to analyze demographic data related to annual household income. Also, an analysis of parental education level may lead to insight as to why there is a lack of helmet knowledge. Lack of knowledge may be influenced by the lack of exposure to literature on the importance of helmet safety, and the lack of skills to seek such information. It may be beneficial to include children of other activities such as skateboarding, roller-skating, riding scooters, etc. Additionally, it may be beneficial to include the children that were not wearing a helmet despite owning a helmet to determine if the TM would lead to an increase in their helmet use practices as well. Also, it would be beneficial to test the pre- and post-tests for validity and reliability.

Conclusion

This study showed that a bicycle program is entirely feasible to be conducted in a PED. The study lacked a generalizable sample size, but did result in a significant increase in helmet use and an increase in knowledge scores. These results provide encouraging potential for study continuation.

This DNP project demonstrates how the pediatric nurse practitioner DNP student assessed, summarized and evaluated current literature and data, utilized the Health Belief Model and Teachable Moment as models and theoretical framework of health promotion to create a bicycle helmet program to promote injury-prevention in an urban population. DNPs are leaders in the community, and most importantly, they are provided with education and training that places them in an important position to positively impact injury-prevention on a large scale.

APPENDIX A:

PATIENT INFORMATION, PRE-TEST, POST-TEST

Bicycle Helmet Participant Information

Child Date of consult:______________________________
Name:______________________________Helmet size given:____________________________
Date of Birth:_________________________Date of follow-up call:________________________
Age/Gender:
Race (check all that apply):
___White, not of Hispanic origin
___Black, not of Hispanic origin
___Hispanic or Latino
___American Indian
___Alaskan Native
___Asian/Pacific Islander
___Other

Parent/Guardian
Name:____________________________Contact Phone number(s): _____________________
Age/Gender:_______________________Best time to be reached: morning/afternoon/evening
Race (check all that apply):
___White, not of Hispanic origin
___Black, not of Hispanic origin
___Hispanic or Latino
___American Indian
___Alaskan Native
___Asian/Pacific Islander
___Other
Household income per year:
___Less $20,000
___$20,000-$39,000
___$40,000-$59,000
___$60,000-$79,000
___$80,000-$99,000
___More than $100,000
Your education level:
___Did not finish high school
___Finished high school or got GED
___Some college or training after high school
___Finished college
___Master's degree or Doctoral degree
Your marital status:
___Married
___Never Married
___Separated
___Divorced
___Widowed

Bicycle Helmet Pre-Test

1. Does your child own a helmet? **YES/NO**

2. Was your child wearing the helmet at the time of the accident/crash? **YES/NO**
(**note**: if #1 is *yes*, and #2 is *no*, family is not eligible at this time)

3. When your child rides a bike, they wear a helmet ______________.
EVERY TIME/SOMETIMES/NEVER
- Who determines how often your child wears the helmet? **PARENT/CHILD**
- If answer is *every time* skip to question 6, if *sometimes* or *never* answer question 4

4. If your child sometimes or never wears a helmet, what is the main reason for non-use?
a) do not own one **b)** forgets to wear it
c) do not think it is necessary **d)** other ________________

5. If RGH PED gave you a helmet/new helmet would your child wear it? **YES/NO**

6. Has your child been involved in a previous bicycle crash? **YES/NO**

*The following questions are designed to assess your bicycle helmet safety knowledge.

7. During a bicycle accident, bicycle helmets reduce the chance of:
a) bleeding in the brain **b)** a broken bone of the skull
c) a scalp laceration (deep cut) **d)** all of the above

8. While riding a bicycle, how often is your child at risk for a serious head injury?
a) always **b)** sometimes
c) never

9. In a bicycle accident, what is the #1 cause of death?
a) severely broken bones **b)** head/brain injury
c) injury to organs in the abdomen (stomach)

10. On average, how many days in a week does your child ride a bike?
1 2 3 4 5 6 7

11. The state of New York has a law in place requiring helmet use by children. Do you know the age range that are required to wear helmet according to the law?
a) yes, ______ **b)** no

Bicycle Helmet Post-Test

1. Do you still have the helmet given to you by RGH PED? **YES/NO**

2. Does your child wear the helmet? **YES/NO**

3. When your child rides a bike, they wear a helmet ______________.
EVERY TIME/SOMETIMES/NEVER
- Who determines how often your child wears the helmet? **PARENT/CHILD**
- If answer is *every time* skip to question 5, if *sometimes* or *never* answer question 4

4. If your child sometimes or never wears a helmet, what is the main reason for non-use?
a) do not own one **b)** forgets to wear it
c) do not think it is necessary **d)** other ________________

5. If RGH PED did not give you a helmet would you have bought one? **YES/NO**

6. Has your child been involved in another bicycle crash? **YES/NO**

*The following questions are designed to assess your bicycle helmet safety knowledge.

7. During a bicycle accident, bicycle helmets reduce the chance of:
a) bleeding in the brain **b)** a broken bone of the skull
c) a scalp laceration (deep cut) **d)** all of the above

8. While riding a bicycle, how often is your child at risk for a serious head injury?
a) always **b)** sometimes
c) never

9. In a bicycle accident, what is the #1 cause of death?
a) severely broken bones **b)** head/brain injury
c) injury to organs in the abdomen (stomach)

10. On average, how many days in a week does your child ride a bike?
1 2 3 4 5 6 7

11. The state of New York has a law in place requiring helmet use by children. Do you know the age range that are required to wear helmet according to the law?
a) yes, ______ **b)** no

APPENDIX B:

BICYCLE HELMET SAFETY EDUCATIONAL HANDOUT

A
Bicycle Helmet
For My Child

Does my child really need one?

- YES!!!
- Nearly 700 bicycle riders die in the U.S. every year.
- **Head injury is the #1 cause of death.**
- 20% of deaths are children 15 years old and younger.
- Your child is at risk for injury every time they ride a bike.
- **Your child can die or suffer permanent personality changes and learning disabilities from a brain injury.**
- Law requires bicycle helmets for all children under the age of 14 years in New York State. Children under the age of 1 year are not allowed on a bicycle, even as passengers.

What does a helmet do for my child?

- A helmet protects your child's head and skull.
- **A helmet protects your child's brain in a crash.**

When does my child need a new helmet?

- If they do not own one currently
- If they are wearing one that has been involved in a crash
- If helmet is too small, and no longer fits

J. Mulholland, 2015; adapted from the Bicycle Helmet Safety Institute, 2014. www.helmets.org

APPENDIX C:

CONTRACT OF COMMITMENT

CONTRACT OF COMMITMENT

When riding a bicycle, I, ______________________________, promise to wear a bicycle helmet ALL THE TIME. If I do not have a helmet to wear that fits properly I will not ride a bicycle.

Patient: _________________________ Date:_____________________

Practitioner: ______________________

APPENDIX D:

BICYCLE HELMET FITTING INSTRUCTIONS

Bicycle Helmet Fitting Instructions

___ Level - The helmet should be level on the rider's head.

___ Rim barely visible - The front rim should be barely visible to the rider's eye. Approximately 1 or 2 of the child's finger-widths above the eyebrow.

___ Y below the ear - The Y of the side straps should meet just below the ear.

___ Snug strap - The chinstrap should be snug against the chin so that when the rider opens their mouth very wide the helmet pulls down a little bit. No more than 1 or 2 of the child's fingers should fit under the strap.

___ Skin moves a little - Move the helmet side-to-side and front to back, watching the skin around the rider's eyebrows. It should move slightly with the helmet. If it does not, the fit pads are probably too thin in front or back, or the helmet may even be too large.

___ Stablilizer snug - If there is a rear stabilizer, adjust it until it is snug under the bulge on the rear of the head.

___ Palm test - Have the rider put their palm on the front of the helmet and push up and back. If it moves more than an inch more fitting is required.

___ Shake test - Have the rider shake their head around. This can be fun. If the helmet dislodges, work on the strap adjustments.

___ Ask about comfort - Ask the rider if the helmet is comfortable and check to make sure there are no comfort issues that still need to be addressed.

___ Be ready to switch - Not all helmets fit all heads. Be prepared to use a different helmet if the one you are fitting just will not work for this rider.

Bicycle Helmet Safety Institute, 2014. www.helmets.org

APPENDIX E:

WAIVER OF RESPONSIBILITY

ROCHESTER REGIONAL HEALTH SYSTEM

**BICYCLE HELMET
DISTRIBUTION PROGRAM**

Parent/Guardian ______________________ **Date** __________

Address ______________________________________

City ______________________ **Zip** __________

Phone ______________ **Emergency Phone** ______________

1st Child's Name ______________ **Helmet #** __________
2nd Child's Name ______________ **Helmet #** __________
3rd Child's Name ______________ **Helmet #** __________
4th Child's Name ______________ **Helmet #** __________

BICYCLE HELMET AGREEMENT

I understand and agree that the provision of this bicycle helmet is a head injury control program provided through Rochester General Hospital and is done as a public service in the interest of safety. The injury control program is not a dealer in bicycle helmets nor is it an agent for any manufacturer or distributor of these helmets. Rochester General Hospital, its staff, volunteers, or agents make no warranty expressed or implied as to the fitness of these bicycle helmets and assume no responsibility for the proper or improper use of same.

In consideration of the above injury prevention service, I agree to forever refrain from instituting, pressing, or in any way aiding claims, demands, actions, or causes of actions against Rochester General Hospital or its staff, volunteers, or agents, for any injuries, damages, costs, loss of services, expenses, or compensation for, or on account of, or in any way growing out or which may hereafter grow out of the head injury prevention services provided. This agreement is binding upon my heirs, successors, or assigns.

I have read and agree to the conditions set forth in this agreement.

____
PARENT/GUARDIAN SIGNATURE

____
DATE

____
PERSON ADMINISTERING AGREEMENT/DATE

APPENDIX F:

PARTICIPANT DEMOGRAPHIC INFORMATION

Participant Demographic Information

Parent	Gender	Age	Race	Household Inc.	Education Level	Marital Status
1	Female	36	White	$60,000-$79,000	Some college	Married
2	Female	42	White	$60,000-$79,000	High School/GED	Married
3	Female	30	Black	$20,000-$39,000	High School/GED	Never Married
4	Female	30	Black	$20,000-$39,000	High School/GED	Never Married
5	Female	34	Black	Less than $20,000	High School/GED	Never Married

Child	Gender	Age	Race
1	Female	9	White
2	Male	12	White
3	Male	8	Black
4	Male	9	Black
5	Male	8	Black

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