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Bryan Harris
brharris@nmu.edu

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IMPLICATION OF CONCUSSION PREVENTATIVE BEHAVIOR THROUGH YOUTH EDUCATION ON PLAYGROUND SAFETY

By

Bryan Francis Harris

SCHOLARLY PROJECT

Submitted to
Northern Michigan University
In partial fulfillment of the requirements
For the degree of

DOCTOR OF NURSING PRACTICE

School of Nursing

August 2018

SIGNATURE APPROVAL FORM

IMPLICATION OF CONCUSSION PREVENTATIVE BEHAVIOR THROUGH YOUTH EDUCATION ON PLAYGROUND SAFETY

This DNP Scholarly Project by Bryan Harris is recommended for approval by the student's Faculty Chair, Committee and Department Head in the School of Nursing

Dr. Jane Campbell	8/12/18
Committee Chair: Dr. Jane Campbell, DNP, RN, NE-BC	Date
Dr. Melissa Romero	8/12/18
First Reader: Dr. Melissa Romeo, PhD, FNP-BC	Date
Michelle Johnson	8/12/18
Second Reader: Michelle Johnson, MSN, RN, CNE	Date
Dr. Kristi Robinia	8/12/18
Department Head: Dr. Kristi Robinia, PhD, RN	Date

ABSTRACT

IMPLICATION OF CONCUSSION PREVENTATIVE BEHAVIOR THROUGH YOUTH EDUCATION ON PLAYGROUND SAFETY

By

Bryan Francis Harris

The concern with concussions has taken our society by storm as it relates to the health consequences either: acute, chronic, and/or later in life as a result of experiencing a single or multiple concussions. Research is thriving on concussion diagnosis, management, and treatment and will continue to do so in the years to come. Preventative measures in a variety of forms is the cornerstone for dealing with concussions at this time; with evidence showing formal educational programs are effective. Children as young as 6 years old have had concussion education, but finding a way to relate material to developmental stage can be a challenge. This scholarly project takes a preventative approach by educating fourth grade students at a rural elementary school on playground safety. ThinkFirst: National Injury Prevention Foundation, provides educational programs for first through eighth grade students on prevention of brain, spinal cord, and trauma injuries with the use of the Health Belief Model (HBM). The scholarly project was guided by both the fourth grade curriculum on playground safety from ThinkFirst and the HBM. Evaluation of the education provided to fourth grade students was done through a pre-test and post-test format with the use of a four point Likert scale to analyze a change in behavior. Demographic information was also analyzed. Further intentions with the scholarly project is for the students to transcend the behaviors learned on playground safety into everyday life.

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BRYAN FRANCIS HARRIS

August 2018

DEDICATION

This project is dedicated to my family. Without their assistance, I would never have been able to achieve my dream of advancing my education. The past four years has been a struggle with trying to balance working full-time, school, and family. Though I made many sacrifices in my life, my family made just as many, if not more. I could never thank them enough for all they have done over the past four years. I hope deep down in their hearts they understand the time was right in my professional career to advance my degree.

ACKNOWLEDGEMENTS

I would like to acknowledge Dr. Jane Campbell for being the committee chair for the scholarly project. Her thoughts and input with the direction of the project was priceless. She has served as a mentor and a true asset for both my personal and professional growth. I could never truly thank her enough for her contributions throughout the years. I would also like to acknowledge Dr. Melissa Romero and Michelle Johnson for their time, input, and serving as readers for the scholarly project. I would also like to acknowledge Michael Strahan for his assistance with editing and APA formatting.

A special acknowledgment to Ryan Reichel who did an astonishing job in coordinating a multitude of activities with the rural elementary school in order for the scholarly project to take place. Ryan is a tremendous role model for youth as both a teacher and coach. The community which he serves has been beyond thankful for his contributions over the years and luckily enough will have the opportunity to enjoy his services for many years to come.

A special thanks to Debby Gerhardstein, Executive Director at ThinkFirst: National Injury Prevention Foundation who provided educational material and gave permission to utilize the student researcher developed pre- and post-tests for the scholarly project. A special thanks to Jake Rich for his time in helping with the data analysis of the scholarly project.

TABLE OF CONTENTS

List of Tables

List of Figures

Chapter One

Introduction to Problem

Over the past few years the concussion topic, especially sports related, has become a significant point of emphasis for multiple groups including the media which has further magnified the issue (Guskiewicz, Teel, & McCrea, 2014). The release of the movie *Concussion* in 2015 starring Will Smith further promoted the long term health consequences one may suffer as a results of concussions (Wijdicks, 2016). Research in the past 20 years has advanced the diagnosis, management and treatment of concussions; however, further research and evidence-based intervention to reduce morbidity and long term consequences is needed (Levin & Diaz-Arrastia, 2015).

A concussion is defined as "a traumatically induced transient disturbance of brain function and involves a complex pathophysiological process" (Harmon et al., 2013, p. 15). The mechanism of action typically associated with a concussion is an acceleration to deceleration pattern with force being either linear or rotational resulting in changes at the neuron level (Mapstone, 2016). A metabolic cascade results from the injury causing an imbalance within the presynaptic and postsynaptic regions leading to a concussion (Mapstone, 2016).

Approximately 3.8 million concussions occur in the United States each year (Harmon et al., 2013). From 2001 to 2012, the rate of emergency department visits for sports related concussions or traumatic brain injuries (TBI) with or without other injuries doubled for children under the age of 19 (Centers for Disease Control and Prevention [CDC], 2017c). A couple of factors may contribute to the increase in the incidence of concussions being reported. The first is a better understanding of concussions by athletes and those providing medical assistance during

athletic events (Bailes, 2009). The second is more reporting is being done on concussions (Bailes, 2009). Youth sports participation for ages six through 12 years of age on the other hand has gone down 8% in the past decade (Bogage, 2017).

More jaw dropping than the incidence of concussions reported are those that are not. "Although reports have varied, up to one half of sports concussions are not recognized, not deemed as serious injuries, or are not consistently identified to the athletic training staff" (Bailes, 2009, p. 509). According to the CDC's Proposed National Concussion Surveillance System, current data sources only capture 1 out of 9 concussions (CDC, 2017b). The most common reasons for not reporting an event was the perception that the injury was not that serious (Register-Mihalik et al., 2013). Other reasons for not reporting the injury include: not wanting to be removed from the game, fear of letting down teammates or coaches, lack of awareness that one was experiencing concussion symptoms, and belief that a "bell ringer" is not a concussion (Register-Mihalik et al., 2013).

The highest incidence of concussions occur in football, hockey, rugby, soccer, and basketball; but despite this generalization concussions do occur in all sports (Harmon et al., 2013). Similar sports with the same playing rules have found a higher incidence of concussions in females compared to their male counterparts (Harmon et al., 2013). One study involving a large public high school system with data collected over a two year period from 12 high school boys and girls sports found that girls had an equal amount or more concussions than their male counterparts and twice the risk for concussions in similar sports (Lincoln et al., 2011).

The Michigan High School Athletic Association (MHSAA) has taken a front running nationally for conducting concussion research. In the fall of 2015, the MHSAA began collecting comprehensive data from its schools on possible concussions (National Federation of State High

School Associations [NFHS], 2015). The MHSAA was the first state within the association to collect concussion data over the duration of a whole sports season (NFHS, 2015). The MHSAA has since completed two full school years' worth of concussion data for 2015-16 and 2016-17 with 99% compliance by schools within the state (Michigan High School Athletic Association [MHSAA], 2018). Boys accounted for 67% and 66% of head injuries and a higher percentage of head injuries occurred at the varsity level (MHSAA, 2018). Football and ice hockey accounted for the highest percentage of head injuries, followed by girls' soccer and girls' basketball (MHSAA, 2018). Similar sports played by both boys and girls found significantly more head injuries to be suffered by girls (MHSAA, 2018).

Athletics has a big impact on the incidence of concussions and much of today's research links concussions with athletics; however, other areas of life also play major contributions. These include for examples: falls, accidents, motor vehicle crashes, being struck by an object and violence. Though not all concussions can be prevented, taking the appropriate action in order to prevent acute and/or chronic harm one may suffer from a concussion is warranted. A multitude of preventative measures can be used against concussions either directly or indirectly and include: education, awareness of surroundings, rules/laws/regulations, and safety equipment.

Focus of Project

The focus of this scholarly project was to implicate concussion prevention through behavior change by educating youth on playground safety. Premises of the project include: 1) having both boys and girls participate, and 2) focusing on preventative measures through a variety of playground safety methods. An elementary school in a rural Midwestern town was contacted for the project. The fourth grade was utilized as the appropriate age due to: 1) oldest age within the academic setting, 2) most likely to pay attention to educational material, 3) age of

expedited growth and development, and 4) age of less parental supervision and more independence.

ThinkFirst: National Injury Prevention Foundation (2015, ThinkFirst) was originally developed in 1986 with a mission "to prevent brain, spinal cord, and other traumatic injuries through education, research, and advocacy" (para. 1). Originally developed for teens, ThinkFirst has since developed educational programs that now cover first through eighth grade (ThinkFirst, 2015). Chapters exist throughout the United States and expansion has also occurred internationally (ThinkFirst, 2015). ThinkFirst has had an influence on public policy initiatives as well as the care, treatment, and rehabilitation for children's hospitals and medical universities (ThinkFirst, 2015).

Educational material used for the scholarly project was guided by ThinkFirst, by using the fourth grade playground safety curriculum. This information was provided by the Executive Director at ThinkFirst (see Appendix A). ThinkFirst (2015) utilizes the Health Belief Model (HBM) as the basis of their educational curriculum and stress the concept that: "in order to invoke behavior change, a person must recognize that something serious in the form of a disease or injury could happen to them, and that there is something relatively simple they can do to prevent it" (para. 6).

Significance for Population

Primary preventative measures are best suited for a younger age group. This population was at an age where less parental monitoring would occur in the years to come. They were also at an age where strength and mobility allows them to be further daring and unsafe by utilizing playground equipment in a manner that is not intended. The decision to practice being safe within a playground setting is of individual responsibility. It is critical to have the appropriate

knowledge to behave in a manner that keeps the individual as well as friends and/or classmates safe. Furthermore, our society has taken a proactive approach in concussion prevention. Behavior change through playground safety could transcend to further safety measures in all aspects of life; including concussion prevention that could extend throughout this populations youth and adolescents.

Chapter Two

Literature Review

Screening for a concussion should include a comprehensive history, review of the mechanism of action as it relates to the injury, a thorough neurological examination, identifying symptoms, cognitive function, and balance (Mapstone, 2016). A multitude of diagnostic and screening tools are available and have been revised and improved over the years for a thorough assessment. Most recognizable is the Sports Concussion Assessment Tool (SCAT 3) or the child SCAT 3 with the latter screening used for children under 13 years old (Mapstone, 2016). These screening tools can be utilized in office settings, emergency departments, and on the sidelines of athletic events (Mapstone, 2016). Clinical criteria and an appropriate assessment of the patient can help determine those who need neurological imaging such as CT scan which is the preferred scanning method for acute mild traumatic brain injuries (Useche & Bermundez, 2018). MRI scanning should only be utilized if a CT scan demonstrates a normal scan but further neurological decline occurs (Useche & Bermundez, 2018). Just recently, the U.S. Food and Drug Administration (FDA) expedited the approval of a blood biomarker with hopes to provide a quick diagnosis for those who have experienced a head injury and avoid radiation exposure with unwarranted imaging (Costandi, 2018).

The signs and symptoms of a concussion can be categorized into four main headings: a) physical, b) cognitive, c) emotional, and d) sleep (CDC, 2017c; Harmon et al., 2013; Mapstone, 2016). In both males and females, headache is the most commonly reported symptom (Frommer et al., 2011). Male symptoms tend to be more cognitive related which includes amnesia, confusion, and disorientation; females on the contrary experience drowsiness and dizziness (Frommer et al., 2011). Acetaminophen is the recommended drug of choice for the treatment of

post-concussion headaches (Petraglia, Maroon, & Bailes, 2012). Dizziness can be treated with medications such as meclizine and scopolamine (Petraglia et al., 2012)

Most concussions resolve in 7-10 days but in some cases the symptoms associated with a concussion may last weeks and even months (Harmon et al., 2013). Symptoms resolution between males and females is similar (Frommer et al., 2011). Children and adolescents take longer to recover from a concussion in comparison to adults thus requiring a more cautious approach with their management (Guskiewicz & Valovich McLeod, 2011; Mapstone, 2016). Individuals who have suffered multiple concussions have prolonged symptoms, a greater recovery time, and are at a higher risk for experiencing future concussions (Covassin, Moran, & Wilhelm, 2013). An increase in neurological vulnerability occurs with individuals who have suffered multiple traumatic brain injuries (Connery, Baker, Kirk, & Kirkwood, 2014). A lack of symptom resolution in 1-2 weeks may need referral to either a neurologist or concussion specialist (Mapstone, 2016).

Medical management for concussion usually includes close observation and both physical and cognitive rest with a focus on symptom management (Petraglia et al., 2012). The steps taken in order to return to play is a low level of physical exertion, followed by an increase in duration and intensity (Putukian & Kutcher, 2014). Physical contact activities may resume after the individual has returned to their baseline neurological function (Putukian & Kutcher, 2014). Complete symptom resolution is a crucial component in the medical management due to the possibility of second impact syndrome occurring before the prior concussion has resolved (Stovitz et al., 2017).

Concussion legislation exists in all 50 states and “each state has the jurisdiction to mandate a program for concussion education or to establish a minimum standard for the

instructions each school district must provide to its athletes, parents, and school officials" (Williamson et al., 2014, p. 132). Independent state legislation covers three areas: a) education, b) removal of a youth athlete from competition, and c) returning a youth athlete to practice or competition (National Conference of State Legislatures [NCSL], 2015). Michigan took the initiative on June 30th, 2013, to become the 39th State to implement a law regulating sports concussions and return to participation (Michigan Department of Health and Human Services [MDHHS], 2018).

Two bills passed in 2012 were part of the Michigan concussion law and include: a) Public Act 342, and b) Public Act 343 (MDHHS, 2018). Public Act 342 is an enrolled Senate bill and provides definitive terms including: health professional, athletic activity, concussion, organizing entity, school, and youth athlete (MDHHS, 2018). Public Act 343 covers the educational requirements by coaches, volunteers, and youth athletes (MDHHS, 2018). Educational material provided to Michigan student athletes is from the *CDC: Heads up Concussion* program (MDHHS, 2018). Public Act 343 also includes the removal of a youth athlete from activity if a concussion is suspected as well as the clearance process involved in returning the student athlete to play (MDHHS, 2018). In the State of Michigan, an appropriate assessment of suspected concussed student athlete must be provided by a healthcare professional or other qualified individuals before returning the student athlete back into the game (MDHHS, 2018). A student athlete with a diagnosis of a concussion must receive written clearance by a healthcare professional before returning to play (MDHHS, 2018). A current trend for Michigan student athletes is for baseline function testing be performed which includes: balance, memory, attention, concentration, reaction time, and a neuropsychological test with repeat testing performed every one to two years (MDHHS, 2018).

Health implications later in life due to concussions has drawn a significant amount of concern in recent years. The disease Chronic Traumatic Encephalopathy (CTE) can be traced back to the 1920s when boxers were affected and given the terms punch drunk syndrome or dementia pugilistica (Boston University, CTE Center, n.d.-b). CTE is a progressive degenerative disease of the brain that may result from repetitive head impact, head trauma, and/or concussions (Boston University, CTE Center, n.d.-b; Harmon et al., 2013). Asymptomatic subconcussive hits to the head that do not cause concussion-like symptoms may also contribute to the development of CTE (Boston University, CTE Center, n.d.-b; McKee, Alosco, & Huber, 2016). Further belief in the development of CTE is that it may be attributed to the number of years a contact sport was played and not necessarily the amount of concussions suffered (McKee et al., 2016).

Changes in the brain can begin months, years, and even decades after head trauma was experienced (Boston University, CTE Center, n.d.-b). Symptoms usually manifest themselves after about a 15 year latency period of these changes (McKee et al., 2016). Symptoms include: memory loss, confusion, impaired judgment, impulse control problems, aggression, depression, suicidality, parkinsonism, and dementia (Boston University, CTE Center, n.d.-b; McKee et al., 2013). Concussion injuries have also been linked to the development of neurodegenerative disorders (McKee et al, 2013; Monaco & Tempel, 2015). Individuals with CTE in some cases have been found to have a dual diagnosis of a neurodegenerative disorder (McKee et al., 2013). The severity of CTE pathology, symptoms, and other associated neurodegenerative diseases correlate with playing at the highest level of competition (Mez et al., 2017). Psychological disorders have been found to be associated in those with a history of TBI (Kerr et al., 2014; Perry et al., 2016). Former professional athletes who had CTE symptoms and took their own lives were found to be clinically diagnosed with CTE on post mortem autopsies (Korngold, Farrell, &

Fozdar, 2013). "In contrast to the heightened public awareness of CTE, the actual science of CTE remains in its infancy with a great deal to be learned about its incidence, prevalence, risk factors, and diagnosis" (Montenigro et al., 2015, p. 314).

Preventative measures have been implicated to minimize the incidence of concussions. There is no set in stone educational approach or program to educate student athletes on concussions; however, evidence shows that formal educational programs are effective (Williamson et al., 2014). Recent attempts to educate youth on concussions has been utilized for children as young as 6-8 years old (Daugherty et al., 2018; Kroshus, Gillard, Haarbauer-Krupa, Goldman, & Bickham, 2016). Concussion education at this age can be a challenge due to matching concussion material with developmental stage (Kroshus et al., 2016).

Rules within particular sports have been modified for player safety (Harmon et al., 2013). Safe techniques such as tackling in football, checking in hockey, and heading the ball in soccer are required to be both taught and demonstrated prior to being used in game situations (Harmon et al., 2013). Strength training techniques with neck muscles may help reduce impact in contact sports where a helmet is required (Harmon et al., 2013). Sports where frequent contact occurs may limit the amount of contact practices in a particular time frame (Harmon et al., 2013). In the 2017 season, some National Football League (NFL) players were using a newly designed helmet called the Vicis Zero1; a flexible, four layer helmet that absorbs the shock and force from impact with hopes to reduce concussions (Garcia, 2017). Despite continued efforts and research, it is important for all those involved in athletics to understand that there is currently no athletic equipment that fully prevents concussions from occurring (Guskiewicz et al., 2014).

Theoretical Framework

The HBM has been around since the 1950s and been utilized for a variety preventative health behaviors in regards to health promotion and health risk (Abraham & Sheeran, 2015). Demographic variables and psychological characteristics can play a role in health behavior patterns, but it is hypothesized that these patterns can be modified through educational interventions (Abraham & Sheeran, 2015). The HBM consists of two individualized areas: threat perception and behavioral evaluation (Abraham & Sheeran, 2015). Threat perception includes perceived susceptibility and perceived severity, whereas behavior evaluation consists of the perceived benefits and perceived barriers (Abraham & Sheeran, 2015). Cues to action acts as trigger and can activate the health behavior (Abraham & Sheeran, 2015). There is no clear linear direction amongst the components within the HBM and multiple factors can play a role in its success (Abraham & Sheeran, 2015). An evaluation including meta-analysis of HBM demonstrates its usefulness as it relates to "behavior change, intervention design, and evaluation" (Abraham & Sheeran, 2015, p. 58). The components of the HBM can be visualized on Figure 1. Permission to utilize the figure was granted by the author Pashal Sheeran, Ph.D. (See Appendix B).

Figure 1. The Health Belief Model

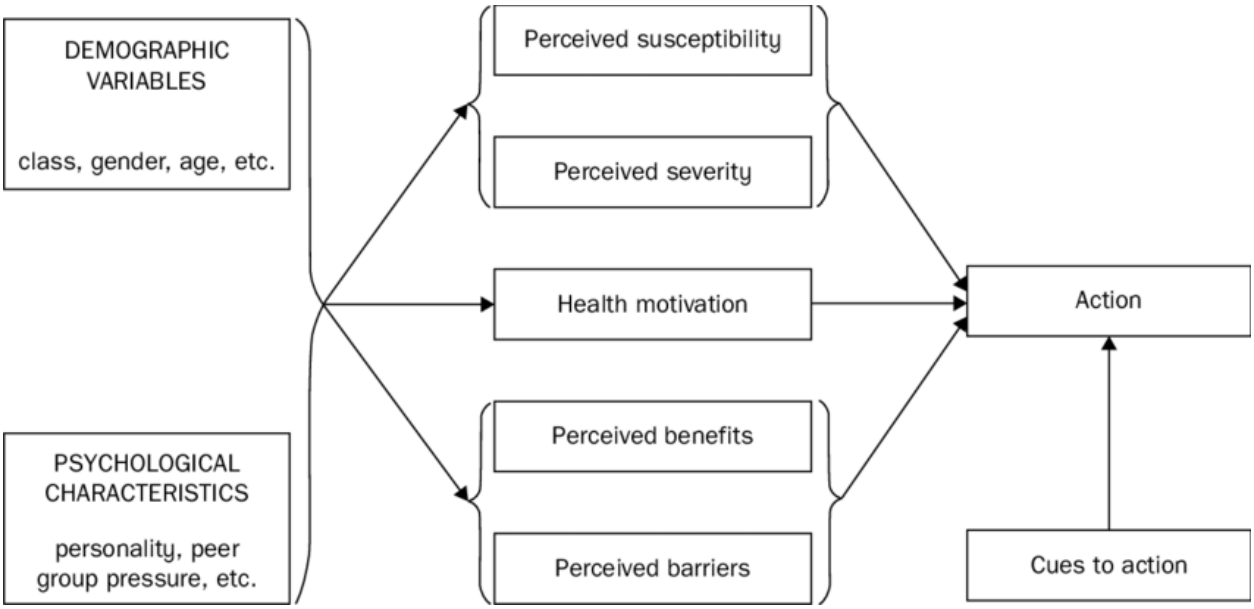


Figure 1. From "The Health Belief Model," by C. Abraham and P. Sheeran, in M. Conner & P. Norman (Eds.) *Predicting and Changing Health Behaviour: Research and Practice with Social Cognition Models* (3rd ed., p. 32), 2015 (https://www.researchgate.net/publication /290193215_The_Health_Belief_Model). Copyright 2015 by Paschal Sheeran. Reprinted with permission.

Chapter Three

Methods

Purpose and Sample

The purpose of the scholarly project was for concussion prevention to occur through behavior change by educating youth on playground safety. Furthermore, lessons learned on playground safety could be used in multiple aspects of life in order to further promote safety initiatives, including concussion prevention. A rural physical education teacher was reached out to for the scholarly project. Responsibilities for the physical education teacher within the school district was to provide physical education for all the fourth grade students. Student recruitment for the scholarly project included a convenience sample of all the fourth grade students within the school district with an approximation of 40-50 students. By using the entire fourth grade population of 50 students and a confidence level of 95%, a sample size of 45 students was calculated.

Project Approval

IRB approval was granted through an administration review at the university on May 2, 2018 (see Appendix C). Further support of the scholarly project was provided by both the physical education teacher and elementary school principal.

Instrument

A pre-test and post-test was developed by the student researcher to evaluate a change in behavior based off the ThinkFirst: fourth grade playground safety curriculum (see Appendices D and E). The format and questions used in the pre- and post-test were similar. Demographic information included: age and gender. The pre-test asked if an injury occurred on the playground in the month of April and similarly the month was changed to May on the post-test.

A four-point Likert Scale was used to evaluate behavior and included: 1) Never; 2) Rarely; 3) Sometimes; and 4) Always. Questions asked on the pre- and post-test included: a) I wait my turn; b) I look out for others; c) I use playground equipment regardless of how safe it may be (broken, weather permitting); d) I let someone know if I hurt myself on the playground; e) I tell someone if I hurt my head; f) I let someone know if another kid is hurt. Approval to use the pre- and post-test was granted by the Executive Director at ThinkFirst (see Appendix A). The instrument was not tested for reliability or validity. Comprehension was evaluated with the utilization of two fourth grade students not involved with the scholarly project.

Design

A PowerPoint presentation guided by the ThinkFirst: fourth grade playground safety curriculum was developed. The areas covered in the presentation included: a) following age and height recommendations, b) being aware of surroundings when swinging objects, c) using good judgment, d) not using broken playground equipment, e) notifying an adult if playground equipment breaks, f) being cautious of wet or icy playground equipment, g) avoiding use if weather impacts playground safety in any way, h) using playground equipment as intended, i) avoiding jumping from heights, j) staying clear of classmates on swings and coming down slides, k) not rushing, l) taking turns, m) being respectful of fellow classmates, n) reporting injuries of self or other to an adult, o) notifying an adult immediately if you hurt your head. Graphics were taken from bing.com to help further enlighten the presentation. A 36" x 48" poster using the educational material and graphics from the PowerPoint was developed and gifted to the school.

Arrangements were made by the physical education teacher for a presentation to be done on May 11th, 2018. Students were brought into a computer lab from two separate fourth grade classes. Pre-tests were handed out to students along with a No.2 pencil. It was stressed to

students to be honest with their answers. Students were also told there was no right or wrong answers, but to choose their behavior that best supported each question. Assistance was provided with the pre-test as needed. Pre-tests were collected after approximately five minutes and prior to the educational presentation so behavioral responses could not be modified.

Students were asked prior to beginning the presentation on playground safety whether they had heard of a concussion. Every student in the class raised their hand. A brief discussion took place on concussions and preventing them from occurring. A projector was used in the computer classroom to help assist with the presentation on playground safety. The physical education teacher was present for the duration of the presentation. Students were allowed to ask questions and share experiences. Presentation time was approximately 25 minutes in duration. After the presentation, students were once again allowed to ask questions and share experiences. Prior to dismissing the students; it was stressed that the education on playground safety was a way of preventing concussions and that many of the components used from this presentation can be utilized in other areas of life.

The post-tests were handed out on June 6th, 2018 to students while they were in their regular classroom setting. Only students who participated the day playground safety education took place were allowed to fill out the post-test. It was stressed once again to the students to be honest with their answers. Students were also told there was no right or wrong answers, but to choose their behavior that best supported each question. Post-tests were collected individually after approximately five minutes.

Data Analysis

Results from the pre- and post-test were originally entered into Microsoft Excel (Version 15.0.5041.1001). It is to note that not all data was filled out by students on the pre- and post-test.

Behavior evaluation was done by assigning a value to each behavior response (Never =1; Rarely =2; Sometimes = 3; Always =4). The behavior that addressed equipment usage needed to be rescaled in order to measure safety positively. In this case, the higher value would correspond to a safer behavior. The behavior scores were then combined across the six questions on both tests, providing a maximum of 12 observations per student. This allowed for a total of 404 observation to be analyzed.

Data analysis occurred through two different methods: exploratory data analysis and linear mixed model analysis. Exploratory data analysis was performed using graphics created in the ggplot2 package in R (Version 2.2.1). A linear mixed model is an extension of a linear regression allowing for analysis of a continuous response variable (behavior response) as a function of multiple explanatory variables (age, gender, injury, and test); thus giving the opportunity to combine multiple demographic variables and see their impact simultaneously. A higher chance of error would have resulted had multiple smaller unrelated tests been performed and grouped together. The liner mixed model avoids these potential errors.

An equation for the linear mixed model analysis was developed:

$$\mathbf{Score} = \hat{4}\mathbf{.75} - \mathbf{0.196Age} + \mathbf{0.294Injury}_{\boldsymbol{Injured}} + \mathbf{0.558Gender}_{\boldsymbol{Girl}} - \mathbf{0.040Test}_{\boldsymbol{Pre-test}} + \boldsymbol{Student}_{\boldsymbol{i}}$$

which includes a random intercept depending on the student in order to control independence; demonstrated as i is the i^{th} in the equation (see Table 1). Boy, not injured, and post-test were used as baselines and do not appear in the model.

Table 1

Random Intercepts Estimates for Each Student

Student	Intercept Estimate
1	0.096464248
2	0.159575904
3	0.044226723
4	-0.003790787
5	0.060185378
6	0.105561372
7	0.173940042
8	-0.110724864
9	0.067034631
10	-0.258814921
11	-0.024962219
12	-0.145242747
13	-0.042549647
14	-0.072264391
15	-0.372793018
16	-0.067584463
17	0.064587882
18	-0.042549647
19	0.365211443
20	0.053006812
21	-0.240189719
22	0.014264765
23	0.082964620
24	0.021447481
25	-0.051488906
26	-0.006249814
27	0.203398325
28	0.173940042
30	0.078087510
31	-0.049390215
32	0.028085579
33	-0.354890886
34	-0.026387540
35	-0.017290415
36	0.108854517
37	0.094228654
38	-0.074222561
39	-0.101956961
40	0.009891330
41	0.058386462

The pre- and post-tests filled out by students participating in the scholarly project has remained in possession of the student researcher. The Microsoft Excel results from the pre- and post-tests were shared with a statistician who helped with data analysis. The statistician was aware of confidentiality as it relates to the scholarly project. Sharing of data occurred only between the student researcher and statistician. Research material from the scholarly project including the pre- and post-test filled out by students will remain in the student researchers possession where such materials are locked in a safe and will be destroyed after seven years.

Chapter Four

Results

A total of 41 fourth graders between the ages of nine and 11 years old participated in the scholarly project. There were 16 boys, 23 girls, and two no responses with the pre-test. The post-test consisted of 16 boys and 25 girls. There were 11 injuries on the playground in the month of April according to responses on the pre-test including nine girls (two: 9 year olds; seven: 10-year-olds) and two boys (one: 9 year old; one: 10 year old). The pre-test had 20 non-injury responses and 10 tests with no response. In the month of May, after playground education, the post-test demonstrated 12 injuries occurring; eight girls (one: 9 year old; seven: 10-year-olds) and four boys (all 10-years-old). There were 25 non-injury responses and four tests with no response. The frequency of each behavior occurring on the pre-and post-test was quantified and means calculated (See Figure 2 and Tables 4 & 5). The mean scores shown for the question on equipment usage is the actual mean value before being flipped to a positive value.

Figure 2. Histogram: Frequency of Behavior Values

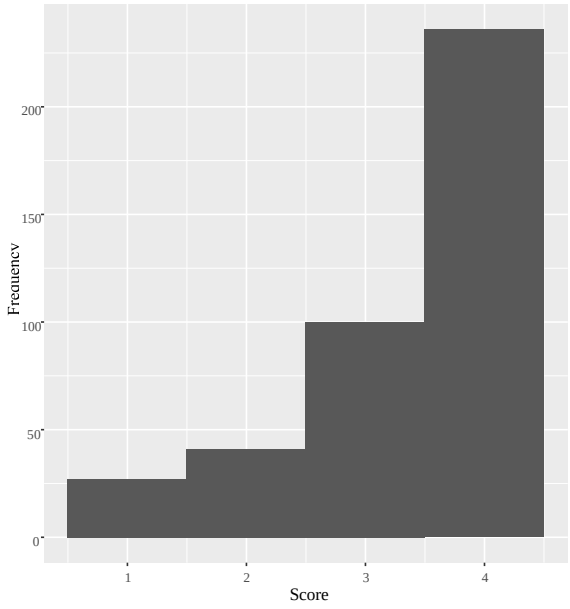


Table 2

Pre-Test Numerical Count Results and Means

	Never=1	**Rarely=2**	**Sometimes=3**	**Always=4**	**Total Responses**	**Average Score**
Wait Turn	**2**	**3**	**19**	**16**	**40**	**3.23**
Look Out Others	**1**	**2**	**9**	**28**	**40**	**3.6**
Use Playground Equipment (Broken or Weather Impact)	**6**	**18**	**9**	**5**	**38**	**2.34**
Let Know if Hurt	**6**	**3**	**12**	**19**	**40**	**3.1**
Let Know if Hurt Head	**5**	**2**	**10**	**24**	**41**	**3.29**
Let Know if Someone Else Hurt	**0**	**0**	**7**	**34**	**41**	**3.83**

Table 3

Post-Test Numerical Count Results and Means

	Never=1	**Rarely=2**	**Sometimes=3**	**Always=4**	**Total Responses**	**Average Score**
Wait Turn	**1**	**3**	**16**	**21**	**41**	**3.4**
Look Out Others	**0**	**3**	**4**	**34**	**41**	**3.76**
Use Playground Equipment (Broken or Weather Impact)	**9**	**12**	**16**	**4**	**41**	**2.37**
Let Know if Hurt	**8**	**4**	**6**	**22**	**40**	**3.05**
Let Know if Hurt Head	**2**	**4**	**6**	**29**	**41**	**3.46**
Let Know if Someone Else Hurt	**0**	**3**	**7**	**31**	**41**	**3.68**

Two main questions were sought with the scholarly project. The first question is whether there was a difference in scores between the pre- and post-test. The second question is whether there was a difference in scores amongst the variables: gender, age, and injury. Results from the linear mixed model are seen in Table 4. Estimate values in the table represent the difference in means between the variables being explored which are identified within the parentheses (not injured, girl, and pre-test) and their counterpart. The variable age in Table 4 represents 10 year olds. The p-value gives indication as to the strength of evidence with strong evidence occurring with a p-value of less than 0.05.

Table 4

Coefficient Estimates from Model

Variable	Estimate (95% Conf. Int.)	Std. Error	Deg. of Freedom	t-value	*p*-value
Intercept	4.7501 (2.738, 6.722)	1.00807	209.75	4.712	< 0.000001
Age	-0.1962 (-0.394, 0.006)	0.1012	221.87	-1.939	0.0537
Injury (Not Injured)	0.29419 (0.093, 0.496)	0.1038	161.45	2.833	0.0052
Gender (Girl)	0.5581 (0.358, 0.756)	0.1015	133.05	5.496	< 0.000001
Test (Pre-)	-0.0398 (-0.209, 0.131)	0.0868	398.97	-0.460	0.6455

Exploratory data analysis on the variables: test (Table 5, Figure 3); gender (Table 6, Figure 4); age (Table 7, Figure 5); and injury (Table 8, Figure 6) are represented on the following pages. The label “sample” found on the corresponding tables indicates the number of observations that occurred for the variable of interest. Figure 6 consists of four plots of the variables: test, gender, age and injury. The four plots provide a visualization on the difference in means between the variables.

Table 5

Summary of Scores by Test

Test Period	Samp. Size	Min.	1st Quartile	Median	Mean (±*SD*)	3rd Q.	Max.
Pre-Test	183	1.00	3.00	4.00	3.339 ± 0.90	4.00	4.00
Post-Test	221	1.00	3.00	4.00	3.357 ± 0.93	4.00	4.00

Figure 3: Summary of Scores by Test

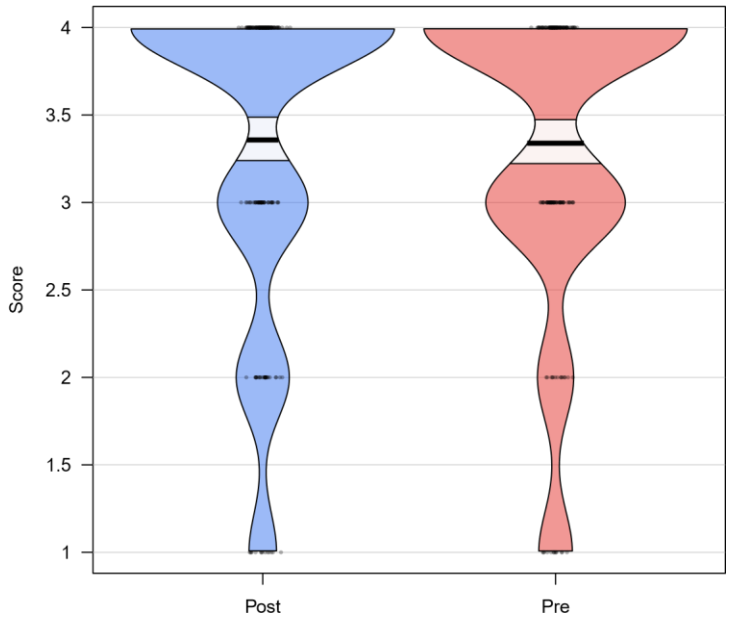


Table 6

Summary of Scores by Gender

Gender	Samp. Size	Min.	1st Quartile	Median	Mean (±*SD*)	3rd Q.	Max.
Boy	162	1.00	2.00	3.00	3.056 ± 1.09	4.00	4.00
Girl	242	1.00	3.00	4.00	3.545 ± 0.71	4.00	4.00

Figure 4. Summary of Scores by Gender

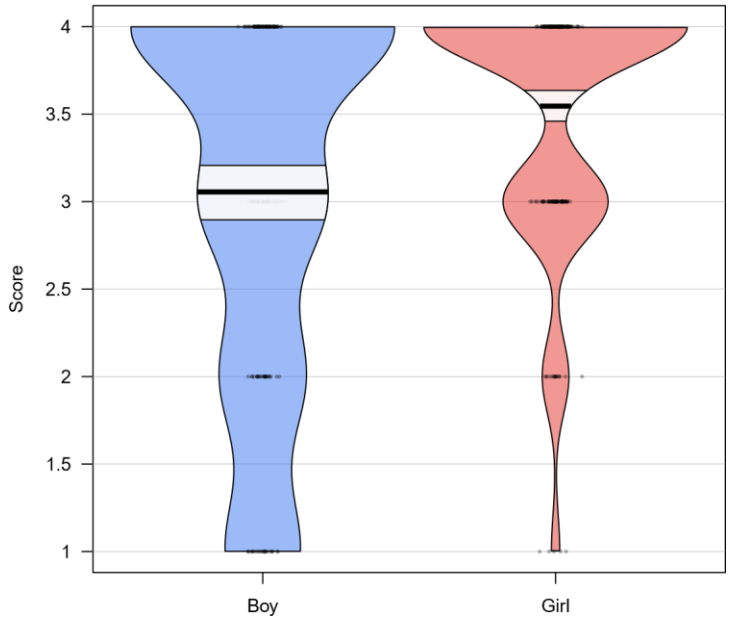


Table 7

Summary of Scores by Age

Age (in Years)	Samp. Size	Min.	1st Quartile	Median	Mean (±*SD*)	3rd Q.	Max.
9	108	1.00	3.00	4.00	3.519 ± 0.75	4.00	4.00
10	290	1.00	3.00	4.00	3.279 ± 0.96	4.00	4.00
11	6	2.00	4.00	4.00	3.667 ± 0.82	4.00	4.00

Figure 5. Summary of Scores by Age

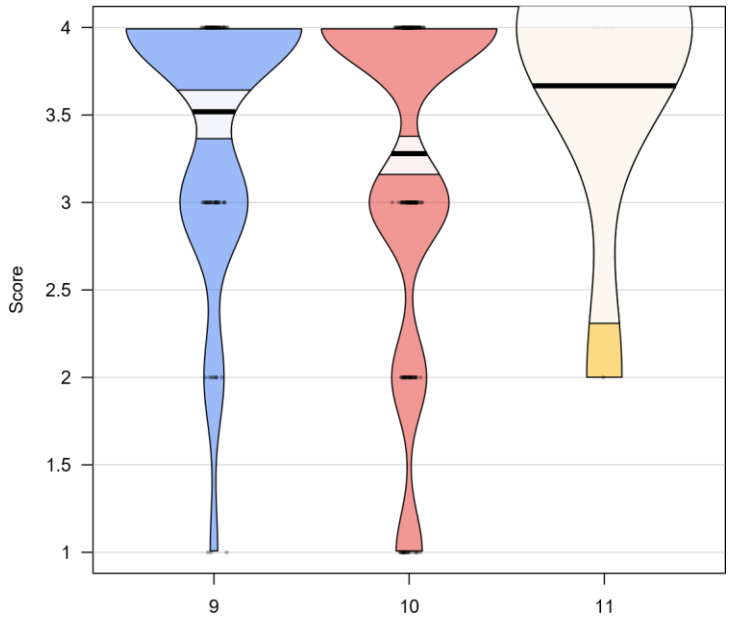


Table 8

Summary of Scores by Injury

Injury (in month of test)	Samp. Size	Min.	1st Quartile	Median	Mean (±*SD*)	3rd Q.	Max.
Injured	135	1.00	3.00	4.00	3.193 ± 0.99	4.00	4.00
Not Injured	269	1.00	3.00	4.00	3.428 ± 0.86	4.00	4.00

Figure 6. Summary of Scores by Injury

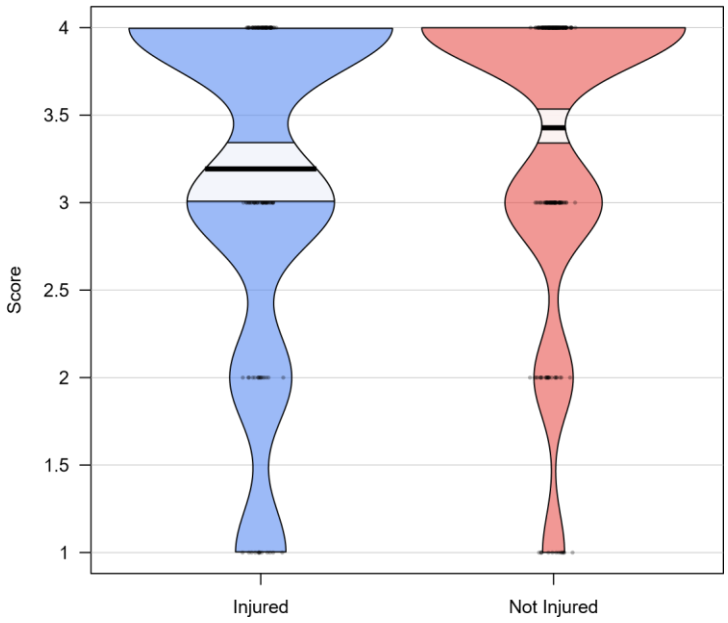
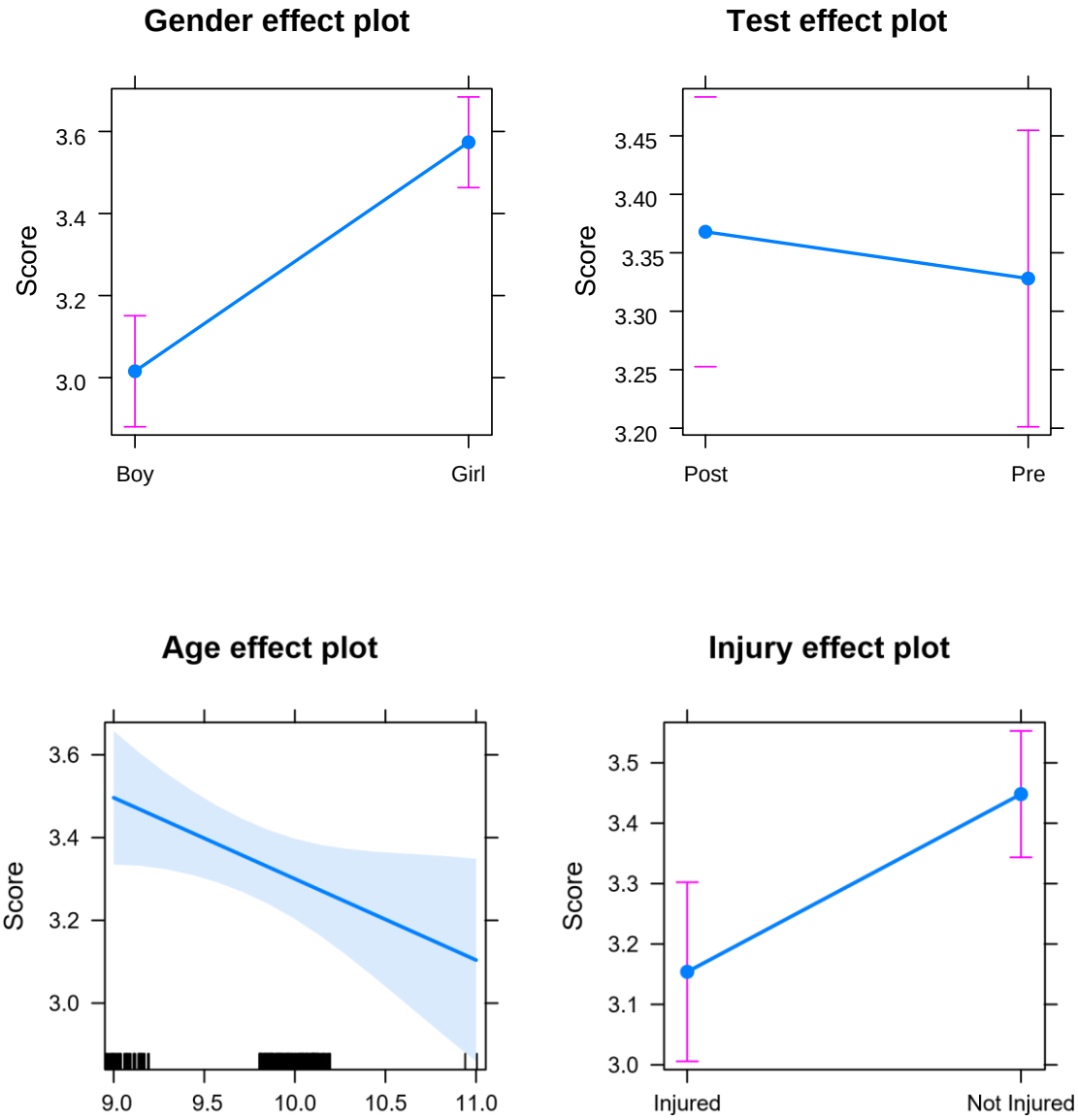


Figure 7. Plot Graphs: Test, Gender, Age, Injury



Discussion

There was no significant differences in the mean scores between the pre- and post-tests. The post-test mean was higher than the pre-test mean which was expected with the scholarly project. With the pre-test having a high mean value, the overall impact of the post-test scores demonstrating a significant difference was limited. This goes to show the sample of students involved in the scholarly project were already choosing appropriate behaviors prior to providing education on playground safety. The physical education curriculum at the elementary school consists of a vast variety of activities; safety is of the highest priority. The school utilizes its large open area just off the school boundaries that consists of hiking/skiing trails and open field for activities. The students even have a day where they go and learn how to make safety shelters with material found in the adjacent woods should they ever become stranded. Safety is re-iterated throughout their physical educational curriculum from early elementary school and throughout the duration of their academic time.

There was a significant difference in mean scores between girls and boys. Girls were found to score more than half a point higher on the behavior means in comparison to boys. This was an expected finding as boys at this age tend to be less cautious.

A significant difference also existed in mean scores between those who had an injury occur and those who were not injured. Students who identified themselves as having an injury occur were found to have a mean score of nearly three tenths of a point lower than those who were not injured. After reviewing the original data collected, this conclusion was surprising as most of the injuries occurred to girls; yet the overall means in comparing boys and girls show girls to score half a point higher. This would indicate that when excluding those girls who

indicated an injury occurring, there would be an even larger significant difference in mean scores with girls scoring higher than boys.

Moderate evidence shows the mean scores with age decrease by nearly a fifth of a point as age increases from nine to ten years old. This may demonstrate a transition period with youth towards a pre-adolescent stage where more risky behaviors may be chosen. For this school district, students transition from fourth grade elementary to fifth grade middle school. This would result in students interacting and possibly being influenced by older kids in the near future. Having preventative safety education for slightly older children based on the data trend of behavior means may be more beneficial.

Limitations

The scholarly project had 41 students participate. All of these students were from the fourth grade at rural elementary school. Recruitment of students was mandatory if the students attended school the day the playground education took place. The same occurred the day the post-test took place, despite it being mentioned that only the students who participated in the playground education were allowed to fill out the post-test. Though 41 students participated in filling out the pre- and post-test, some of the students may not have been the same as attendance was not taken to control the students involved.

The playground itself may have also had an influence on the behavioral responses. The elementary school the scholarly project took place at was actively looking to upgrade their playground equipment. Though the playground was intact and safe, having the scholarly project occur at a school with brand new playground equipment or one that had dysfunctional and broken playground equipment may have had different results. Sledding activities were also still

occurring in the month of April and it was not mentioned if sledding was a different entity or included as part of the playground.

The environment which the playground education and the pre- and post-test occurred may have also impacted the outcome. The environment was not entirely controlled. Students were sitting by friends and conversing during the aforementioned aspects of the scholarly project. Behavioral responses could have been modified by picking/copying responses as there was no isolation. The scholarly project was performed in a manner that was quick and feasible in order to limit the amount of time students were removed from their normal school activities.

Missing information was found on both the pre- and post-tests. This occurred with all aspects of the tests including: behavior, gender, age, and injury. For example, it was expected that the amount of injuries would have decreased after playground education was provided; however, this was not the case. There were 11 identified injuries on the pre-test and 12 injuries on the post-test. The pre-test had ten no responses and the post-test four no responses to the injury question. Another reason to expect a decrease in playground injuries was due to the weather. The month of April had a snowstorm, melting snow, and ice whereas the playground was clear in the month of May. The true impact of the unanswered questions on the pre- and post-tests as it relates to the results of this scholarly projects is unknown.

The pre- and post-test was developed by the student researcher based off the material within the ThinkFirst: fourth grade playground safety curriculum. Questions addressing behavior were developed in order to correlate with the ThinkFirst fourth grade playground safety material as well as the attributes specific to the students involved in the scholarly project. Testing for validity and reliability did not occur prior to the implementation of the pre- and post-test.

Future Implications

Though much of the research on concussions uses a sports analogy to a certain perspective, concussions occur in other facets of life. The treatment of a concussion regardless of the cause or severity is the same (Mapstone, 2016). First and foremost, "a period of physical and cognitive rest is the cornerstone of acute treatment" (Putukian & Kutcher, 2014, p. 567). Despite this generalization, the process in itself remains individualized, varies, and is dependent on the nature and burden of the injury as well as the degree of neurological dysfunction (Putukian & Kutcher, 2014). It is suggested that young athletes be removed from play for several days after they are symptoms free (Guskiewicz & Valovich McLeod, 2011).

Concussion legislations remains independent to each state with a focus on education, removal, and return to play (NCSL, 2015). Though these law are in effect to help protect youth athletes, "state concussion laws are sometimes difficult to enforce and therefore do not outline penalties for individuals and institutions failing to comply" (Guskiewicz, Teel, & McCrea, 2014, p. S116). In one instance in North Carolina, a portion of legislation to be ratified included a section where parents would be allowed to give written clearance for their child to return to play (Bieler, 2017). This passage drew such controversy nationally that it was removed (Bieler, 2017).

The true ramifications from those who have suffered concussions is yet to be seen. Boston University in collaboration with VA Boston Healthcare System and Concussion Legacy Foundation, hopes to advance their research in order to provide a diagnostic test for CTE in living individuals and further understand the risk factors such as length of play, age of first exposure, and the role environmental and genetic factors play in the development of CTE; with an ultimate goal of finding a treatment (Boston University, CTE Center, n.d.-a). CTE is not

limited to professional athletes; it has also been found in athletes who did not play sports after high school or college (Boston University, CTE Center, n.d.-b).

As a society, great strides have occurred over recent years to make concussions a serious issue, marketing its severity nationally and even globally. It is crucial to treat any possible concussion as a serious issue. In doing so, there may be the need to stand up against the pressure applied by the concussed athlete, parents, and even the local community to allow the student athlete back into play prematurely; thus risking further acute and/or chronic injury. A decision to remove a child from a sport if concussions become an issue should not be a difficult decision. Unfortunately, many parents see the athletic gateway as an avenue to receive a scholarship to college or even highly less likely make a living. A whole life exists outside of the timeframe of youth, adolescents, and young adulthood, though for many it may not seem this way.

A certain degree of individual responsibility plays a role in decreasing the incidence and/or severity of a concussion. Contributing to this individualized persona is the decisions being made and the behaviors being acted upon. Not all concussions will be prevented, but taking the necessary steps in order to prevent concussions when readily available is one's own responsibility. The goal with this scholarly project was for students to be educated to behave in a manner that kept themselves and/or classmates safe. By reducing the incidence of injuries occurring through behavior modification the incidence of concussions in essence would be decreased. The lessons learned on playground education would hopefully transcend to other aspects of daily life. From a primary preventative standpoint, choosing a population that was young and capable of comprehending the information relayed was crucial. One can only hope that in the years to come, lessons learned from this scholarly project will be reinforced and the appropriate behavior be utilized.

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Appendix A

ThinkFirst
National Injury Prevention Foundation

July 30, 2018

Bryan Harris

Dear Mr. Harris,

Please accept this letter as acknowledgement that I gave you permission to use the ThinkFirst For Youth Curriculum chapter on Playground Safety for your 2018 school project, teaching the material to fourth grade students. I understood you would be giving a presentation on the material and testing the children with a pretest and posttest you created.

I hope you found the project rewarding and that the children benefitted from your information on preventing injuries.

Best wishes in your graduation and career,

Debby Gerhardstein

Debby Gerhardstein, RN, BSN, MA

Executive Director

ThinkFirst National Injury Prevention Foundation

Appendix B

Permission to Utilize Figure: Health Belief Model

Bryan Harris **<brharris@nmu.edu>** 7:41 AM (8 hours ago)

to psheeran

Dr. Sheeran,

My name Bryan Harris. I am registered nurse and student in the Doctoral of Nursing Program at Northern Michigan University. I am reaching out to you in regards to a scholarly project I am finishing up. The project is on concussion prevention by educating youth on playground safety. Material used for the project was provided by ThinkFirst: National Injury Prevention Foundation. They use the health belief model as the basis of their educational curriculum and similarly I am using it as well for the theoretical framework with my project. While doing research I came across a figure of the health belief model in Chapter 2 of *Predicting and changing health behaviour: Research and practice with social cognition models.* The chapter was written by yourself and Dr. Charles Abraham. I am seeking permission to utilize the health belief model figure found on page 32 in the section explaining the theoretical framework supporting my scholarly project. Any further questions please let me know. I would be glad to answer. Thank you for your time.

Sheeran, Paschal J. **psheeran@email.unc.edu via adminliveunc.onmicrosoft.com** 8:44 AM (7 hours ago)

to me

Of course, Bryan. Please feel free to use the figure.

Very best of luck with completing your doctorate.

Kind regards,

Paschal Sheeran

Paschal Sheeran
http://psheeran.web.unc.edu

Appendix C

Institutional Review Board Approval

Memorandum

TO: Bryan Harris
School of Nursing

CC: Jane Campbell
School of Nursing

FROM: Dr. Robert Winn
IRB Administrator

DATE: May 2, 2018

SUBJECT: IRB Proposal HS18-958
"Implication of Concussion Preventative Behavior through Youth Education on Playground Safety"
IRB Approval Dates: 5/2/18 – 5/1/19
Proposed Project Dates: 5/7/18 – 6/8/18

Your proposal "Implication of Concussion Preventative Behavior through Youth Education on Playground Safety" has been approved via the administrative review process. Please include your proposal number (HS18-958) on all research materials and on any correspondence regarding this project.

Any changes or revisions to your approved research plan must be approved by the Institutional Review Board (IRB) prior to implementation.

If you do not complete your project within 12 months from the date of your approval notification, you must submit a Project Renewal Form for Research Involving Human Subjects. You may apply for a one-year project renewal up to four times.

All forms can be found at the NMU Grants and Research website: http://www.nmu.edu/grantsandresearch/node/102

Appendix D

Pre-Test for Playground Safety

Age:

Gender: Boy or Girl

Have you hurt yourself on the playground in April, 2018? Yes or No

	Never	**Rarely**	**Sometimes**	**Always**
I wait my turn				
I look out for others				
I use playground equipment regardless of how safe it may be (broken, weather permitting)				
I let someone know if I hurt myself on the playground				
I tell someone if I hurt my head				
I let someone know if another kid is hurt				

Appendix E

Post-Test for Playground Safety

Age:

Gender: Boy or Girl

Have you hurt yourself on the playground in May, 2018? Yes or No

	Never	**Rarely**	**Sometimes**	**Always**
I wait my turn				
I look out for others				
I use playground equipment regardless of how safe it may be (broken, weather permitting)				
I let someone know if I hurt myself on the playground				
I tell someone if I hurt my head				
I let someone know if another kid is hurt				