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Prevention of Overuse Injuries in High School Athletes

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Executive Summary

Overuse injuries are a significant health problem that affects the health and well-being of adolescent athletes. Almost 50 percent of sports-related injuries in the adolescent population are considered overuse injuries and half of these injuries are preventable. Overuse injuries occur over time when repetitive demands, placed on the musculoskeletal system, result in tissue damage.

The purpose of the DNP project was to educate high school coaches on the identification and prevention of overuse injuries in adolescent athletes. The project was designed with the goal of quantifying knowledge acquired by coaches participating in the project. Prevention and reduction of overuse injuries are expected to be a secondary result of the educational program.

The project consisted of the development of an educational module which was accessed online. The model was designed specifically for coaches. Information was provided on overuse injuries as well as strategies coaches can implement to prevent and reduce these injuries.

A pre-survey/post-survey technique was used to assess whether a change in coaching knowledge occurred because of the educational intervention. Injury data prior to the project and following the project was obtained from the athletic trainer. The purpose of collecting this data was to see if the education of coaches changed rates of athletic injuries.

Mixed statistical methods were used to analyze the data collected from the surveys as well as the data collected from records on overuse injuries prior to and following the education of coaches. While injury data from the athletic trainer reflected a lower incidence of injuries after the educational intervention, there was no statistically significant change in coaching knowledge based on the post-survey results.

Prevention of Overuse Injuries in High School Athletes

As an advanced practice nurse in school health, the author has become aware of an increase in adolescents who have experienced sports-related injuries at the large suburban high school, near Columbus, Ohio, where she is employed. Many of the injuries are chronic injuries such as stress fractures, torn rotator cuffs, tendonitis, and joint inflammation. Such injuries are commonly called overuse injuries. These injuries are most often the result of repetitive motion during conditioning or active sports participation.

The number of students requiring elevator passes, rest breaks, ice or other therapies during the school day have increased over the past several years. Between the 2010-2011 school year and the 2015-2016 school year, at a suburban high school, the author noted an increase of more than one thousand reported athletic injuries in the electronic data system. Frequently, this school nurse has been asked to provide both therapies and support to assist students with chronic sports injuries and to help them manage at school. Because of the identified increase in chronic (overuse) injuries in high school athletes, preventing these injuries as much as possible is indicated.

Background and Significance

Overuse injuries are a significant health problem that affects the health and well-being of adolescent athletes (American Academy of Pediatrics, 2015; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014). Greater than 3.5 million athletes ages 14 and younger are medically treated for sports injuries annually. Another study estimates an additional 2 million high school athletes experience some type of sports injury (Veciana-Suarez, 2014).

Almost 50 percent of sports-related injuries in the adolescent population are due to overuse injuries (American Academy of Orthopedic Surgeons, 2009). These injuries result in both short- and long-term consequences including physical disability, pain, and psychosocial consequences (DiFiori, 2010; DiFiori et al., 2014). A young athlete's quality of life can be affected by overuse injuries. Not only do they experience pain and disability related to the injured body part, athletes worry about disappointing coaches, parents, and team members when they are not able to participate in their sport. Injured athletes miss out on the social aspect of sports participation, too. Inability to participate results in social, psychological, and emotional stress for many young athletes (DiFiori, 2010; DiFiori et al., 2014).

Approximately half of overuse injuries are preventable (American College of Sports Medicine, 2011). The key to preventing overuse injuries in adolescent athletes is the education of athletes, parents, coaches, athletic boosters, and other key stakeholders in youth sports. Education defining overuse injuries, explaining the cause of overuse injuries, and presenting strategies for preventing overuse injuries is essential to minimizing the occurrence of such injuries. Discouraging specialization in a sport at an early age is a major factor in reducing overuse injuries (Andrews, 2010; Comstock, Collins, & Currie, 2014; DiFiori, 2010; DiFiori et al., 2014; McLeod et al., 2011). Reduction and prevention of overuse injuries supports the health of adolescent athletes and helps to promote long-term overall well-being (DiFiori, 2010; DiFiori et al., 2014; McLeod et al., 2011).

Annually, 4.3 million hospital emergency room visits are due to sports injuries (Centers for Disease Control and Prevention, 2011; American Academy of Orthopedic Surgeons, 2009). Injuries among high school athletes account for 500,000 doctor visits and 30, 000

hospitalizations annually (Andrews, 2010). The American College of Sports Medicine (2011) estimates that 50 percent of overuse injuries in the pediatric population are preventable.

Considering that many overuse injuries are preventable, the proposed project addressed coaches' education on overuse injuries among adolescent athletes. While adolescence is defined as youth between the ages of 10 and 19 (World Health Organization, 2016), the pilot project focused on athletes between the ages of 14 and 19. The pilot project was conducted at a suburban high school, in Columbus Ohio, with athletes in grades 9 through 12.

Although a detailed accounting for sports participation among children and adolescents does not exist, large numbers of youth do not limit their sports participation to only one given season. These young people are often involved in sports throughout the calendar year.

Accentuating this problem is the emphasis on competitive success which has become widespread at younger ages in youth sports. Pressure exists for youth to begin training with greater frequency and intensity than in previous years (Andrews, 2013; DiFiori, 2010; DiFiori et al., 2014; Jayanthi, 2013). When coupled with parental hopes for scholarships to college, national team selections, and, possible professional careers, participation in sports programs extends far beyond school-based or community-based programs (Andrews, 2013; DiFiori, 2010; DiFiori et al., 2014; Jayanthi, 2013).

Definition of Overuse Injury

Overuse injuries are chronic injuries that occur when repetitive demands on the musculoskeletal system results in tissue damage. Repetitive submaximal loading of a specific musculoskeletal unit causes mechanical fatigue of tendons, ligaments, neural tissue, and other soft tissues (DiFiori, 2010; DiFiori et al., 2014; Laker et al., 2015; McGraw-Hill Concise

Dictionary of Modern Medicine, 2002). Inflammation of tissue surrounding the injured area is present as well. These types of injuries occur over the course of time (American Academy of Pediatrics, 2015; Laker et al., 2015; Yang, et al., 2014). Overuse injuries are commonly referred to as repetitive strain injuries. Repeated motions and ungainly postures often result in minor injuries to soft tissues. When these postures and movements occur over and over, the body does not have time to heal. Wear and tear on the body from such repetitive movement causes damage to bone and soft tissue alike. This damage results in pain, inflammation, and loss of function in the affected area of the body (American Academy of Pediatrics, 2015; Laker et al., 2015; Yang, et al., 2014).

Purpose

The purpose of the pilot project was to reduce short- and long-term effects of overuse injuries in adolescent athletes at a suburban Midwestern high school by reducing the frequency of overuse injuries.

Clinical Problem

The clinical problem addressed was reducing overuse injuries. DiFiori (2010), McLeod, (2011), Comstock, Collins, and Curry (2014), and DiFiori et al., (2014) all state that educating coaches and other stakeholders in youth sports is instrumental in preventing and reducing overuse injuries. The development of a pilot educational program for coaches may increase knowledge of overuse injuries in high school athletes and, thus, could be key to preventing some or all of these injuries and their sequelae.

Project Development

Coaches are in a unique position to influence the health and safety of young athletes. According to Parker et al. (2015), "Sports coaches set the tone for safety among their athletes" (p.198). Well-trained coaches are in a position to recognize potential injuries, and as a result, coaches can respond in ways that reduce the risk of adverse health outcomes, such as when a coach pulls an injured player from a game to prevent exacerbation of the injury. The key role that coaches play in fostering safety among young athletes makes it imperative that they are knowledgeable about sports-related injuries, including overuse injuries (DiFiori, 2010; DiFiori et al., 2014).

Recent studies have demonstrated the positive influence of educational programs for coaching staff on their knowledge and practice of coaching. Parker et al. (2015) evaluated an online training program *Heads Up! Concussion in Sports: What You Need to Know* to assess knowledge change among study participants. The study demonstrated that online education is an effective tool for reaching large audiences and for improving knowledge about health and safety issues such as sports injuries. Coaching knowledge assessed prior to the online educational offering revealed that only 21% of the coaches answered all the pre-test questions correctly. Following the online educational program, 60% of coaches answered all the posttest questions correctly. The data indicated that the online program had a positive effect on increasing coaching knowledge (Parker et al., 2015). While this online program evaluated in the study addressed concussions in the young athlete, this type of program could be translated to educate coaches on overuse injuries and the strategies to prevent and reduce these injuries.

Mitchko et al. (2007) documents the effectiveness of comprehensive health education with coaches. The focus of this study was to evaluate a comprehensive, multi-media health education toolkit developed by the Centers for Disease Control and Prevention (CDC). The multimedia toolkit was designed to educate high school coaches about traumatic brain injuries and how to manage and prevent such injuries. The CDC's National Center for Injury Prevention and Control (Injury Center) developed the multi-media health education toolkit based on a comprehensive health education approach. The tool-kit was developed from a thorough process including: (1) developing an expert panel, (2) pre-testing message concepts, (3) pilot testing, and (4) promoting and evaluating the final product. The CDC has found that this multi-media educational toolkit is effective and increases coaching knowledge about sports injuries and injury prevention.

A position statement from the National Athletic Trainers' Association (NATA) supports the importance of educating coaches to prevent pediatric overuse injuries. After an extensive systematic review of literature, NATA found overuse injuries to be a significant health concern for adolescent athletes. The association supports education for all stakeholders, including coaches, as a critical tactic for addressing overuse injuries. NATA not only promotes knowledge of preventative mechanisms for overuse injuries, but suggests that all coaches should have knowledge of the general signs and symptoms of overuse injuries. Such symptoms include gradual onset of pain, pain presenting as an ache, no history of direct injury, aching or stiffness after or during competition or training, extended periods of time for pain to resolve, visible swelling and point tenderness, missed training sessions resulting from pain or injury, and orthopedic health problems that persist. While more research should be conducted in overuse

injuries in the pediatric population, education of coaches is supported as an effective tool for reducing and preventing overuse injuries in adolescents (Comstock et al., 2014; McLeod et al., 2011).

Serving in a leadership position in the school community, oversight of school health policies and programs is an essential part of school nursing. Such oversight includes the provision of health services and the promotion of health education. Although school nurses provide health care services to students and staff, the school nurse also coordinates services between school personnel, families, communities, and healthcare providers. The purpose of coordinating services is to advocate for health care and a healthy school environment (American Nurses Association & National Association of School Nurses [ANA & NASN], 2011).

Because both health promotion and education are roles of the school nurse, the pilot project focused on the education of high school athletic coaches. The development and presentation of an educational program for coaches is within the scope of practice of the school nurse. As a leader, the author embraced the role of liaison between school administrators, athletic coaches, parents, athletic boosters, athletes and other interested parties. The author desired to reduce overuse injuries in high school athletes by educating coaches and working with them to develop strategies for the prevention of overuse injuries. Such an initiative supports the school nurse roles of health advocacy and fostering a healthy school environment (NASN, 2012).

The leadership role of the school nurse expands beyond the local school community. The school nurse partners with nurses from other school districts and various community agencies to develop and implement services that enhance the health and well-being of the school-aged population. Nursing leaders, including school nurses, serve an essential role in promoting

wellness and in protecting the health and well-being of the people with whom they work. Per the American Nurses Association,

Nursing is the protection, promotion, and optimization of health and abilities, prevention of illness and injury, facilitation of healing, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, groups, communities, and populations. (ANA, 2016)

School nurses epitomize the role of the nurse as defined by the ANA. Prevention of overuse injuries in high school athletes is within the role and scope of practice of the school nurse. In educating coaching staff about such injuries, the school nurse works to promote wellness and to optimize the health of adolescent athletes (DiFiori, 2010; DiFiori, et al., 2014).

The Doctor of Nursing Practice (DNP) Nurse Executive focus area educates nursing leaders to look not only at individuals, but at aggregates as a system (AACN, 2008). Aggregates include populations, systems, and organizations, with national and state policies included in the practice focus. In designing and implementing this DNP Scholarly Project, the author focused on the health of adolescent athletes in the high school setting as an aggregate. The project setting was a suburban high school and the organization was a public school district. Overuse injuries were identified to be a health concern for adolescent athletes. In conducting a needs assessment prior to designing the project, the need to address overuse injuries in adolescent athletes at a local suburban high school was identified.

The literature revealed an inconsistency in the training coaches receive prior to working with young athletes (DiFiori, 2010; DiFiori et al., 2014; McLeod et al., 2011). Per NATA, standardization of coaching education will help prevent injuries among high school athletes,

including overuse injuries (McLeod et al., 2011). The standards promote athlete safety as well. A gap in knowledge among coaching staff was identified.

NATA is a proponent of certification for all staff coaching youth sports. Certification would indicate a level of proficiency with coaching practices and safety standards (Institute for Sport Coaching, 2005; McLeod et al., 2011). Because of the knowledge gap among coaches, the pilot project addressed an organizational need by developing and implementing an educational program for athletic coaches within the high school.

The development and implementation of the scholarly project involved working with various stakeholders. Collaboration with the superintendent and the human resources director facilitated the acquisition of district approval to conduct the scholarly project. Specific to project implementation, the athletic director and principal at the high school granted permission to educate coaching staff on overuse injuries and prevention strategies.

The pilot project involved an online educational module designed for coaches. The coaches were asked to complete pre- and post- intervention surveys as well. The athletic director was committed to encouraging coaching staff participation in the project.

When validating the need to educate coaches on overuse injuries in high school athletes, the athletic trainer at the high school was consulted. The trainer confirmed that overuse injuries are a significant problem in high school athletes. The trainer believes that proper education of coaching staff is essential to reducing and preventing overuse injuries in adolescent athletes (Institute for Sport Coaching, 2005; M. Townsend, personal communication, July 8, 2016).

Development of relationships with administration, the building principal, the athletic director and the athletic trainer were essential in terms of gaining support for the pilot project.

Further support was needed to cultivate support among the high school athletic coaches.

Explanation of the pilot project and how it benefits coaches and their athletes motivated coaches to participate in the project. By maximizing the number of coaches participating in the project, there was a larger scope of influence. Involvement with various staff members demonstrated the ability to work with various stakeholders to achieve intra-organizational health related goals (AACN, 2006).

Per NATA, overuse injuries in the pediatric population represents a significant health concern. In addition to direct and indirect medical expenditures, these injuries result in lost participation time, multiple physician (health care provider) visits, and lengthy (often recurring) rehabilitation. Compounding the situation is that athletes sustaining overuse injuries are prone to stop participating in sports and recreational activities. As a result, they are more prone to a sedentary lifestyle which can lead to obesity (McLeod, et al., 2011).

Coaches who promote strategies to prevent overuse injuries in athletes foster healthy athletes and lifelong health (DiFiori, 2010; DiFiori et al., 2014; Institute for Sport Coaching, 2005; McLeod et al., 2011). Recommended strategies for overuse injury prevention are: (1) proper training and conditioning, that is, encouraging athletes to establish a well-rounded fitness routine which encompasses strengthening, flexibility, and endurance; (2) instruction on proper body mechanics and technique (i.e., pitching; landing following a jump shot; or throwing a football); (3) monitoring intensity of training; (4) promoting taking breaks from sports training and participation at least one day per week (although single-sports participants are encouraged to take off 2-3 months annually from that particular sport), and (5) encouraging general fitness

through participation in a variety of fitness activities, including recreational activities (DiFiori, 2010; DiFiori et al., 2014; Jayanthi, 2013; McLeod et al., 2011; NWCH, 2015).

The PICOT question for the scholarly project was: With high school athletic coaches, how does providing training on prevention and reduction of overuse injuries in athletes compared to not providing such training affect the knowledge base of coaches in identifying overuse injuries during the school year? To narrow the pilot project, the focus of the project became varsity, junior varsity and freshman coaches at a single, suburban high school in Columbus, Ohio. Coaches interact with young athletes regularly, and such interaction creates an opportunity to influence athletes in many ways. This influence covers the mental, physical, and ethical aspects of sports participation. Sports safety is another area of coaching influence. Because of the relationship coaches have with athletes, coaches were the target population for the educational intervention. The goal of the pilot educational program was to provide coaches with the knowledge and skills needed to prevent and reduce overuse injuries in high school athletes (Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; and Nationwide Children's Hospital, 2015).

Review of Literature

A review of literature revealed that overuse injuries are a significant problem among high school athletes. Such injuries present a threat to the health and well-being of adolescents (Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; and Nationwide Children's Hospital (NWCH), 2015). The literature review highlighted predisposing risk factors for overuse injuries in young athletes including: sport specialization at a young age involving intensive training and competition; imbalance of strength or joint range of

motion; anatomic misalignment; and improper footwear (NWCH, 2015). Predisposing conditions and susceptible cartilage in a rapidly growing skeleton are risk factors for overuse injuries as well (DiFiori, 2010; Di Fior et al, 2014).

Per the literature, there is little research focused on the incidence and prevalence of overuse injuries in children and adolescents (Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori, et al., 2014). A major issue raised in the literature was the fact overuse injuries are underreported and epidemiological studies define injury as necessitating time lost from participation (DiFiori, 2010; DiFiori et al., 2014).

Another reason that there may be limited research on overuse injuries in young athletes is that the phenomenon of such injuries has been notably observed in recent years. Youth sports participation has markedly increased in the last 20 years according to the American Academy of Pediatrics (2015). This increased participation in sports has resulted in an increase in sports related injuries among children and adolescents. It is estimated that half of all sports related injuries are attributed to overuse injuries (American Academy of Pediatrics, 2015; Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; McLeod, et al., 2011; Schroeder et al., 2015).

The literature review revealed the key to preventing overuse injuries is education. Multiple orthopedic and sports medicine experts supported educational programs as a major strategy for addressing overuse injuries. Education must be provided to athletes, parents, coaches, athletic trainers and other key stakeholders. The goal of such educational programs is to facilitate changes in sports programs to prevent overuse injuries and to promote long-term health and well-being for the athlete (American Academy of Pediatrics, 2015; Andrews, J., 2011;

DiFiori, 2010; DiFiori et al. 2014; McLeod, 2011; Testoni, Hornik, Smith, Benjamin, & McKinney, 2013). Educational programs should include: the epidemiology of overuse injuries; the reasons youth are susceptible to overuse injuries; the importance of proper conditioning and training for young athletes; and the measures to prevent overuse injuries including not specializing in a sport at an early age. Other preventative measures include avoiding intense training and participation in a sport without allowing the body time to rest between sporting activities, not playing on more than one team in a sport during a season, having a thorough physical exam prior to sports participation, and taking a break from competitive sports at some point during the year. Per DiFiori, 2010; DiFiori et al., 2014), high school athletes who participate in 3 or less seasons per year report fewer overuse injuries than athletes participating throughout the year. Parents, athletes and coaches must be informed of the importance of diversified sports training in young and middle adolescence. This type of training may be more effective in developing elite level skills in the athlete's primary sport because of skill transfer. Diversity in sports participation and conditioning has also been shown to reduce overuse injuries due to more well-rounded physical conditioning and training (American Academy of Pediatrics, 2015; Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; McLeod et al., 2011; Schroeder et al., 2015).

Because the focus of the scholarly project was high school coaches, the literature review included pediatric journals as well as orthopedic and sports medicine resources. The literature sources validated the need to address overuse injuries in high school athletes. Such injuries are more prevalent in youth ages 13-17 years than in younger children ages 5-12 years (Schroeder et al., 2015). While more research must be done in overuse injuries in young people, current studies

indicate that measures to address overuse injuries must be developed and implemented (American Academy of Pediatrics, 2015; Andrews, 2011; Biber & Gregory, 2010; DiFiori et al., 2010; DiFiori et al., 2014; Jayanthi, 2013; McLeod et al., 2011; Schroeder et al., 2015).

In narrowing the scope of the scholarly project, the focus was high school coaches. High school coaches play a key role in preventing and reducing overuse injuries. A specific literature search for coaching education was conducted. The literature not only supported the need to educate coaches but also presented content that should be included in an educational program. Coaches who are knowledgeable about overuse injuries can detect such injuries and guide athletes towards rehabilitation. Knowledgeable coaches are also able to implement conditioning, training, and body mechanic techniques that prevent and reduce injuries. Because of the influence coaches have on athletes, they can encourage athletes to take breaks from training and participation, and to maintain a well-rounded fitness routine (Cassas, & Cassettari-Wayhs, 2006; Coach Safely, 2014; Institute for Sport Coaching, 2005; McLeod, et al., 2011; NWCH, 2015).

Conducting the literature review revealed the need to address overuse injuries in high school athletes. While the research on overuse injuries among children and adolescents is limited, the scholarly articles consistently present solid data indicating that there is an increase of overuse injuries among youth as more young people are participating in competitive sports. Prevention and reduction of overuse injuries in youth is imperative as these injuries may have long term consequences for the athlete. Developing an educational program geared towards high school coaches is an intervention that may make coaches more aware of the significance of overuse injuries and could result in them implementing strategies to prevent and reduce overuse injuries.

Project Implementation and Measures

Design of Educational Program

The pilot project consisted of the development and implementation of a pilot educational program for high school coaches at a public high school in a suburb of a large Midwestern city.

The project was influenced by the “Cycle of Change” endorsed by Carey, Buchan, and Sanson-Fisher (2009). The model involves creating a cycle of change through implementing evidence-based clinical practice. Use of this model as a template for the pilot project was considered the best way to instigate change in coaching knowledge of overuse injuries in adolescents. The model provides a three-step process for putting evidence-based knowledge into clinical practice. Sanson-Fisher and Carey (YEAR) state that whereas evidence-based guidelines have the potential to improve health outcomes, a mechanism is needed to close the gap between evidence and clinical practice. Their “Cycle of Change” model provides a process for achieving this objective. This model has 3 phases: (1) writing actionable best-evidenced guidelines that prioritize key recommendations; (2) developing plans of implementation for priority guidelines recommended; and (3) piloting the effectiveness of proposed approaches to see if the desired clinical change is observed. The authors acknowledge that refinement of implementation strategies may need to occur before conducting the official project (Carey, Buchan, & Sanson-Fisher, 2009).

Theoretical Framework

The theoretical framework for the pilot project was based on change theory (REF?). In the endeavor to educate coaching staff to prevent and reduce overuse injuries in adolescent athletes, changes in the sports environment must take place. The key to changing the youth

sports environment and preventing overuse injuries is education. Any adult affiliated with youth sports programs must be educated regarding overuse injuries in young athletes. According to both the American Academy of Pediatrics (2007) and the National Athletic Trainers' Association (2011), education of adults connected with youth sports is essential to preventing overuse injuries. In selecting the “Cycle of Change” model (Carey, Buchan, & Sanson-Fischer, 2009), the belief was that applying evidence based information to create a cycle of change was the best means to initiate change in overuse injuries in athletes. Once evidence-based guidelines were established, the plan for implementation considered such components as: training and accreditation; social influences including opinion leaders; environmental factors; monitoring and feedback; and patient (or audience) influences.

The audience in the project was coaches. Incentives for clinical change were considered as well. The project was a pilot test conducted to determine whether the education of coaches produced a change in knowledge. If the project results mandate a systems change and evaluation at an organizational level, the use of other research designs might be considered.

The goal of evaluation was to enable refinement of the implementation plans before widespread dissemination (Carey, Buchan & Sanson-Fisher, 2009). This author endorses evidence-based practice and believes a model for change, based on solid evidence-based data, is the model to use for preventing injuries in young athletes.

A second theory for the pilot project was Albert Bandura’s theory of self-efficacy (1997). Self-efficacy refers to a person’s belief in his or her capabilities to perform a certain task or skill (Bandura, 1997). The individual who embraces self-efficacy believes they have the capability to exercise control over certain activities or events. For this project coaches who

believe they have the capability to exercise control over preventing overuse injuries will be more confident in initiating strategies to prevent and reduce them (Saville, Bray, Ginis, Cairney, Shupe, & Pettit, 2014). The purpose of the educational module is to increase coaches' knowledge about overuse injuries and therefore, consistent with Bandura, increase their belief in their ability to detect and prevent overuse injuries (Saville, Bray, Ginis, Cairney, Shupe, & Pettit, 2014)

Goal for the Project

The overall goal for the project was to develop educational strategies for coaches to prevent overuse injuries in adolescent athletes at a local suburban high school. The objectives to meet the goal were: (1) develop a pilot educational program on overuse injuries in high school athletes; (2) measure the change in coaches' knowledge after the educational program; (3) measure the frequency of overuse injuries among athletes before and after program implementation; and (4) investigate financial implications of the impact of this change.

Target Population

The target population for this project was the coaching staff at the target school. At this high school 99 coaches and assistant coaches were on staff. The population for this study comprised the entire coaching staff, including coaches of both boys and girls athletics at various levels.

The sample for this study was a convenience sample of the coaches who agreed to participate. In recruiting the coaches for program participation, the author attended a coaches' meeting at the beginning of the 2016-2017 school year to solicit participants. The athletic director at the high school made a verbal commitment to endorse the project and to encourage all

coaches to participate in the project. Electronic messages were sent to invite the coaches to participate in the study online, where they would take the pre-intervention questionnaire, engage with the online educational module, and then complete the post-intervention questionnaire.

Development of the Online Educational Module

Following in depth research and interviews with both the high school and Otterbein athletic trainers, a comprehensive online educational program was developed. Resources from the National Association of Athletic Trainers and Nationwide Children's Hospital Sports Medicine program were consulted to determine the content of the educational module (McLeod et al., 2011; NWCH, 2015). The module included: an overview of overuse injuries, including epidemiology; examples of overuse injuries; information about the role coaches play in preventing overuse injuries; preventative strategies to implement during training and conditioning; how to identify an overuse injuries; and proper treatment of overuse injuries. Specific teaching points were the importance of diversified training and skill transfer. Coaches were instructed to encourage athletes to take rest breaks during times of intense training and participation. Coaches should discourage athletes from playing on more than one sports team per season. The end of the module encouraged coaches to inform athletes, parents, and other stakeholders in the athletic community on the importance of embracing strategies that prevent overuse injuries (American Academy of Pediatrics, 2015; Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; McLeod et al., 2011; NWCH, 2015; Schroeder et al., 2015).

The online educational module was developed in Google Sheets. The online format was selected to allow coaching staff to access the educational program at a convenient time in their

schedule. A time-frame to access the educational module was established (three weeks), allowing some flexibility for accessing the educational module to increase. The goal of the project was to educate as many of the coaching staff as is possible.

In developing the pilot educational program for the coaching staff, the school's athletic trainer was consulted. The trainer works closely with coaches at all levels. He is aware of the knowledge deficits coaches have related to overuse injuries. He was able to provide information to enhance the educational module (M. Townsend, personal communication on July 8, 2016). Consultation with the athletic trainer at Otterbein University also provided guidance on coaching education. The Otterbein University trainer works with athletes who have various disabilities resulting from overuse injuries in high school athletics. The athletic trainer specified information that high school coaches should know (A. Lamentrice, personal communication on August 24, 2016).

Survey Instrument

Data were collected using an online questionnaire. It was developed in Google Forms so that it could be sent to coach participants online. The survey provided some basic demographic information and included several questions that incorporated a Likert-type scale for responses. The survey also incorporated some "yes" and "no" responses to some of the questions. The coaching staff completed the questionnaire before and after the educational intervention. The questionnaire administered prior to the intervention was intended to collect information about coaches' baseline knowledge related to overuse injuries. The questionnaire administered after the intervention measured whether coaches' knowledge about overuse injuries after the educational intervention.

Validity and Reliability

The educational module was reviewed by the athletic trainers at Otterbein University and the target high school and by faculty members on the author's DNP Committee for content validity. Calculating reliability of the instruments was outside of the scope of this translational project.

Protecting the Rights of Human Subjects

Once the author received approval by Otterbein University's Institutional Review Board, a letter was sent explaining the project to the coaches. The letter contained information about consent to participate as well as measures taken to maintain safety and confidentiality of the project participants. The pre-intervention questionnaire included a "consent to participate" at the beginning of the instrument. The consent stated that completion and return of the survey indicated consent to participate in the project. The consent also stated that participation was voluntary and that participants could exit the project at any time. Participants were also guaranteed that all identifying information about them would be kept confidential.

Sample Size and Statistical Methods

Once the post-surveys were collected, data from the pre-survey and post-survey were collated. Incomplete data was deleted. Each respondent was assigned a number so the pre-and post -surveys could be matched one to one. More respondents 47 (n=47) completed the pre-survey. At total of 27 (n=27) respondents completed the post-survey. After matching the respondents' pre-and post-surveys and deleting surveys with incomplete data, the final sample for data analysis was n=20. Matching the respondent's surveys pre- and post- educational module allowed for accurate comparison of the response data. The paired t-test was used to

compare the pre-survey group and post-survey group responses on several variables. The variables were: 1) How knowledgeable are you about overuse injuries? 2) Do coaches play a key role in preventing overuse injuries? and, 3) How much influence do you have in preventing overuse injuries? Using the paired t-test, would statistically determine if there was any change in knowledge among survey respondents following the presentation of the educational module. The paired t-test is considered a powerful test in detecting differences between “before and after” groups in an experiment, especially, when statistically comparing identical samples (CBG’s Marine & Environmental Science 2017; Salkind, 2014).

The demographic data was compiled and analyzed using the mode. Mode reflects which response occurs most frequently and is the best way to look at central tendency for the demographic questions. Mode is used when data is categorical and when values fit into one category such as, “What is your level of education?” Because the response choices in the demographic questions were categorical and were mutually exclusive, mode was the best statistical measure for this data (Salkind, 2014).

For the questions requiring a “yes” or “no” answer, the Test and CI for Two-Sample Proportions was used (Penn State, 2017). Using the paired t-test, the mode for central tendency, and the Two-Sample Proportion test on the appropriate survey questions, would produce a comprehensive understanding of the data. The student’s objective was to use the best data evaluation test for each type of question. The goal was to produce the most accurate and complete understanding of the data possible (CBG’s Marine and Environmental Science, 2017; Penn State, 2017; Salkind, 2014).

The coaching staff was given three weeks to complete the pre-intervention questionnaire. Following the deadline, an online educational module was sent to all coaching staff who responded to the initial survey. Coaches were given three weeks to complete the online educational module. At the end of the three-week time frame, a post-intervention questionnaire was sent to the initial survey respondents and returned within a three-week timeframe.

The responses from the pre- and post-intervention questionnaires were tallied. Other data collected from athletic trainers was the number of overuse injuries documented by the athletic trainer at the high school between December 1, 2015 and March 1, 2016. Following the educational intervention, the author reviewed the record of overuse injuries between December 1, 2016 and March 1, 2017 to determine if a reduction in injuries has occurred after the educational intervention (Townsend, M.; personal communication on July 8, 2016).

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Analysis and Outcome Evaluation

The twelve questions in the survey were designed to elicit specific types of information. Six questions requested demographic information. These questions were; What sport do you coach? Do you coach boys or girls? What level of sport do you coach? How long have you been a coach? What type of education or training have you had as a coach? and, Have you had formal training on overuse injuries? Four questions elicited information pertaining to the coaches' knowledge of overuse injuries and prevention strategies. These questions were: Are you knowledgeable about overuse injuries? How much influence do coaches have on preventing overuse injuries? Do coaches play a key role in preventing overuse injuries? and, Do you feel equipped to prevent overuse injuries in high school athletes? One question asked whether or not the coach had encountered overuse injuries in adolescent athletes. A follow-up question asked "How many injured athletes have you encountered?" The final question involved a short answer response. The question asked was, "What type of education or training do coaches need to prevent and reduce overuse injuries in athletes? The surveys were designed to provide information about whether the educational intervention increased coaches' knowledge about overuse injuries and prevention strategies.

Analysis of Survey Data

In reviewing the demographic data, the majority of coaches had been coaching sports for six years or longer and held a bachelor's degree in a subject other than health. The most frequent respondents were coaches of varsity sports. Coaches of football and boys sports responded most frequently as well (**See Table 3**). The fact that well-educated experienced coaches participated in the pilot study indicates the concern about and the need to address overuse injuries.

The paired t-test was used to determine whether a change in coaching knowledge occurred as a result of the pilot educational module. The results of the paired t-tests revealed that there were no statistically significant differences between the pre-survey and post-survey results **(See Table 1)**. The interesting fact is that when the pre-survey and post-survey data are displayed on a bar graphs, the post-survey graph reflects a slight increase in knowledge following the educational intervention **(See Appendices A-C)**. While the data from the paired t-test implied that the educational module did not significantly change coaches' knowledge, the bar graph reveals that some knowledge change occurred.

The p value for data analysis was set at 0.05. Because the p-values in each of the paired t-tests was greater than the set p-value of 0.05, there were no statistically significant differences in coaches' knowledge when comparing post-survey responses to pre-survey responses. The data for the question, "do coaches play a key role in preventing overuse injuries? may reflect some change in coaches' knowledge with a p-value of 0.058 which is very close to the p-value of 0.05 **(See Table 1)**.

The Two-Sample Proportion test was used to the compare pre- and post-survey variables of "Have you had formal training on overuse injuries?", "Do you feel equipped to prevent overuse injuries?", and "Have you had experience in the past year with injured athletes?" These questions all required a "Yes/No" response. After completing the two-sample proportion test for the three questions (categorical variables) identified, it appears that the educational intervention had minimal effect on coaches' responses to the questions. The pre-and post-survey results were similar for both populations and the p-value for the two-sample proportion test was greater than 0.05 when testing all three variables **(See Table 2)**.

As with the data analyzed using the paired t-test, data used in the two sample proportion analysis was graphed. While the two sample proportion results show no statistically significant changes between the pre-and post-survey samples, the bar graphs show otherwise (**See Appendices D-F**). When reviewing the short answer responses, the author noted that the majority of coaches believed continuing education was essential for keeping them abreast of current trends in sports safety and coaching strategies. Half of the respondents wanted updates about overuse injuries and prevention. Two coaches recommended certification in a specific sport. Some of the coaches wanted to know more about signs of overuse injuries and when to pull a player out of a game. One coach recommended working with parents and athletes to educate them about playing sports year around with no time for the body to recover from physical stress. Coaches also suggested the need for athletes to work closely with the athletic trainer who will provide workouts and stretches to help with injury prevention.

Sports Injury Data

After collecting and collating the survey data, the author met with the high school athletic trainer to review data on student injuries before and after administration of the educational module. The author wanted to know if there was any change in student injury rate following the educational offering presented to coaches. Injury data was obtained from the time periods of December 1, 2015 to March 1, 2016 and December 1, 2016 to March 1, 2017. The time frame for data collection on injuries was the same length of time before and after the educational intervention. Maintaining consistent time frames was an effort to control for any factors that would affect results. The number of athlete injuries at the high school was 50 during the December 1, 2015 to March 1, 2016 data tally. The number of injuries during the December 1,

2016 to March 1, 2017 was calculated to be 44. The number of student athletes injured was lower after the educational intervention than before the intervention (M. Townsend, personal communication on March 1, 2017).

Outcome Analysis

In reviewing the data, the number of coaches who responded to the pre-survey was much larger (n=47) compared to the number of coaches responding to the post-survey (n=27). The diminished number of post-survey responses may have been due to several factors. The first factor is that the post-survey was administered in December when end of the academic semester occurs as well as the end of fall sports. There are exams and projects to be developed and graded (many coaches are classroom teachers). A second factor may have been end of the season sporting activities such as play-off games and banquets occur in the late fall. A third factor was the holiday season. This may have affected the number of responses as coaches may have been preoccupied with social and family events.

The use of descriptive statistics was beneficial to understanding the characteristics of the coaches who participated in the project. While the coaches who participated were involved in 15 different sports, mode revealed that football was the most frequently occurring sport in terms of coaching staff participating in the project. Data analysis also revealed a majority of coaches had been coaching for more than five years and held a bachelor's degree in a subject area other than health. Most coaches oversaw varsity athletes based on the frequency of responses under "level of sport coached." In looking at the gender of athletes coached, participants coaching male athletes occurred more frequently than those who coached female athletes (**See Table 3**). The

interesting finding from the data analysis is that most the coaches participating in the project were varsity level coaches with many years of coaching experience.

While the paired t-tests and the Two-Sample Proportion tests showed no statistically significant differences between the pre-survey and post-survey sample populations, the author believes the project was beneficial in terms of educating coaches about overuse injuries. The author had anticipated that the educational module would show a change in knowledge among coaches at the high school following the educational intervention. While some knowledge change may have occurred, the data did not reflect a significant difference in knowledge between the pre- and post-survey populations. The lack of significant change in knowledge may be attributed to several factors. The first factor is that this public school highly values the athletic program and invests a lot of money into the program. Per the both the athletic director and the athletic trainer, coaches receive extensive training including CPR, first aid, and concussion recognition training (D. Cullen, personal communication on August 12, 2016 and M. Townsend, personal communication on July 8, 2016). These coaches are heavily invested in the athletes they coach, many may have become aware of overuse injuries and the need to prevent these injuries. Another factor may be that, as predominantly seasoned coaches, the coaches participating in the project may have had a self-perception of being knowledgeable about overuse injuries prior to the administration of the educational module. Whether this was the reality, their self-perception would have affected the project findings. A third factor is that more information is being produced by the National Association of Athletic Trainers about overuse injuries. The athletic trainer at the high school works closely with coaching staff and is

continually communicating current information about safety in coaching. This may have influenced the survey results as well (M. Townsend, personal communication on July 8, 2016).

Review of the survey data indicated that some of the coaches participating in the surveys may have overestimated their confidence about knowledge about overuse injuries. Although the pre- and post-survey results show that negligible knowledge change occurred as a result of the educational intervention, a majority of coaches responded that there is a need for continuing education. Overuse injury was a specific topic requested by coaches for continuing education. There is an indication that some of the coaching staff feel they need more education about overuse injuries. This information may indicate that the educational module may influenced coaching knowledge more positively than the paired t-test results reflected.

Although the project did not produce significant changes in coaching knowledge at the high school in which it was conducted, the author believes that conducting the project at other secondary schools could produce different results. Both rural and urban/suburban schools, with less emotional and financial investment in athletic programs, might show more significant project results. Coaches who receive less rigorous training and education may benefit from the educational module developed for the project. Thus, the change in knowledge among those coaches would most likely be significant.

Because the educational module developed in the pilot project has the potential to change coaching knowledge and to reduce and prevent overuse injuries, the project is regarded as beneficial. Replicating the project in other schools would be the best means of determining its effectiveness. By replicating the program, the author would not only potentially increase

coaching knowledge about overuse injuries, but the student would reinforce the message that overuse injuries are a real health concern for adolescent athletes.

Financial Implications

Sports injuries, including overuse injuries, create a significant economic burden upon healthcare systems, communities and families. These injuries produce both direct and indirect costs. Direct costs are the cost of using health care resources to prevent, detect, and treat an injury. Indirect costs include loss of time from work (parents or athlete), school, or sports participation (Ozturk & Kilic, 2013). Other indirect costs to consider are: 1) disability from injury (potentially long-term); 2) psychological impact of not being able to participate in a sport; 3) long-term health consequences-i.e. chronic pain or arthritis; 4) perceived loss of social status and position among peers; 5) sense of isolation from inability to participate on the sports team; 6) insurance expenditures; and 7) potential legal expenses (Ozturk & Kilic, 2013; Korkmaz, Kilic, Catikkas & Serdar, 2014).

The financial burden of sports injuries in high school athlete is supported by a study conducted by epidemiologists at the University of North Carolina at Chapel Hill (Knowles et al., 2007). The study involved student athletes from 100 high schools statewide. To estimate the cost of injury, an injury cost-model (Revised Injury Cost-Model) was employed. The economic costs of injuries were based on mean costs for adolescents aged 15-19 (Knowles et al., 2007). Three specific costs were estimated. They were: medical costs, earnings, and reduced quality of life. These costs were factored into these categories: medical costs, human capital [medical costs + loss of future earnings], and comprehensive costs [medical costs + loss of future earnings + reduced quality of life costs] (Knowles et al., 2007).

After factoring the costs based on the three categories, the overall cost for sports injuries was calculated. The costs were based on adjusted means. The medical cost per injury was \$709, the human capital cost per injury was \$2223, and the comprehensive cost per injury was \$10432 (See **Appendix G**). The total medical cost of high school sports injuries in the study population was \$940,608. Total annual human capital cost was \$4.2 million and total annual comprehensive cost was \$13.7 million respectively. Knowles et al. found that the cost of sports related injuries in high school athletes is often underestimated. Most studies attempt to quantify medical costs by reviewing insurance claims retrospectively. Thus, medical costs are underestimated because only injuries for which an insurance claim was filed are included. Other factors that must be considered in calculating the total economic burden of sports injuries in high school athletes are lost wages and reduced quality of life (Knowles et al., 2007).

Reimbursement Sources for Health Care Expenditures

In considering the cost of injuries on families, the community, and the healthcare system, it is necessary to look at how health care costs are paid for. Money from a variety of sources cover hospital, health care provider, and other health service expenditures. The monetary sources include: the government; insurance; managed care companies, and individual payers (Waxman 2013). Government insurance programs (Medicaid and Medicare) and private insurance consider the risk for certain diagnosis as they determine what medical conditions they will cover. Private insurance companies base premiums and co-pays on risk of occurrence of various conditions. If the incidence of occurrence is greater than the projected risk, the insurance company may lose money. To offset financial loss, insurance companies pass the increased expenses onto the consumer via increased premiums and copays (Waxman, 2013).

Effect of Sports Injuries on the Insurance Industry

The rise of sports injuries in youth, including overuse injuries, has increased the rate of risk to be considered by insurers. Per both Safe Kids Worldwide (2012) and U.S.A. Today (2013), 1.35 million children and adolescents are seen in the emergency room annually for sports injuries. The estimated cost of sports injuries among youth is \$ 935 million per year [Safe Kids Worldwide (2012) & U.S.A. Today, (2013)]. As the rate of youth sports increases, the cost to government insurance plans, private insurance plans, and managed-care plans has increased. The cost increase is passed on to individuals and families via higher premiums and co-payments for health care services. The public subsidizes government insurance via increased taxes (Waxman, 2013).

In considering health insurance coverage for overuse injuries, the author reviewed a private insurance plan (United Healthcare PPO from Pennsylvania) and (Medicaid). The UnitedHealthcare plan covered all orthopedic services with a 10% copay for in-network providers and a 30% copay for out-of-network providers (United Healthcare PPO, 2014). Medicaid covered most services required for sports injuries including hospitalization, doctor/nursing services, outpatient services, non-emergent transportation, and physical therapy. Some services may require prior authorization, but essential services are covered (Georgia Department of Community Health, 2016). As the risk for sports injuries increase, the demands for health services increase also. The increased need for services will increase cost to both the insurer and the consumer. The insurer will have to increase rates which will be passed onto the consumer as increased premiums and copays. Government supported health insurance plans will

require an increase in tax support at the state and federal level. These tax increases will be passed onto individuals as well (Waxman, 2013).

The Impact of Overuse Injuries on Families and Communities

Considering both the direct and indirect cost of overuse injuries, these injuries have a great financial impact on society. Not only do sports injuries result in a huge financial burden on the United States Healthcare system, but it presents economic stressors on families and communities as well. Along with the financial stress of overuse injuries, there are indirect costs resulting in stress. Athletes incur time lost from sports participation and school. Often they face the psychological challenges from not participating in a sport, isolation, and loss of social status. While many injured athletes suffer short-term disability from injury, some athletes incur long-term consequences including chronic pain, arthritis, and the inability to participate in sports in the future (Ozturk & Kilic, 2013; Korkmaz, Kilic, Catikkas & Serdar, 2014).

Sports injuries, including overuse injuries, have a significant impact on health care expenditures and finance in the United States. Not only do such injuries increase direct healthcare costs, they dramatically affect the quality of life of both individuals and their families. When adolescents incur a sports injury, parents take time away from work, students miss school (academic time), and the athlete misses time away from athletic participation. The overall effects are economical, sociological, and psychological (Korkmaz, et al., 2014).

The key to reducing the financial burden of overuse injuries in adolescence is prevention. Research on overuse injuries and the development of prevention strategies for these injuries are essential. A multidisciplinary approach is required as well. Health care providers, policy makers, and community members must work together to develop strategies to reduce the

financial burden of sports injuries. Reducing the financial burden of overuse injuries is of benefit to individuals, communities, and society overall (Waxman, 2013). Overuse injuries not only affect the quality of life of young athletes but also place a huge financial burden on families, health insurers, government agencies, and society. The pilot project was aimed at preventing and reducing overuse injuries by educating high school coaches. Education of coaches and other stakeholders in youth sports is promoted as the key method of preventing and reducing overuse injuries (American Academy of Pediatrics, 2015; Andrews, 2011; Biber & Gregory, 2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; McLeod et al., 2011; Schroeder et al., 2015).

Barriers and Facilitators

During implementation of the project, potential barriers were inherent. Barriers were: 1) resistance by coaches to participate in the project; 2) incomplete data based on rate of survey return; and 3) time constraints between the educational intervention and follow-up review of injury rates. The student was cognizant of these barriers and initiated steps to prevent such barriers when possible. One intervention was sending e-mail reminders to complete the surveys and another measure was to utilize the athletic director's support in encouraging coaching staff to participate in the project. A final incentive to encourage coaches to participate in the project was offering a gift card to a local bakery as an incentive for participation.

Facilitators for the project were the athletic trainer and the athletic director who have a vested interest in reducing overuse injuries in the athletes at the high school. Both acknowledged the value of the project and committed to supporting the project. The school librarian, who is a certified Google Trainer, facilitated the project by assisting with the development of the online surveys and the online educational module. Other facilitators for the project included a faculty

member at Otterbein who teaches statistics and a statistician employed by The Ohio State University (B. Harper, personal communication on March 3, 2017; G. Young, personal communication on February 12, 2017). These statistical experts provided guidance about what type of statistics and data analysis programs were appropriate for analyzing the survey data. A final person that helped facilitate the project was the athletic trainer at Otterbein University who provided input on the development of the project (A. Lamentrice, personal communication, August 24, 2016).

Summary

Overuse injuries are a significant health problem that affects the health and well-being of adolescent athletes. Almost 50 percent of sports-related injuries in the adolescent population are due to overuse injuries (The American Academy of Orthopedic Surgeons, 2009). Approximately half of overuse injuries are preventable (The American College of Sports Medicine, 2011). In defining overuse injuries, these injuries are chronic injuries that occur, over time, when repetitive demands on the musculoskeletal system results in tissue damage (Yang, Tibbetts, Covassin, Cheng, Nayar, & Heiden, 2014; American Academy of Pediatrics, 2015).

Because of the tissue damage that occurs with overuse injuries, many young athletes suffer long term consequences from their injuries. Some of the consequences are: disability in the affected limb; osteoarthritis; and burnout. Emotional burnout and injury frequently results in athletes refraining from sports participation which can lead to further health consequences. Depression from being isolated from peers and health effects of a less active lifestyle are some of the consequences (American Academy of Pediatrics, 2015; Andrews, 2011; Biber & Gregory,

2010; DiFiori, 2010; DiFiori et al., 2014; Geier, 2011; McLeod, et al., 2011; Schroeder et al., 2015; Wheaton, 2010).

The financial implications of overuse injuries are great. A total of 4.3 million dollars (Knowles et al., 2007) are spent on human capital annually [skills, knowledge, and intangible assets that benefit the individual, employers, or the community] (Dictionary.com., 2017). Overall, a total of 13.7 million dollars are spent on comprehensive care for overuse injuries (Knowles et al., 2007). The financial burden of overuse injuries is not only related to direct costs [copayments, public and private insurance costs, and other expenditures], but it is related to indirect costs. Such costs are student time away from school, sports practice, and work. Parent time away from work is considered a financial burden as well (Ozturk & Kilic, 2013). Because of the financial burden of overuse injuries, prevention of such injuries must be addressed.

Conducting a needs assessment and a thorough review of the literature facilitated the development of a strategy to prevent overuse injuries. As both an advocate for adolescent health and a champion for facilitating health services in a local public school district, the author viewed reduction and prevention of overuse injuries as a health concern that needed to be addressed.

The purpose of the pilot project was to educate coaches on overuse injuries in high school athletes in hopes of reducing and preventing these injuries. Experts in overuse injuries have found that education of key stakeholders in youth sports, especially athletic coaches, is the best way to reduce and prevent such injuries.

Because education of key stakeholders is the recommended intervention to preventing and reducing overuse injuries, a pilot educational module was developed to use with high school coaching staff. The goal of the project was to increase coaches' knowledge about overuse

injuries and how to prevent such injuries. The population for the project was the coaching staff at a local suburban high school. The project involved a pre-survey (determining coaches' knowledge of overuse injuries), a pilot educational module on overuse injuries, and a post-survey (determining change in coaches' knowledge). The goal was to measure change in coaching knowledge after the educational intervention. The desire was to increase coaching knowledge and to decrease overuse injuries because of the educational intervention.

Upon completion of the project, no statistically significant differences between the pre-survey and post-survey results were observed. This result may have been due to high level training of coaching staff at the specific high school. The seasoned coaching staff (predominantly 6 years or more of experience) may have also believed they are knowledgeable about overuse injuries so underestimated their knowledge level about preventing such injuries which would have limited change in knowledge. The final factor that may have limited change in coaching knowledge is the fact that the local athletic trainer is very aware of information about preventing overuse injuries in high school athletes and keeps coaches abreast of training, conditioning, and prevention strategies for high school athletes.

Because the high school coaching staff is well- educated, well-trained, and experienced (years coaching), the results of the pilot project may have been skewed. Less experienced, less educated coaching staff may benefit to a greater degree from the educational module than the coaching staff at the school in which the project was conducted. Reproducing the project to prevent overuse injuries may produce a different result in another population of coaches. The plan is to replicate the project with other coaching populations. Not only would this provide the opportunity to improve both the project content and implementation, more coaches would be

educated on the significance of overuse injuries and strategies to prevent the injuries. There are plans to disseminate information on the importance of addressing overuse injuries and developing multifaceted prevention strategies at school health conferences and at various adolescent health events also.

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Appendix

Table 1

Table of Paired t-test results

How knowledgeable are you about overuse injuries?	<p> N Mean StDev SE Mean 20 3.950 0.686 0.153 20 3.750 0.851 0.190 Difference 20 0.200 1.152 0.258 </p> <p> 95% CI for mean difference: (-0.339, 0.739) T-Test of mean difference = 0 (vs ≠ 0): T-Value = 0.78 P-Value = 0.447 </p>
Do coaches play a key role in preventing overuse injuries?	<p> N Mean StDev SE Mean 20 4.450 0.686 0.153 20 4.000 0.918 0.205 Difference 20 0.450 0.999 0.223 </p> <p> 95% CI for mean difference: (-0.017, 0.917) T-Test of mean difference = 0 (vs ≠ 0): T-Value = 2.02 P-Value = 0.058 </p>
How much influence do you have on preventing overuse injuries?	<p> N Mean StDev SE Mean 20 4.000 0.918 0.205 20 3.950 0.826 0.185 Difference 20 0.050 0.945 0.211 </p> <p> 95% CI for mean difference: (-0.392, 0.492) T-Test of mean difference = 0 (vs ≠ 0): T-Value = 0.24 P-Value = 0.815 </p>

Table 2

Table Displaying the Test and CI for Two-Sample Proportions

Have you had formal training on preventing overuse injuries?	<p>Sample X N Sample p</p> <p>1 2 47 0.042553</p> <p>2 2 27 0.074074</p> <p>Difference = p (1) - p (2)</p> <p>Estimate for difference: -0.0315209</p> <p>95% CI for difference: (-0.145925, 0.0828833)</p> <p>Test for difference = 0 (vs ≠ 0): Z = -0.54 P-Value = 0.589</p>
Have you had any experience with injured athletes?	<p>Sample X N Sample p</p> <p>1 2 45 0.044444</p> <p>2 2 25 0.080000</p> <p>Difference = p (1) - p (2)</p> <p>Estimate for difference: -0.0355556</p> <p>95% CI for difference: (-0.157763, 0.0866519)</p> <p>Test for difference = 0 (vs ≠ 0): Z = -0.57 P-Value = 0.569</p>
Do you feel equipped to prevent overuse injuries?	<p>Sample X N Sample p</p> <p>1 2 42 0.047619</p> <p>2 2 25 0.080000</p> <p>Difference = p (1) - p (2)</p> <p>Estimate for difference: -0.0323810</p> <p>95% CI for difference: (-0.156708, 0.0919462)</p> <p>Test for difference = 0 (vs ≠ 0): Z = -0.51 P-Value = 0.610</p>

Table 3

Characteristics of Coaches Based on Most Frequent Responses

Variable (characteristic)	Mode-reveals most frequent response
Sport coached	Mode= 3 (football)
Level of sport coached	Mode=3 (varsity)
Length of time coaching	Mode= 3 (6-10 years)
Type of education received	Mode= 2 (bachelor's degree in area other than health)
Gender of sport coached	Mode=1 (boys)

Figure 1.

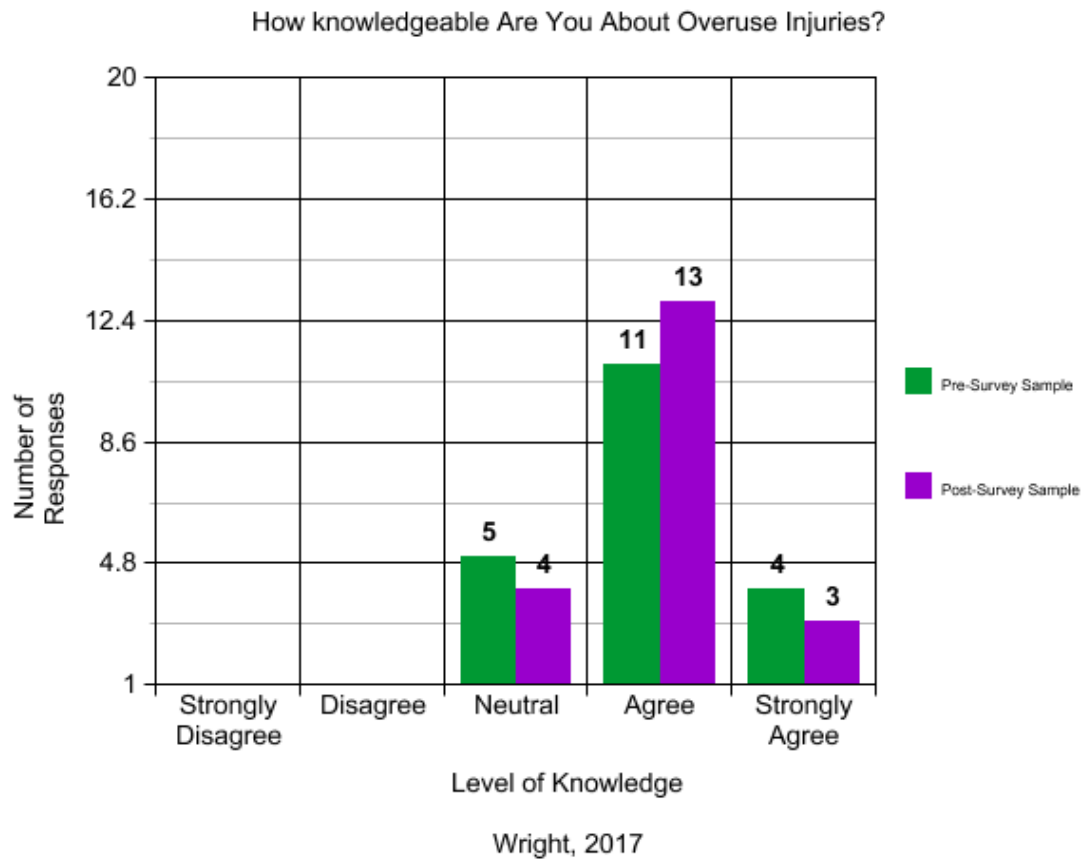


Figure 2.

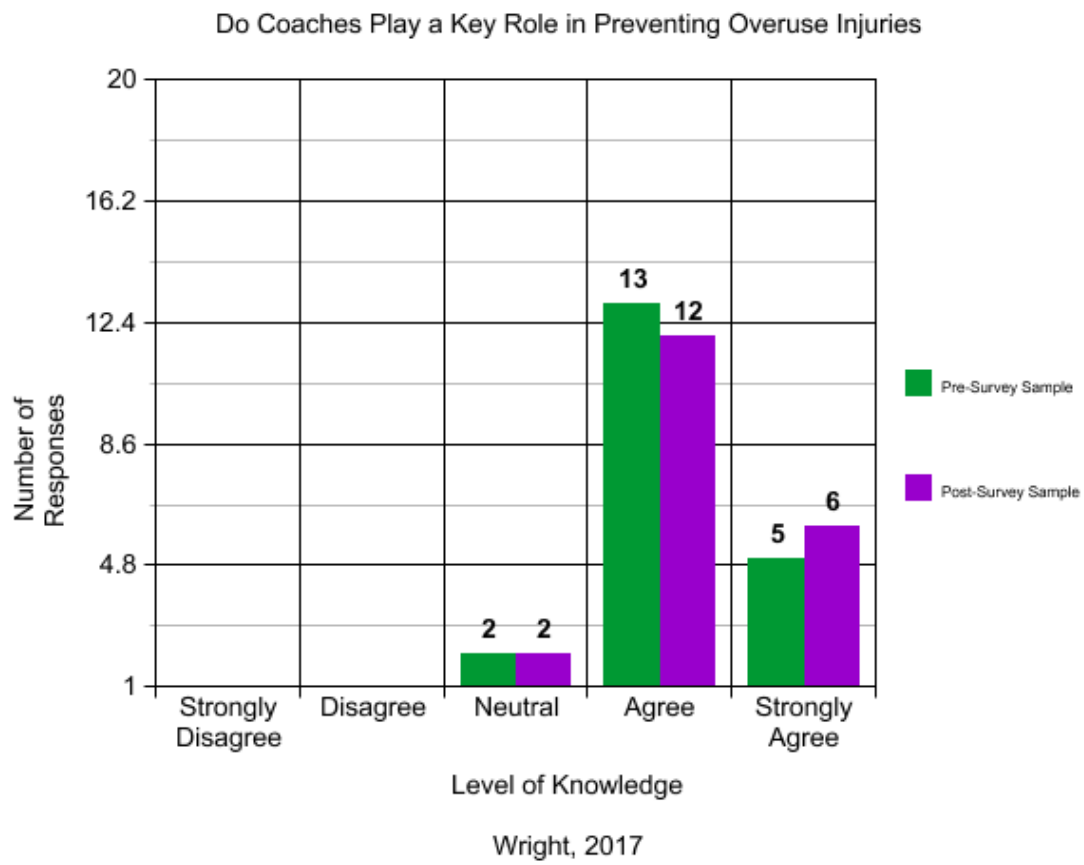


Figure 3.

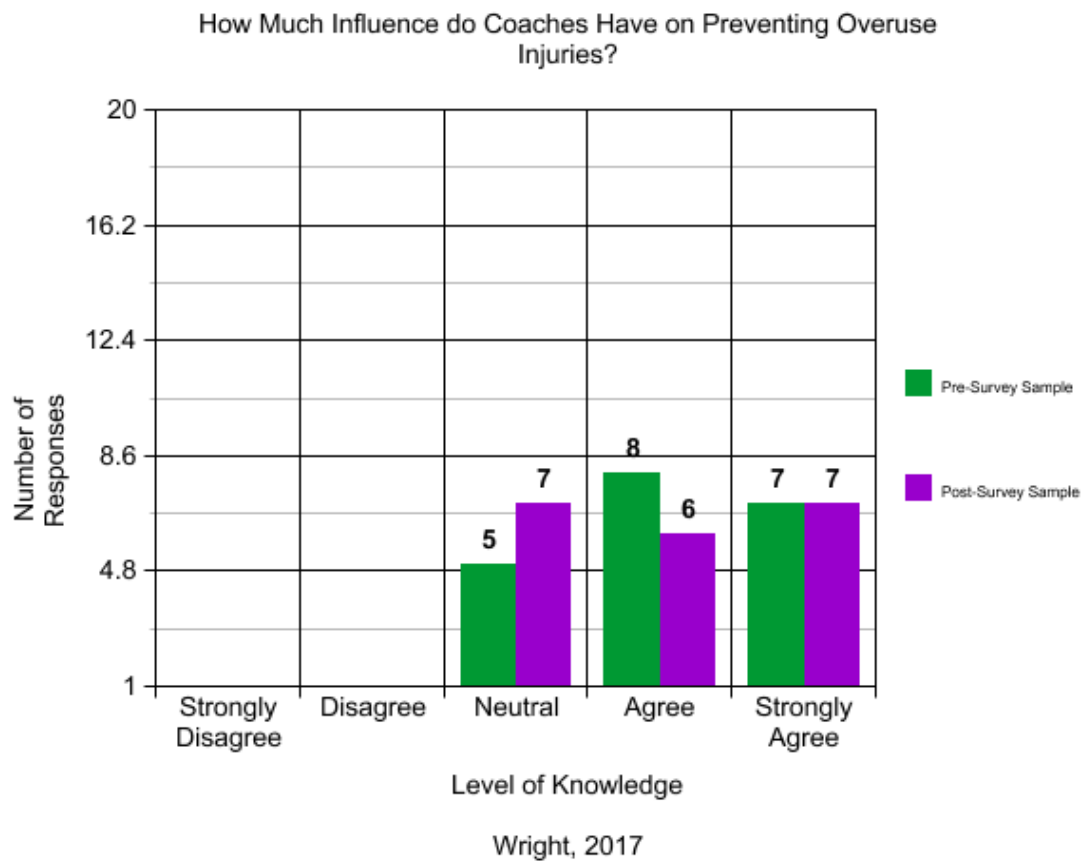


Figure 4.

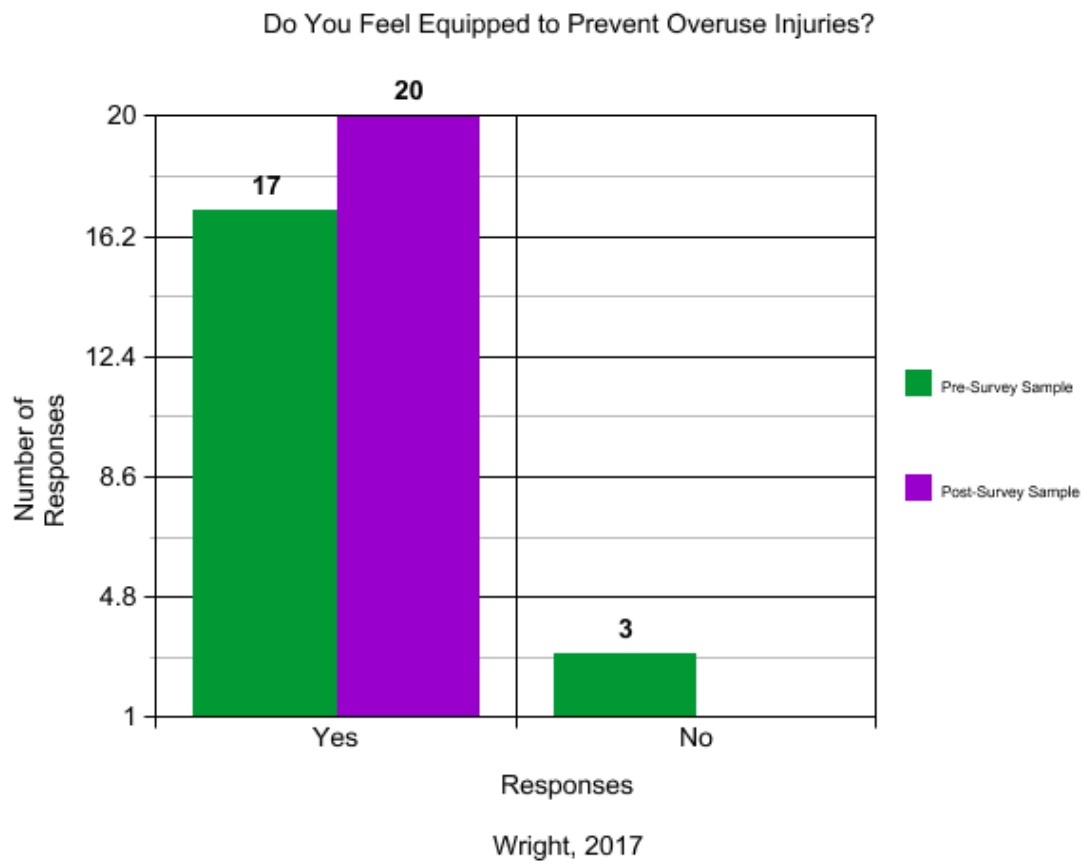


Figure 5.

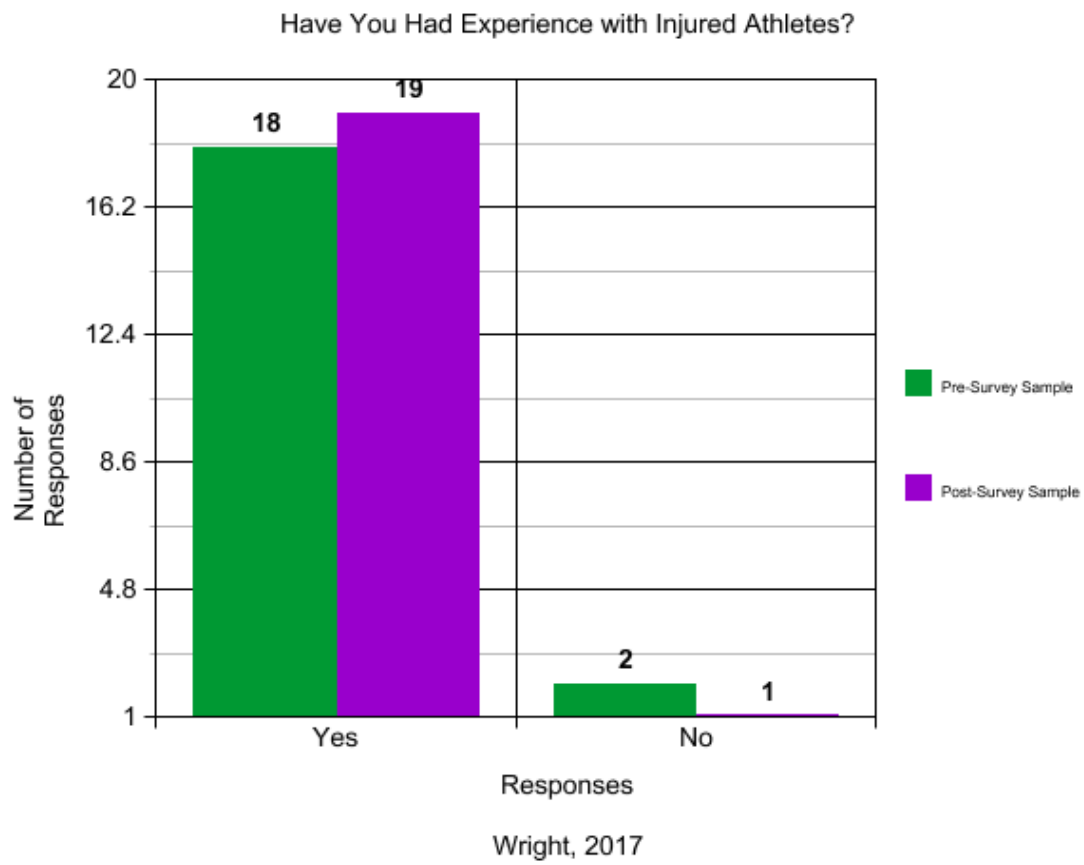
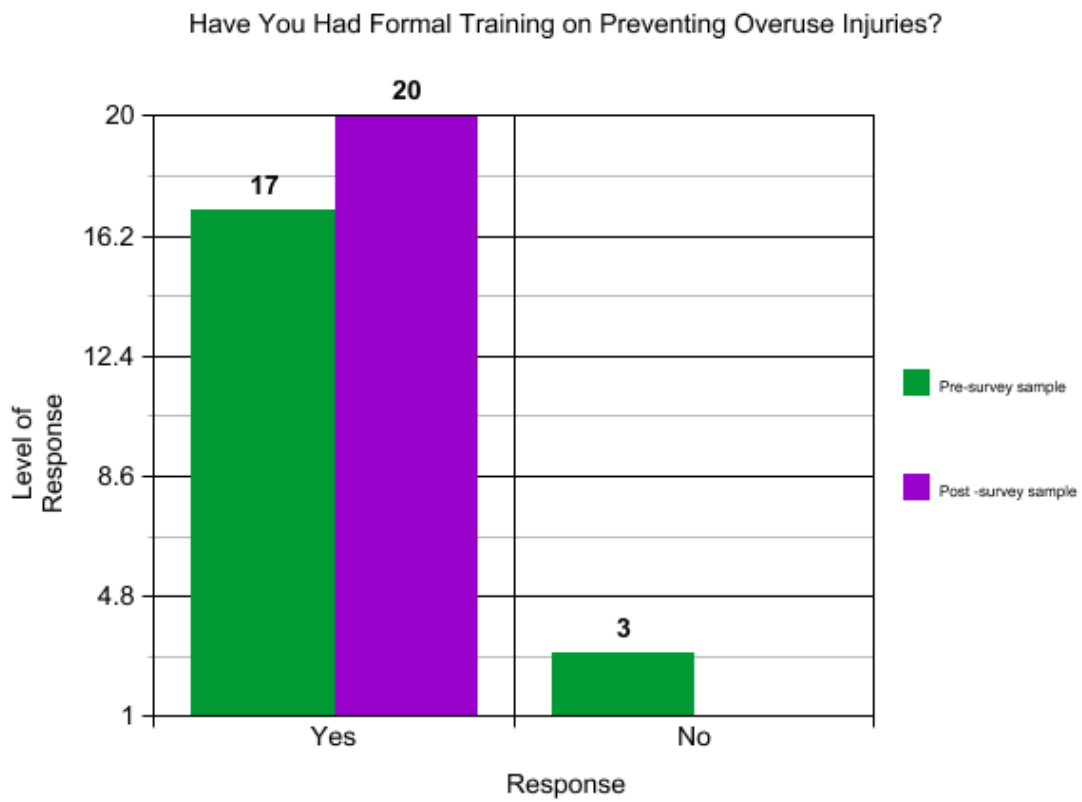


Figure 6.



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Figure 7.

