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Sports Specialization and Injury Prevalence

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SPORTS SPECIALIZATION AND INJURY PREVALENCE

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ABSTRACT

This retrospective study examines musculoskeletal injury prevalence rates among high school athletes. Specifically, it examines if there is a higher injury prevalence amongst single sport athletes compared to multi-sport high school athletes. Also, it looks at injury prevalence by gender to determine if male or female athletes are more prone to injuries. The population for this study consisted of student athletes from Bethel University in Arden Hills, Minnesota. In order to qualify for the study the athletes must have participated in a State High School League sanctioned sport prior to competing at the collegiate level. Consent forms and questionnaires were administered to the athletes that chose to participate in the research study. The questionnaire allowed us to obtain minor demographical information such as the athlete's age, gender, and year in school, as well as information on the number of sports they played and any potential injuries they may have sustained while competing in a high school sport. Surveys were analyzed to see if there was any statistical significance between single and multi-sport athletes in regards to injuries, as well as gender and injury prevalence. The researchers received 28 completed questionnaires (19 male participants and 9 female participants). Of the 28 participants there were 16 multi-sport athletes and 12 single sport athletes. Using Phi Correlation Tests the researchers determined there was no significant correlation between injury prevalence and single sport athletes. Also, the data did not show a significant difference in injury prevalence amongst male and female athletes. Going forward, more research is needed to determine if sports specialization puts young athletes at an increased risk of injury prevalence.

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Chapter 1: Introduction

Introduction

Overuse injuries in the pediatric population is becoming more and more of a concern. Athletes are starting to specialize in one sport at an early age which potentially puts them at an increased risk for injuries due to repetitive micro-trauma (Anderson et al., 2000). This chapter will provide the reader with background information on high school athletes and sports specialization. It also contains the problem statement, research questions, and significance of the problem, as well as a definition of terms frequently used in the study.

Background

The percentage of student athletes that are specializing in one specific sport has grown significantly in recent years. Along with a rise in sport specialization, sports-related injuries have also shown a dramatic increase. According to a position statement from the American Medical Society for Sports Medicine, the current trend of sports specialization in youth sports is related to several adverse effects on young athletes and has contributed to the recent growth of the sports medicine specialty (DiFiori et al., 2014). Sports medicine and orthopedic practices across the country are creating advertisements that are marketed towards the youth population in an attempt to capture the rising population of young athletes with sports related overuse injuries (Jayanthi, Labella, Fischer, Pasulka, Dugas, 2015). Recent studies have shown that the increase in sports-related injuries, specifically overuse injuries, in student athletes is directly related to sport specialization (Jayanthi et al., 2015).

Significant research has been conducted to determine if there is a correlation between the increase in sports related injuries and the prevalence of sports specialization at young ages. Participation in high school athletics is at an all-time high. According to the National Federation

of High School Associations, over 7.8 million students participate in athletics. That is nearly 60% of all high school students in the United States (National Federation of High School Associations, 2014). High school athletics are an excellent opportunity for student athletes to get exercise, learn sportsmanship, develop leadership skills, and socialize with peers in a safe environment (Minnesota State High School League, 2015). High school sports are also known to bring communities together, as stadiums and gyms are often packed with community members coming to watch high school athletics.

Along with all of the benefits of high school athletics, there are negative aspects as well. High school athletes already feel the need to perform at a high level and are constantly striving for perfection. This can lead to anxiety and feelings of inadequacy if they do not achieve their goals (Patel et al., 2010). Also, students may be pressured to participate in year round intensive training from external sources like parents and coaches. This pressure may be why children are engaging in high intensive training and sports specialization at younger ages (Baxter-Jones, Maffulli, 2003).

Sport specialization is defined as year round intensive training in one particular athletic activity (Johnson, 2008). Traditionally in the United States, this was a rare occurrence. A small population of high school athletes may have specialized in a particular sport, but the majority of athletes would participate in multiple sports depending on their interests and abilities (Jayanthi, Pinkham, Dugas, Patrick, LaBella, 2013). Today, there is a growing rate of young, multi-sport athletes that are deciding to focus on one sport year round. Often times these athletes will play on select teams that travel the state, or country, during the offseason, and play for their high school team during the main season (Johnson, 2008). The main intention of becoming a sport-specialized athlete is to gain an advantage in that particular sport and potentially play it at the

collegiate or professional level (Hill, Hall, Appleton, 2010). Many young athletes that dream of competing at the highest level will decide to specialize in a sport based on their personal goals. Unfortunately, recent studies have shown that young athletes often become specialized in a sport due to outside influences that may not always have the athlete's best interests in mind (Hill et al., 2010). The main three influences for specializing in a particular sport across all major athletic activities are coaches, parents, and the athlete's personal interest (Baxter-Jones, Maffulli, 2003).

With the rise in sports-related injuries, overuse injuries have been found to be the most common (Brenner et al., 2007). An overuse injury is trauma caused by the excessive or repetitive use of a muscle, tendon, bone, or joint (Prentice & Arnheim, 2011). Unlike acute sports-related injuries (concussion, fracture, torn ligament, etc.), overuse injuries develop over time. Some of the most common sports-related injuries in athletes of all ages include: achilles tendinitis, shin splints, patellofemoral pain, epicondylitis, and ulnar collateral ligament (UCL) damage. Overuse injuries are especially common in major league baseball (MLB). Pitchers in the MLB are some of the most specialized athletes in the world, as they repeat the same motion hundreds of times a day for most of the year. This puts pitchers at a much higher risk of developing UCL damage compared to the positional players (Petty et al., 2004). Similar types of injuries have been seen in young baseball players that specialize as pitchers early in their playing careers. Over-training as a pitcher puts far more stress on a young athlete's elbow due to the excessive amount of repetitions throwing a baseball (Petty et al., 2004). Overuse injuries are not only seen in baseball. Many young athletes that specialize in other sports are also at a high risk of overuse injuries due to the increased volume of repetitive movements.

Along with sports-related injuries, social and psychological problems may also be associated with sport specialization. One theory regarding sport specialization is that the athlete

may “burnout” and become uninterested in an activity they previously enjoyed (Brenner et al., 2007). Burnout is defined as a state of physical, mental, and emotional exhaustion (Johnson, 2008). This could prevent athletes from participating in healthy, recreational activities later in life (Johnson, 2008). Also, a young athlete that specializes in one sport may miss out on many social opportunities with their peers. This is particularly a concern in individual sports where the athlete spends most of their time with a coach or parent (Atkinson, 2014). In addition, the pressure on young athletes to succeed has been shown to have adverse effects on their mental health and may even lead to severe problems such as anxiety, drug use, and depression (Brenner et al., 2007).

Problem Statement

Athletes are specializing in sports at a young age (prior to high school). Currently, there are more and more athletes being pushed by parents, coaches, and even peers to be bigger, faster, and stronger. With the pressure to be “great,” some athletes are specializing in one sport at an early age. The American Academy of Pediatrics has stated that, "Young athletes who specialize in just one sport may be denied the benefits of varied activity while facing additional physical, physiologic, and psychologic demands from intense training and competition” (Anderson et al., 2000, p. 115).

Research Questions

1. What significance, if any, does the degree of early (prior to high school graduation) sports specialization have on young athletes in regards to musculoskeletal injury prevalence?
2. What significance, if any, does gender have on injury prevalence among specialized high school athletes?

These research questions will help determine if there is any correlation between sports specialization and injury prevalence. Also this study will demonstrate if gender plays a role in injury prevalence among young, single sport athletes. The results will help us to determine what further research needs to be done on the effects of sports specialization, and if more specific education needs to be given to athletes, coaches, and parents.

Significance of the Problem

Prior research on this topic has shown a possible correlation between early sports specialization and an increased risk of overuse injuries and burnout in athletes. This study may help support the current literature and it may allow us to further educate athletes, coaches, and parents. The goal of this study is to help minimize the risk of injuries and burnout in young athletes.

Definitions

Sports specialization is defined as year round training in one specific sport with limited or no rest (Johnson, 2008).

Acute injury can be defined as a physical injury of sudden onset and severity which may require immediate medical attention (Prentice & Arnheim, 2011).

Overuse injury can be defined as excessive use or repetitive trauma caused by, but not limited to, running, throwing, or jumping (Prentice & Arnheim, 2011).

Sports periodization is defined by Prentice and Arnheim as, "An approach to conditioning that brings about peak performance while reducing injuries and overtraining in the athlete through a conditioning program that is followed throughout the various seasons" (Prentice & Arnheim, 2011, p. 116).

Burnout is defined as a state of physical, mental, and emotional exhaustion (Johnson, 2008).

For the purpose of our study, we are categorizing the athletes into groups: single sport athletes and multi-sport athletes. Single sport athletes are those who only participated in one high school sport from 10th grade through the end of their high school career. Multi-sport athletes played two or more high school sport from 10th grade and on.

Chapter 2: Literature Review

Introduction

In recent years youth sports have become increasingly more competitive. Traditionally athletes would participate in multiple activities over the course of a year, but in order to stay more competitive some athletes are deciding to quit certain activities in order to focus on one sport year round. This phenomenon is starting to make multi-sport athletes a thing of the past. Unfortunately athletes who focus on one sport early in life may be at an increased risk of injury and burnout according to the latest research. This chapter will provide a review of the current literature regarding sports specialization, overuse injury prevalence, burnout, injury prevention, and sports periodization.

Sports Specialization

Participation in athletics is at an all-time high for children and adolescents. According to Atkinson (2014), author of the article "How parents are ruining youth sports," an estimated 45 million school-aged kids participate in some form of organized sport in the United States (Atkinson, 2014). Sports often provide children with a safe and enjoyable environment where they can socialize with their peers and learn key values like teamwork and sportsmanship. Brenner et al., (2007), authors of the clinical report "Overuse Injuries, Overtraining, and Burnout in Child and Adolescent Athletes," acknowledged that athletics are a healthy and enjoyable activity for children, but also recognize the increased risk of injury and burnout that is associated with early sports specialization.

Year round intensive training in a single sport is becoming increasingly more prevalent (Brenner et al., 2007). The drive to gain a competitive advantage in their respected sport has led many young athletes across the country to compete on multiple teams and practice for long hours

year round (Anderson et al., 2000). Athletes, and often their parents, believe that if they specialize in a sport at an early age, they may be able to earn a scholarship to play at the collegiate level or maybe even compete at the professional level (Johnson, 2008). Unfortunately, the athletes and their families often do not realize that only 0.2% to 0.5% of all high school athletes will go on to compete at the professional level (Brenner et al., 2007). Also, early sport specialization has been linked to several adverse effects including a higher prevalence of overuse injuries and burnout which will be discussed in more detail later on.

Young athletes (age 17 and younger) often feel pressure from outside sources such as peers, coaches, and parents to perform well in sports. This external pressure may play a role in the increasing number of sports specialization among young athletes. A study by Baxter-Jones and Maffuli (2003) evaluated how young athletes initially became interested in their sport and what lead them to begin year round intensive training in a specific sport. This study focused on elite young athletes ages 8 to 17 that were actively competing year round in either soccer, gymnastics, tennis, or swimming (Baxter-Jones & Maffuli, 2003). Researchers conducted an interview with the athletes and with their families separately to determine what influenced the athletes to begin their sport and transition to year round intensive training. The results from the study varied depending on the sport but overall the most common reasons a young athlete became interested in their sport was due to parental influence and the athlete's personal interest (Baxter-Jones & Maffuli, 2003). When making the transition to begin high intensity training in one sport, the coaches of the athletes were the main influence (Baxter-Jones & Maffuli, 2003). This study suggests that parents and coaches may be pressuring young athletes into sport specialization. These influences may not always have the athlete's best interest in mind and the

pressure coaches and parents are putting on young athletes may lead to physical and psychological distress.

Injury Prevalence

One of the major concerns of athletes specializing in sports at an early age is the increased risk of sports related injuries. The increase of single sport athletes in the United States within the last few decades has created a demand for research regarding the effects of sport specialization on young athletes. Young athletes are engaging in year round intensive training without having a solid understanding of the adverse effects it may have on them (McLeod et al., 2011).

A recent clinical case-control study by Jayanthi et al., (2015) analyzes the correlation between sport specialization, age, growth rate, and risk of injuries in young athletes. This study focused on injured athletes between the ages of 7 and 18 and compared their degree of sport specialization with a control group of uninjured athletes (Jayanthi et al., 2015). The results showed that the injured athletes spent more hours per week participating in organized athletics and had a higher degree of sport specialization than the non-injured control group. The study also analyzed the type of sports related injury and found that athletes undergoing sports-specialized training were 1.9 times more likely to suffer a serious overuse injury compared to a multi-sport athlete (Jayanthi et al., 2015). The risk of developing an acute injury was equal between the sport specialized and multi-sport athletes (Jayanthi et al., 2015).

The risk and type of injuries in young, single-sport athletes varies significantly depending on a number of variables. Some of these variables include gender, age when the athlete specialized, number of hours per week the athlete rains, the level of physical contact of the sport, and the amount of repetitive movements in the particular sport. One recent study by Hall, Foss,

Hewett, and Myer (2015), focused on female basketball, soccer, and volleyball players that were either single-sport or multi-sport athletes. The results showed that young female athletes who specialized in one sport were 1.5 times more likely to develop patellofemoral pain than multi-sport athletes (Hall et al., 2015). Also, single-sport athletes in basketball, soccer, and volleyball were at a four-fold greater risk of being diagnosed with patellar tendinopathy and Osgood Schlatter disease (Hall et al., 2015).

Burnout

Due to the rise of sports specialization early on in child's athletic career, higher rates of mental fatigue and exhaustion is being seen in high school athletes (Jayanthi et al., 2013). While athletes, parents, and coaches think that specializing in one sport year round will greatly increase an athlete's success, it is actually being shown to often have the opposite effect. "Research has shown there is no evidence that intense training and specialization before puberty are necessary to achieve elite status" (Johnson, 2008, p. 30). Johnson also found that the risks of early sports specialization include higher rates of injury, increased psychological stress, and quitting sports at a young age (Johnson, 2008).

In a recent retrospective 10-year review study that focused on high school tennis players and elite college swimmers, Jayanthi et al., (2013), found that athletes who specialized earlier and spent more hours training from ages 4 to 16 years, rated their health lower and experienced less fun compared to non-specialized athletes (Jayanthi et al., 2013). High school tennis players who burned out early had less input in their amount of training, higher perceived parental criticism, and lower levels of intrinsic motivation (Jayanthi et al., 2013). Elite college swimmers who dropped out reported that the main reasons for leaving the sport were psychological fatigue, general health, and difficult loads (Jayanthi et al., 2013).

Prevention

The best way to decrease the number of injuries is to prevent them. Coaches, athletic trainers, and athletes have come up with several ways to train properly and creatively to help avoid repetitive and overuse injuries (McLeod et al., 2011). The purpose of prevention is to focus on the elements that are controllable. Difiori et al., (2014), has suggested that about 50% of overuse injuries in children and adolescents can be prevented. The most frequent cause of overuse injuries is due to improper training methods (Jayanthi et al., 2013). Prevention needs to start with a close look at coaching and training techniques to help bring about the desired result without injury (Jayanthi et al., 2013). Examining daily practices and workouts is one place to start.

According to the National Athletic Trainers Association (NATA) in a position statement on sports specialization by McLeod et al., (2011), "Preseason and in-season preventive training programs focusing on neuromuscular control, balance, coordination, flexibility, and strengthening of the lower extremities are advocated for reducing overuse injury risk, especially among pediatric athletes with a previous history of injury" is category A evidence (McLeod et al., 2011, p. 208). Category "A" evidence is defined as, "Recommendation is based on consistent and good-quality patient-oriented evidence" (McLeod et al., 2011, p. 207).

Regardless of the sport or activity, all workouts, practices, and competitions should be preceded by a thorough warm-up 15-20 minutes in length (Johnson, 2008). The warm-up should be sport specific and functional (Johnson, 2008). The classic study performed by Safran, Garrett, Seaber, Glisson, and Ribbeck in 1988 showed muscles that were warmed by pre-stimulation were more resistant to muscle tears than muscles that had not been previously stimulated, therefore warming muscles by repeated contractions helped to prevent muscle tears.

Emerging evidence indicates that the sheer volume of sport activity, whether it is measured as a number of throwing repetitions or the amount of time participating is the most consistent predictor of overuse injury (Jayanthi et al., 2015). Efforts should be made to limit the total amount of repetitive sport activity engaged in by pediatric athletes to prevent or reduce overuse injuries (McLeod et al., 2011). The NATA position statement also says, "General guidelines for pediatric athletes include no more than 16-20 hours per week of vigorous physical activity" (McLeod et al., 2011, p. 213).

Sports Periodization

Many serious youth athletes no longer engage in only preseason conditioning and in-season competition. Sports conditioning has changed to a year round endeavor. According to Prentice & Arnheim, (2011), periodization is defined as, "An approach to conditioning that brings about peak performance while reducing injuries and overtraining in the athlete through a conditioning program that is followed throughout the various seasons" (Prentice & Arnheim, 2011, p. 116). Sports periodization is a great way for athletes to train because it takes into account the different conditioning needs each athlete encounters throughout their sport (Prentice & Arnheim, 2011).

Sports conditioning often falls into three seasons: preseason, in-season, and off-season. The preseason is considered the power phase. The power phase will be high intensity, moderate volume, and sport specific (Prentice & Arnheim, 2011). The in-season is known as the competition phase. In this phase the intensity level is high, low volume, skill-training, strategy, and general maintenance of strength and power that was gained during the off-season (Lorenz et al., 2010). The off-season is the most crucial season and is broken down into four phases: transition phase, preparatory phase, hypertrophy/endurance phase, and the strength phase.

The transition phase begins after the last competition and comprises the early part of the off-season (Prentice & Arnheim, 2011). This phase is unstructured and recreational. The preparatory phase is when cross training takes place. Cross training is an approach to training and conditioning for a specific sport that allows the athlete to substitute alternative activities that have some carry over value into his or her sport (Lorenz, Reiman, & Walker, 2010). The hypertrophy/endurance phase consists of low-intensity, high volume, and non-sport specific activities. The last phase of the off season is the strength phase. This phase consists of moderate intensity, moderate volume, and more sport specific activities (Prentice & Arnheim, 2011).

Summary

This literature review outlines the growing concerns surrounding sport specialization in young athletes and discusses potential actions to avoid these problems. Significant research has been done suggesting that athletes are specializing in one sport and participating in year round intensive training at younger ages than ever before. The higher degree of sports specialization has been linked to an increased prevalence of sports related overuse injuries. Studies have also shown that sport specialization at young ages may contribute to certain adverse psychological effects such as athlete burnout from a healthy activity they previously enjoyed.

Chapter 3: Methodology

Introduction

The purpose of this study was to see if there is a relationship between sports specialization and injury prevalence. The following research questions were addressed:

1. What significance, if any, does the degree of early (prior to high school graduation) sports specialization have on young athletes in regards to musculoskeletal injury prevalence?
2. What significance, if any, does gender have on injury prevalence among specialized high school athletes?

Population

The population of interest for this study consisted of the student athletes on the football and cross country teams at Bethel University. This included males and females ages 18 and older. In order to be eligible for the study, the athletes must have competed in a sanctioned high school sport prior to attending Bethel. Recreational, club, and intramural activities were not included. No contact was made between the participants and the researchers prior to the study. The athletes were informed of the opportunity to participate in the study by their respective coaches prior to receiving the consent form and survey. No identifying information was obtained during the research study in order to ensure the confidentiality of the participants.

Equipment and Instruments

The evaluation tool for this study consisted of a one page, 15 question survey. The survey contained several demographic questions regarding the athlete's age, gender, and year in school. The remainder of the questions were focused on the athlete's degree of sports specialization and the number of sports related injuries the athlete may have sustained during their high school

athletic career. Participants were also able to provide more details about their injuries, including the location, type, significance, and amount of sports time missed for each injury. The questions on the survey were carefully designed by the researchers in order to accurately answer the research questions. See Appendix B.

Study Design

This was a retrospective study that utilized a combination of quantitative and qualitative analysis. The dependent variables were the participants' injuries and gender, while the independent variable was the athletes' degree of sport specialization. The data was scored using a Phi Correlation test.

Validity and Reliability

The questionnaire was created by the researchers that performed the study and it was designed to obtain data related to the research questions. The survey was evaluated by a review panel consisting of two coaches, the sport and exercise wellness teacher, and three student athletes. These individuals determined that the survey was written at an appropriate level for the students at Bethel University and that it successfully addressed the research questions. Reliability will need to be tested in the future as this was the first time this survey tool was used.

Procedures

Approval to use the student athletes at Bethel University was obtained by collecting written consent from the head coach of the football and cross country teams prior to data collection (Appendix E). The survey was printed and administered to the head coaches for their approval. Once the survey had been approved by the head coaches, the researchers presented the study to the IRB for final approval. With IRB's official approval (Appendix A), a consent form and survey was then administered to the student athletes. The athletes were able to decide if they

wanted to participate in the study or not and the coaches were not informed on which of their athletes participated. Researchers then collected the signed consent forms and completed surveys from the athletes. Surveys that were returned without a signed consent form were discarded. Surveys that were filled out incorrectly / incompletely were also discarded.

Statistical Methods

Once all of the surveys were collected, the researchers placed the subjects into specific categories depending on their gender and degree of sport specialization. Degree of sport specialization consisted of two categories: single sport athletes, those who participate only in one high school sport in a calendar year, and multi-sport athletes, those who compete in more than one high school sport in a calendar year. The Phi correlation test was then used to determine if there was any correlations between an athlete's degree of sports-specialization, injury prevalence, and gender differences.

Limitations

The following are limitations that the researchers believe are potential weaknesses of the study:

1. General location: Research was limited to the upper Metro area in Minnesota.
2. Access to athletes/schools/programs: Limited access to certain schools and populations due to a lack of permission from certain administrations.
3. Time: Time constraints for the research will be limited due to graduation date in August 2017.
4. Survey: Using a new survey instrument with unknown validity and reliability.
5. Participants: The data depends upon their subjective interpretation of the questions and their experience.

Delimitations

The following are delimitations to this study:

1. College athletes: The researchers for this study are limiting the sample size to only college athletes from the Bethel University football and cross country teams. The athletes also must have competed on a sanctioned State High School sport.
2. One college: The research team chose to study football and cross country athletes at Bethel University only due to time constraints and cost.

Chapter 4: Results

Technique

The surveys were collected and categorized by the researchers with the help of an experienced statistical analysis researcher from Dakota Wesleyan University in Mitchell, South Dakota. After obtaining signed consent from the coaches and athletes the surveys were handed out to the student athletes from the Bethel University football and cross country teams. Once completed they were returned to the researchers and data analysis was achieved. A comparison of single sport vs multi-sport athletes in regards to injury prevalence was obtained using a Phi correlation test as demonstrated below in figure 1.

Another Phi correlation test shown in figure 2 was used to determine if gender had any significance on injury prevalence. The responses to each question in the survey were analyzed and compared to see what statistical significance, if any was found.

Figure 1:

Phi Correlation Test: Single Sport vs. Multi-Sport Athletes

	Injury	No Injury
Single Sport Athletes	7 (A)	5 (B)
Multi-Sport Athletes	12 (C)	4 (D)

$$\text{phi}(\phi) = \frac{BC-AD}{\sqrt{(A+B)(C+D)(A+C)(B+D)}}$$

$$\phi = \frac{(12X5)-(7X4)}{\sqrt{(7+5)(12+4)(7+12)(5+4)}} = \frac{60-28}{\sqrt{(12)(16)(19)(9)}} = \frac{32}{\sqrt{32{,}832}} = 0.1766$$

$$\text{chi square value } (X^2) = N \times \phi^2 = 28 \times (0.1766)^2 = 0.87$$

df = 1
Critical value = 3.84

Since 0.87 is less than 3.84, there is no significant correlation.

Figure 2:

Phi Correlation Test: Male vs. Female Athletes

	Injury	No Injury
Male Athletes	14 (A)	5 (B)
Female Athletes	5 (C)	4 (D)

$$\text{phi}(\phi) = \frac{BC-AD}{\sqrt{(A+B)(C+D)(A+C)(B+D)}}$$

$$\phi = \frac{(5X5)-(14X4)}{\sqrt{(14+5)(5+4)(14+7)(5+4)}} = \frac{25-56}{\sqrt{(19)(9)(19)(9)}} = \frac{-31}{\sqrt{29{,}241}} = -0.181$$

$$\text{chi square value } (X^2) = N \times \phi^2 = 28 \times (-0.181)^2 = 0.92$$

df = 1
Critical value = 3.84

Since 0.92 is less than 3.84, there is no significant correlation.

The findings from the data analysis did not demonstrate any statistical significance between single sport and multi-sport athletes in terms of injury prevalence. Using the Phi correlation formula as demonstrated in figure 1, the critical value was 3.84 and our Phi value was 0.87. This means there is no significant correlation because 0.87 is less than our critical value of 3.84. This did not support our hypothesis that single sport athletes would be more prone to injury due to repetitive mechanisms compared to multi-sport athletes with no repetitive mechanisms.

The researchers also looked at comparing gender, male athletes vs female athletes, compared to injury prevalence. Using the Phi correlation formula as demonstrated above in figure 2, the critical value was 3.84 and our Phi value was 0.92. This means there is no significant correlation because 0.92 is less than our critical value of 3.84. This does support our hypothesis as we did not believe gender would play a significant role in injury prevalence.

Looking more specifically at the data collected, we found that there were a total of 28 participants. Of those 28 athletes 12 were single sport and 16 were multi-sport athletes. There was a total of 19 participants that reported some form of injury during their high school years. Of those 19 injuries 14 of them were males.

Chapter 5: Discussion

Limitations

One limitation to this study was finding a high school that would allow their students to participate in a research study. Four different high schools were contacted in regards to participating in this research project but unfortunately none of the schools agreed. Several of the administrations that were asked to participate in the study denied access to their students without giving an explanation as to why. Other schools stated that they would not allow their students to participate because the majority of students were under the age of eighteen years old. While there are added challenges to working with a youth population, such as requiring a higher level of IRB approval and the need to obtain permission from a parent or guardian, the researchers feel it would have been more beneficial and accurate to have surveyed a population of current high school athletes.

The decision to partner with the Bethel University football and cross country programs allowed us to complete our research project in a timely manner. We were fortunate that the coaches from both teams were willing to participate in the study and assist in the data collection process. With the survey mainly consisting of open ended questions, the researchers were pleased overall with the level of responses they received from the student athletes. It appeared that the majority of the athletes that chose to participate in the study appropriately understood the questions and put forth ample effort. None of the surveys the researchers collected needed to be discarded.

Although the Phi correlations did not show a significant correlation between male and female athletes in regards to injury prevalence, we do know that more males, fourteen, were injured then females, five. This was most likely due to the fact that there were more male

participants in this study and that the males typically played high school sports with more physical contact.

Another limitation that may have played a role in the researchers study was location. Being located in the upper mid-west with a variable climate can make it more difficult for young athletes to specialize in a sport early on in their athletic career. Southern locations may have more athletes that participate in one sport due to the weather being more consistent year round.

The most significant limiting factor for this research study was the small sample size. Unfortunately the researchers only received a total of 28 completed surveys. Of those 28 athletes 19 were male and 9 were female. Had there been a larger number of responses, and a more even ratio of males and females, the data would have better represented the general population. This would have made for a much more accurate study in regards to the correlation between sports specialization and injury prevalence.

Recommendations

Based on the findings from this study, further research is needed to see if there is a significant difference between single sport and multi-sport athletes in regards to injury prevalence. The results of this research study were inconclusive as the data was limited by sample size. A larger sample size would help to improve the overall reliability and validity of the survey tool. Once way to increase the sample size would be to include multiple colleges and to survey athletes from a larger variety of sports. This would make for a larger, more diverse population and it would give a much more accurate answer on whether early sports specialization is connected with an increase in injury prevalence.

Another recommendation for future research studies would be to test if athletes from different cultures and socioeconomic backgrounds had significant differences in injury

prevalence. Schools could be chosen based on location and access to resources to see how these variable affect the injury prevalence rates of high school athletes.

This study laid the foundation for future researchers. If a large enough sample size was achieved, further research could look at endless variables. Future researchers could compare two different sports comparing injury prevalence. Research could be done looking at the severity of injuries, breaking down severity by duration of time missed. Research could also look into whether or not age was a factor.

Conclusion

Overall, the results of this research study were inconclusive. There was not a large enough sample size to prove any significance. This research is just the beginning of looking at injuries in athletes during high school. In conducting this research the main goal was to identify if single sport or multi-sport athletes are at a higher risk of injury during high school. Education about sports specialization and injuries has come a long ways in the past decade, but there is still a need for further investigation into how modifications can be made to help better educate student athletes, coaches, and parents on overuse injuries.

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Appendix A

IRB Approval

BETHEL UNIVERSITY

Jacob Berwyn <jab66825@bethel.edu>

Bethel Level 3 IRB Approval

Wallace Boeve <w-boeve@bethel.edu> Thu, Nov 3, 2016 at 1:42 PM
To: Jacob Berwyn <jab66825@bethel.edu>, Jordan Reiner <jor83675@bethel.edu>
Cc: Christy Hanson <c-hanson@bethel.edu>, Lisa Naser <l-naser@bethel.edu>, Peter Jankowski <p-jankowski@bethel.edu>

November 2, 2016

Jake & Jordan;

As granted by the Bethel University Human Subjects committee as the program director, I write this letter to you in approval of Level 3 Bethel IRB of your project entitled: "The Effects of Early Sports Specialization on Injury Prevalence." This approval is good for one year from today's date. You may proceed with data collection and analysis. Please let me know if you have any questions.

Sincerely;

Wallace Boeve, EdD, PA-C

Program Director

Physician Assistant Program

Bethel University

w-boeve@bethel.edu

651 308-1398 cell

651 635-1013 office

651 635-8039 fax

http://gs.bethel.edu/academics/masters/physician-assistant

CC: Bethel IRB Chair

Faculty Chair Advisor

PA Program Research Coordinator

Appendix B

Survey Questionnaire

Survey

Gender: _____ Age:_____ Year in school: Fr. So. Jr. Sr.

Please list all of the **school organized sports you played** during high school and complete the table below. Do not include club, recreational, or intramural sports.

Sport:	How many years did you play that sport?	Do you currently play this sport in college?	If not, when and why did you stop playing?

In the course of a year, what sport do you play the most?

How many hours a week do you participate in your most time consuming sport during the high school season?

How many months out of the year do you spend playing this sport? Please include your in-season time and any out-of-season teams/ training you may be involved in.

Have you ever sustained any injuries (major or minor) while playing a sport? Yes No

If yes:

-What was the injury?

-What sport were you playing when it happened?

-How much time, if any, did you miss of that sport?

Appendix C

Confidentiality Agreement

Confidentiality Agreement

Title: Sports Specialization in Young Athletes

Principal Investigators: Jake Berwyn & Jordan Reiner
Research Advisor: Christina Hanson, PA-C

As a member of this research team I understand that I may have access to confidential information about study sites and participants. By signing this statement, I am indicating my understanding of my responsibilities to maintain confidentiality and agree to the following:

- I understand that any identifying information about study sites and participants are completely confidential.
- I agree not to divulge, publish, or otherwise make known to unauthorized persons or to the public any information obtained in the course of this research project that could identify the persons who participated in the study.
- I understand that all information about study sites or participants obtained or accessed by me in the course of my work is confidential. I agree not to divulge or otherwise make known to unauthorized persons any of this information, unless specifically authorized to do so by approved protocol or by the local principal investigator acting in response to applicable law or court order, or public health or clinical need.
- I understand that I am not to read information about study sites or participants, or any other confidential documents, nor ask questions of study participants for my own personal information but only to the extent and for the purpose of performing my assigned duties on this research project.
- I agree to notify the local principal investigator immediately should I become aware of an actual breach of confidentiality or a situation that could potentially result in a breach, whether this be on my part or on the part of another person.

Jake Berwyn (electronic signature) (4/20/17) Jake Berwyn
Signature of local principal investigator Date Printed name

Jordan Reiner (electronic signature) (4/20/17) Jordan Reiner
Signature of local principal investigator Date Printed name

Christina Hanson (electronic signature) (4/20/17) Christina Hanson
Signature of research advisor Date Printed name

Appendix D

Informed Consent Form

Informed Consent Form

You are invited to participate in a study of sports specialization in high school athletes. The purpose of the study is to investigate the potential of sports specialized injuries and burnout in high school athletes. You were selected as a possible participant in this study because you are a high school athlete participating in a school sanctioned sport. The information collected will be used for thesis research in affiliation with Bethel University's Physician Assistant Master's Program.

If you decide to participate, we will give you a survey to that will need to be completed to the best of your knowledge. The survey will not collect any personal information. The survey will consist of demographic questions as well as questions pertaining to sports you participate in. The risks to you as a participant are minimal; there will be no measurements or physical activity needed. You may benefit from participating by gaining knowledge about sports specialization and burnout in high school athletes that may help you as a participant to be better aware of signs and symptoms of burnout. There are no incentives for participation in the study.

Data collection documents you complete will not include your name and will be coded so that you cannot be identified. In any written reports or publications, you will not be identified or identifiable and only aggregate data will be presented.

Your decision whether or not to participate will not affect your future relations with Bethel University or affect your participation in high school athletics at Mounds View High School in any way. If you decide to participate, you are free to discontinue participation at any time without affecting such relationships.

This research project has been reviewed and approved in accordance with Bethel's Levels of Review for Research with Humans. If you have any questions about the research and/or research participants' rights or wish to report a research-related injury, please call Jake Berwyn PA-S, (763) 244-5677, Jordan Reiner PA-S, (605) 770-1517, or Christina Hanson PA-C (651) 635-8042.

You will be offered a copy of this form to keep.

You are making a decision whether or not to participate. Your acknowledgement indicates that you are 18 years of age or have parental consent and have read the information provided above and decided to participate. You may withdraw at any time without prejudice after signing this form should you choose to discontinue participation in this study.

Athlete's signature

Parent/Guardian's Signature

Appendix E

Coach's Permission Form

BETHEL UNIVERSITY

Jacob Berwyn <jab66825@bethel.edu>

Research Project for the Bethel University Physician Assistant Pogram

Jordan Reiner <jor83675@bethel.edu> Thu, Oct 20, 2016 at 2:19 PM
To: Jacob Berwyn <jab66825@bethel.edu>

---------- Forwarded message ----------
From: "Steve Johnson" <johstea@bethel.edu>
Date: Oct 19, 2016 10:47 PM
Subject: Re: Research Project for the Bethel University Physician Assistant Pogram
To: "Jordan Reiner" <jor83675@bethel.edu>
Cc:

I have talked with the athletes and they have agreed to participate in the study. As well as you have given permission for us to do the study.

Steve.

Steve Johnson
Head Football Coach
Bethel University

Sent from my iPhone

> On Oct 19, 2016, at 5:15 PM, Jordan Reiner <jor83675@bethel.edu> wrote:
>
> I have talked with the athletes and they have agreed to participate in the study. As well as you have given permission for us to do the study.

BETHEL UNIVERSITY

Jacob Berwyn <jab66825@bethel.edu>

Research project

Joseph Stephens <j-stephens@bethel.edu> Wed, Oct 26, 2016 at 2:43 PM
To: Jacob Berwyn <jab66825@bethel.edu>

Jacob,

Statement of Permission:
I give Jacob Berwyn and Jordan Reiner the permission to survey the members of the Bethel University cross country team for the purposes of their research project.

[Quoted text hidden]