

AN ANALYSIS OF SPORT SPECIALIZATION  
AMONG CURRENT NCAA DII, DIII AND NAIA  
COLLEGIATE ATHLETES

By

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Submitted to the Faculty of the  
Graduate College of the  
Oklahoma State University  
in partial fulfillment of  
the requirements for  
the Degree of  
DOCTOR OF PHILOSOPHY  
May, 2022

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## ACKNOWLEDGEMENTS

I would like to offer my sincerest gratitude to the following:

- My advisor and chair, Dr. Jay Dawes, for his support and encouragement throughout this process. I am grateful for your willingness to share your expertise and guidance. Your reassurance and advice were always timed perfectly to help me move beyond the next barrier and improve my writing. Additionally, I would like to thank my committee members, Dr. Michael Trevino, Dr. Taylor Dinyer-McNeely, and Dr. Brandt Gardner, for their assistance and feedback throughout the project.
- All those in the School of Kinesiology, Applied Health and Recreation at Oklahoma State University who motivated me to keep moving forward. I feel honored to have had the privilege of working with such outstanding individuals. Your examples have helped shape me as a professional.
- My family and friends for their enormous support and faith that I could achieve all I set out to accomplish, especially during times of doubt and frustration. This journey would not have been possible without your thoughts and prayers. Thank you.

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Date of Degree: May 2022

Title of Study: AN ANALYSIS OF SPORT SPECIALIZATION AMONG CURRENT  
NCAA DII, DIII AND NAIA COLLEGIATE ATHLETES

Major Field: Health, Leisure & Human Performance

Abstract: Sport specialization (SS) is when youth athletes train in one sport for at least eight months a year, excluding all other sports. Early sport specialization (ESS) is specialization at or younger than twelve years. Negative consequences of ESS are both physiological and psychological. Athletes specialize because of the enjoyment of that sport more than others; the desire to improve skill, compete beyond high school, and earn a college athletic scholarship; and pressure from coaches and parents. Few studies have investigated the frequency of SS of collegiate athletes. The primary purpose of this study was to determine the differences in the mean age of competitive sport initiation and SS in current collegiate athletes between school classification (DII, DIII, NAIA), sex, type of sport (team- vs. individual-based), and size of high school. A secondary purpose was to identify the reasons athletes decide to specialize. An online survey was provided via an email sent to the athletes' coach. Current rosters from sanctioned NCAA and NAIA sports were included. A total of 1610 completed surveys were analyzed. Two three-way mixed factorial ANOVAs, and four one-way ANOVAs were used. The mean age of competitive sport initiation was  $7.89 \pm 3.10$  yrs. There was a difference between males and females ( $p < 0.001$ ) and the type of sport ( $p < 0.001$ ). There was an interaction effect of sex and school classification ( $p = 0.008$ ) and school classification and type of sport ( $p = 0.006$ ). Sixty-three percent of the athletes indicated they specialized with a mean age of  $14.33 \pm 2.27$  yrs. There was a difference between males' and females' mean age of SS ( $p = 0.012$ ). There was no difference between school classification, type of sport, or any interaction effects. Athletes from large high schools specialized earlier than those from small-sized high schools ( $p < 0.001$ ). The three most common reasons to specialize were enjoyment of the sport, desire to improve, and desire to compete beyond high school. These findings suggest it may not be necessary to specialize in one sport at an early age to compete beyond high school.

## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION.....	1
Purpose of the Study.....	3
Specific Aims.....	3
Research Questions.....	3
Null Hypotheses.....	4
Significance of the Study.....	5
Delimitations.....	6
Limitations.....	6
Assumptions.....	6
II. REVIEW OF LITERATURE.....	8
Benefits and Consequences.....	10
Physiological Consequences of Sport Specialization.....	10
Psychosocial Consequences of Sport Specialization.....	12
Why Athletes Specialize.....	13
Trends in Sport Specialization.....	14
Sport Specialization Recommendations.....	15
Youth Athlete Training Models.....	16
Long-Term Athlete Development Model.....	16
American Development Model.....	18
Developmental Model of Sport Participation.....	20
Performance and Sport Specialization.....	21
Collegiate Athletes' Prevalence of Sport Specialization.....	22
Age of Competitive Sport Initiation.....	22
Age of Sport Specialization.....	24
Differences Between Types of Sports.....	27
Motivation to Specialize.....	29
III. METHODS.....	32
Participants.....	32
Procedures.....	33

Chapter	Page
Survey Instrument.....	33
Statistical Analysis.....	34
 IV. RESULTS .....	 36
Demographics .....	36
Age of Competitive Sport Initiation .....	38
Hypothesis #1.....	38
Hypothesis #2.....	39
Hypothesis #3.....	39
Hypothesis #4.....	39
Hypothesis #5.....	41
Hypothesis #6.....	41
Hypothesis #7.....	42
Hypothesis #8.....	43
Age of Sport Specialization .....	43
Hypothesis #9.....	45
Hypothesis #10.....	45
Hypothesis #11.....	46
Hypothesis #12.....	46
Hypothesis #13.....	47
Hypothesis #14.....	48
Hypothesis #15.....	48
Hypothesis #16.....	48
Motivation for Sport Specialization.....	48
 V. DISCUSSION .....	 50
Limitations .....	55
Conclusion .....	56
 REFERENCES .....	 57
 APPENDICES .....	 73
APPENDIX #1: IRB Approval Letter .....	73
APPENDIX #2: Sport Specialization Survey .....	74

## LIST OF TABLES

Table	Page
1. Summary of Long-Term Athlete Development Stages .....	16
2. Summary of American Development Model Stages .....	18
3. Summary of Survey Demographics .....	37
4. Age of Competitive Sport Initiation Compared to Sex, School Classification, and Type of Sport.....	38
5. Mean Age of Competitive Sport Initiation by Sport.....	40
6. Interaction Effect of Sex and School Classification on the Mean Age of Competitive Sport Initiation .....	42
7. Interaction Effect of School Classification and Type of Sport on the Mean Age of Competitive Sport Initiation .....	42
8. Team Sport and School Classification Comparison on the Mean Age of Competitive Sport Initiation .....	43
9. Summary of the Characteristics of the Age of Sport Specialization .....	43
10. Age of Sport Specialization Compared to Sex, School Classification, and Type of Sport .....	45
11. Age of Sport Specialization and Size of High School .....	47

## LIST OF FIGURES

Figure	Page
1. Mean Age of Competitive Sport Initiation by Sport.....	41
2. Mean Age of Sport Specialization by Sport .....	46
3. Mean Age of Sport Specialization by Size of High School.....	47
4. Reasons Athletes Specialize in Their Chosen Sport .....	49



## CHAPTER I

### INTRODUCTION

Sport specialization (SS) can be defined as intense year-round single-sport training, excluding all other sports (DiSanti & Erickson, 2019; Hill & Simmons, 1989; Jayanthi et al., 2013; Malina, 2010). A sport-specialized athlete has stopped participating in at least one other sport to focus solely on their chosen sport. The reasons why athletes specialize are multifactorial. Some of these motives include the desire to excel in their chosen sport, pressure from parents and coaches, and the hope of becoming skilled enough to play at the collegiate or professional level (Gould et al., 2009; Myer et al., 2015; & Padaki et al., 2017). An aspect of sport specialization of more concern is early sport specialization (ESS). While a clear consensus of what constitutes ESS is unclear, it is commonly accepted that an athlete who participates in one sport for at least eight months out of the year, at the exclusion of other sports, before the age of 12-years old (i.e., the age-associated with the onset of puberty) would be considered ESS (LaPrade et al., 2016; Mendes et al., 2018; Moseid et al., 2019; Santos et al., 2017; Storm et al., 2012).

Several sports organizations and governing bodies report an increased emphasis on SS (Lloyd et al., 2016; Myer et al., 2015; & Tenforde et al., 2022). As early as 1989, Hill and Simmons reported an increase in athletes choosing to specialize at a younger age. Jayanthi et al. (2013) has since described a positive relationship between the number of youths participating in athletics and the frequency of SS. More recently, Brenner (2016) reported that just over a quarter of the youth (aged 6 – 18 yrs.) involved in sports are specialized.

Gladwell (2008) popularized that a person must spend at least 10,000 hours participating in their chosen activity to become an expert. Although the 10,000-hour rule was first identified in musicians (Ericsson et al., 1993), this concept has also been promoted as the amount of time necessary for an athlete to achieve mastery in their respective sport (Ferguson & Stern, 2015). In addition, focusing on only one sport allows for deliberate practice. Ericsson et al. (1993) identified deliberate practice as highly structured to improve performance for achieving an expert classification. Although deliberate practice and accumulation of 10,000 participation hours are only part of the puzzle of an expert designation, they are often addressed explicitly by specializing in one sport.

Research indicates an increase in youth SS, especially at younger ages (Hill & Simons, 1989; Jayanthi et al., 2015; Malina, 2010; Mostafavifar, 2013; & Wiersma, 2000). Nevertheless, the negative consequences of ESS may outweigh the potential benefits. Research has shown an increase of physiological and psychological problems associated with SS, especially among early specializers, such as overuse injuries and increased stress and pressure, potentially leading to burnout. (Ahlquist et al., 2020; Barynina & Vaitsekhovskii, 1992; Bush et al., 2019; Coakley, 1992; Fleisig, et al., 2009; Gould, et al., 1996; Hall et al., 2015; Jayanthi et al., 2015; McGuine et al., 2017; Post et al., 2017; Wall & Côté, 2007; Wilhelm et al., 2017; & Wolff, 2002).

It may seem that based on the 10,000-hour rule and the importance of deliberate practice, specialization is vital to competing beyond high school. Despite this logic, studies of non-U.S.

athletes have shown that elite athletes specialize at a later age than non-elite athletes (Feeley et al., 2016; Güllich & Emrick, 2014; & Zauner et al., 1989). In addition, Jayanthi et al. (2013) suggest that ESS may not be essential for success in most sports. Those who specialize later in their chosen sports tend to compete at a higher level. Many anecdotal stories in popular media promote the importance of being a multisport athlete to achieve long-term athletic success. One of the main reasons athletes specialize as youth is to excel enough in their sport in order to play at the next level (Ahlquist et al., 2020; Buckley et al., 2020; & Gould et al., 2009), yet the reality is that only a small percentage of athletes compete beyond high school. The most recent NCAA data indicates that almost 7 million students participated in high school athletics, while only roughly 7% of them competed in Division I, II, or III athletics (NCAA, 2020). Knowing the prevalence of collegiate athletes specializing at an early age as youth can help younger athletes who desire to compete beyond high school decide whether they should specialize or not.

### **Purpose of the Study**

The primary purposes of this study are to investigate the differences of mean age of competitive sports initiation and SS in collegiate athletes between three collegiate classifications (NCAA DII, DIII, and NAIA), sexes, and type of sport (team- vs. individual-based). A secondary purpose was to identify reasons athletes decide to specialize in one sport.

### **Specific Aims**

1. To identify the mean age of SS for collegiate athletes
2. To identify the difference in the mean age of SS between NCAA DII, DIII, and NAIA athletes.
3. To identify the reasons why athletes decide to specialize.

## **Research Questions**

1. What are the mean ages of competitive sport initiation among NCAA DII, DIII, and NAIA athletes?
2. Are there differences between the mean ages of competitive sport initiation among NCAA DII, DIII, and NAIA athletes?
3. What is the frequency of ESS among NCAA DII, DIII, and NAIA athletes?
4. Are there differences between the mean ages of SS among NCAA DII, DIII, and NAIA athletes?
5. Are there differences between the mean ages of SS among NCAA DII, DIII, and NAIA athletes by sex?
6. Are there differences between the mean ages of SS among NCAA DII, DIII, and NAIA athletes that participate in the team- versus individual-based sports?
7. Are there differences between the mean ages of different sized high schools?
8. What are the reasons for SS among NCAA DII, DIII, and NAIA athletes?

## **Null Hypotheses**

1.  $H_{01}$ : There will be no differences between the mean ages of competitive sport initiation among athletes by sex.
2.  $H_{02}$ : There will be no differences between the mean ages of competitive sport initiation among NCAA DII, DIII, and NAIA athletes.
3.  $H_{03}$ : There will be no differences between the mean ages of competitive sport initiation among athletes that participate in team- versus individual-based sports.
4.  $H_{04}$ : There will be no differences between the mean ages of competitive sport initiation among athletes of different sports.
5.  $H_{05}$ : There will be no differences between the mean ages of competitive sport initiation among athletes from different size high schools.

6. H<sub>06</sub>: There will be no difference between the mean ages of competitive sport initiation among NCAA DII, DIII, and NAIA athletes by sex.
7. H<sub>07</sub>: There will be no difference between the mean ages of competitive sport initiation among NCAA DII, DIII, and NAIA athletes that participate in the team- versus individual-based sports.
8. H<sub>08</sub>: There will be no difference between the mean ages of competitive sport initiation among the team- and individual-based sports by sex.
9. H<sub>09</sub>: There will be no differences between the mean ages of SS among athletes by sex.
10. H<sub>010</sub>: There will be no differences between the mean ages of SS among NCAA DII, DIII, and NAIA athletes.
11. H<sub>011</sub>: There will be no differences between the mean ages of SS among athletes that participate in team versus individual sports.
12. H<sub>012</sub>: There will be no differences between the mean ages of SS among athletes of different sports.
13. H<sub>013</sub>: There will be no differences between the mean ages of SS among athletes from different size high schools.
14. H<sub>014</sub>: There will be no difference between the mean ages of SS among NCAA DII, DIII, and NAIA athletes by sex.
15. H<sub>015</sub>: There will be no difference between the mean ages of SS among NCAA DII, DIII, and NAIA athletes that participate in team versus individual sports.
16. H<sub>016</sub>: There will be no difference between the mean ages of SS among the team and individual sports by sex.

### **Significance of the Study**

Several medical organizations, national sport governing organizations, and the International Olympic Committee, have recommended that youth refrain from SS until after the age of twelve

(American Academy of Pediatrics, 2000; Côté et al., 2009; Bergeron et al., 2015; DiFiori et al., 2014; LaPrade et al., 2016; USA Basketball; USA Hockey; US Olympic and Paralympic Committee; & USA Swimming). Several studies have identified the desire to compete beyond high school as a reason youth athletes decide on ESS (Bell et al., 2018; Brenner, 2016; Brooks et al., 2018; Gould et al., 2009; Malina, 2010; Mostafavifar et al., 2013; Padaki et al., 2017; & Post et al., 2018). Few studies have quantified the frequency of collegiate athletes as early sport specialists (Black et al., 2019; Buckley et al., 2017; DiFiori et al., 2019; Martin et al., 2017; Post et al., 2017; & Swindell et al., 2019). This study will further clarify the prevalence of ESS in collegiate athletics. A complete picture may influence youth, parents, and coaches in their decision regarding ESS.

### **Delimitations**

1. Participants are limited to NCAA DII, DIII, and NAIA athletic programs.
2. Participants are limited to athletes on current rosters of NCAA and NAIA sanctioned sports.
3. This investigation will require athletes to complete an anonymous survey, which will take approximately 5 minutes.

### **Limitations**

1. Participants will receive the link to the survey from their coach. Therefore, the participant will only know about the study if their coach passes the survey link.
2. Coaches' emails from college athletic websites may or may not be current.
3. Participants are required to recall information from youth athletic experiences more than ten years prior.
4. This study is exclusive to athletes in the United States currently competing at the collegiate level.

### **Assumptions**

1. Coaches will pass the survey information on to their athletes.

2. Participants answer survey questions honestly.
3. Participants remember youth sports experiences correctly.

## CHAPTER II

### REVIEW OF LITERATURE

In 2014, it was estimated that about 60 million youth aged 6 – 18 years old participated in organized athletics, while about 8 million youth participated in high school sports (DiFiori et al., 2014). More recently, the 2019 National survey of children’s health (Child and Adolescent Health Measurement Initiative) reported that 55.1% of youth aged 6 – 17 years were involved in youth sports. There are many benefits of youth sport participation, such as increased self-perceptions and emotional management, reduced health problems, decreased anxiety, and increased self-esteem (Ewing & Seefeldt, 2002; Findlay & Coplan 2008; & Malina & Cummings, 2003). The primary motivating factors for youth sport participation in the past have been for fun and enjoyment (Gill et al., 1983; Seefeldt et al., 1992; Scanlan, Carpenter, Lobel, & Simmons, 1993; Scanlan, Carpenter, Schmidt, Simmons, & Keeler, 1993; & Weiss et al., 2001). There has been a shift from fun, enjoyment, and participation to training, performance, and competition (Wiersma & Fifer, 2008). This focused attention on athletic performance is a component of SS.



There is no standardized definition of SS. Some of the earliest research about SS classify it as “limiting participation to one sport which is practiced, trained for and/or competed in on a year-round basis” (Hill & Simmons, 1989, p. 1). Since then, researchers have classified SS as training one sport to exclude all others, often year-round (Brenner et al., 2016; DiSanti & Erickson, 2019; Jayanthi et al., 2013; & Malina, 2010). To assist in determining SS, Jayanthi et al. (2015) developed a 3-point scale based on the following questions: (1) Have you quit another sport to focus on your primary sport? (2) Do you consider your primary sport more important than your other sports? and (3) Do you train more than eight months a year in your primary sport? One point is given to each agreeing answer and athletes are classified as low (score = 0-1), moderate (score = 2), or high (score = 3) specialization. ESS is when athletes specialize in their sport at 12 years or younger, while late sport specialization (LSS) is specializing after the age of 12 (Balyi, 2001; Côté et al., 2014; LaPrade et al., 2016; Malina, 2010; Mendes et al., 2018; Moseid et al., 2019; Mostafavifar et al., 2013; Santos et al., 2017; & Strom et al., 2012). Baker and colleagues (2009) further delineated ESS indicating that four parameters must be present: (1) early sport start age, (2) early involvement in one sport, (3) early involvement in focused training, specifically high-intensity training, and (4) early involvement in competitive sport. There is still debate if all youth athletes should specialize in one sport early. It should be noted that there are a few sports identified as early entry sports. These sports are gymnastics, figure skating, diving, and to some extent, swimming. There is a tendency for these sports athletes to reach the peak athletic abilities at a younger age, therefore requiring early sport initiation and ESS (Bompa, 1985; Bompa, 1995; Drabik, 1996; Hartley, 1988; Rost & Schon; 1997). This literature review aims to provide insights into the benefits and consequences of SS, why youth specialize in one sport, the trends of SS and ESS, recommendations about SS, youth athletic development models, how SS impacts performance, and current research of SS of collegiate athletes.

## **Benefits and Consequences**

The research supporting SS is limited. A frequently cited study from Ericsson et al. (1993) reports that expert violin players had accumulated 10,000 hours of practice compared to good violinists. Additionally, the study concluded that it would be difficult for late starters to overcome the advantage those that began deliberate practice at a young age acquired. The results from this research have been promoted as the amount of time necessary for an athlete to achieve mastery in their respective sport (Ferguson & Stern, 2015). Therefore, it is hypothesized that youth that start and specialize in their primary sport at an earlier age will obtain the necessary hours of practice to achieve expertise. (Deakin, 2003; Helsen et al., 1998; Starks et al., 1996; & Ward et al., 2007). Several success stories of ESS benefiting athletes such as Tiger Woods, the Williams sisters, and Michael Phelps are widely known (Smith, 2015). Media touting the accomplishments of ESS athletes and the impact of the 10,000-hour rule have influenced those in youth sport to frequently believe ESS as the method by which athletic performance is maximized (Kliethermes et al., 2020).

More research is available identifying the negative impact of SS, especially ESS, rather than the potential benefits. Regardless of the physiological and psychosocial consequences, it is difficult to accurately identify exceptional talent at an early age (Martindale et al., 2010 & Pankhurst & Collins, 2013). The following sections will review research highlighting SS's physiological and psychosocial consequences.

### ***Physiological Consequences of SS***

Several studies have indicated that athletes who specialize in one sport early tend to have more injuries and have a shorter career in youth sports than those that participated in a variety of sports (Brenner, 2007; DiFiori et al., 2014; Jayanthi et al., 2013; Malina, 2010; & Valovich et al., 2011). Using their developed SS classification scale, Jayanthi et al. (2015) surveyed 1190 7- to

18-year-old athletes who were either seen at the sports medicine clinic for an injury or a preparticipation sports physical exam. Athletes with serious overuse injuries were 1.9 times as likely to be classified as highly specialized in one sport. Post and colleagues (2017) surveyed 1544 high school athletes. The athletes' SS status was determined using the scale developed by Jayanthi et al. (2015). Athletes were asked if they had experienced a lower extremity injury (LEI) severe enough to cause them to seek medical attention. The athletes classified as high SS were associated with an LEI independent of sex. Bell et al. (2016) surveyed 302 athletes from two high schools. They also used the SS scale from Jayanthi et al. (2015). The investigators discovered that the athletes classified as highly specialized in one sport were more likely to report overuse knee or hip injuries than those with a low SS classification. McGuine et al. (2017) surveyed 1544 high school athletes using the scale from Jayanthi et al. (2015). The researchers found that those classified as moderately and highly specialized in one sport were more likely to have lower extremity injuries (ankle, knee, & upper leg), ligament sprains, muscle/tendon strains, and tendinitis than those with a low SS classification. Ahlquist et al. (2020) surveyed all the athletes at one NCAA Division I institution. The researchers reported that the athletes who specialized in one sport before 14-years old had an increased history of injuries, multiple injuries in college, an increased number of total injuries, and experienced more time away from their sport due to injuries than those that specialized in one sport after 14- years old.

Professional athletes who specialized in their chosen sport early report similar injury rates as high school and collegiate athletes. Bush et al. (2021) surveyed the top twenty athletes from the USA weightlifting team in each weight class. One-hundred-forty-one athletes completed the survey. SS ages were separated using the international weightlifting federations levels of youth (<16 years old) and junior (17 – 20 years old) classification. Athletes specializing in weightlifting at the youth level were more likely to experience an injury before age 21 than those specializing during the junior level. Wilhelm et al. (2017) surveyed 102 current professional baseball players.

Forty-eight percent were identified as ESS (specializing in baseball before high school). ESS athletes reported more severe injuries during their professional baseball careers than those specializing in baseball during or after high school. In addition to increasing injuries to ESS athletes, Branta (2010) argues that athletes who specialize in one sport early may not develop all the fundamental motor skills needed that an athlete who participates in several sports will. As a result, ESS athletes may become adults who are not comfortable participating in physical activity, decreasing the amount of movement they accumulate.

### ***Psychosocial Consequences of SS***

There are psychosocial effects associated with SS, such as increased stress, burnout, isolation, and dropout rates. Both Boyd et al. (1996) and Law et al. (2007) reported that ESS in athletes could decrease enjoyment of the sport. Similarly, McFadden et al. (2016) indicated ESS athletes had a higher dissatisfaction score than early samplers (tried many sports) and recreational multisport athletes. A variety of factors may cause athletes to feel dissatisfied while participating in their sport. Martens (1993) indicated that youth involved in intense, deliberate practice might encounter increased pressure to win and have sports-related experiences that decrease self-confidence and self-esteem. When youth decide to specialize in one sport early, they often give up other activities because of the time commitment required by additional practices, competition, and travel. Malina (2010) and Wiersma (2000) suggest that the extra time youth spend in their sport can isolate them from peers, family, and parents. Contrary, Strachan et al. (2009) reported that early sport samplers had a more integrated sports experience with their family and community. There may be negative consequences when youth athletes are not having fun in their sport, feel more pressured to win, and are isolated from family and friends. In a survey of athletic directors, Hill & Simons (1989) reported that most athletic directors (55.6%) thought SS increases the chance of burnout in youth athletes.

Furthermore, Strachan et al. (2009) reported higher levels of emotional exhaustion in athletes classified as sport specialists versus those classified as sport samplers. When athletes are exhausted and are experiencing burnout, they may be more likely to quit participating in their sport than those not experiencing burnout. Wall & Côté (2007) found that AAA hockey players who dropped out of the sport were more likely to have begun training at an early age and participated in more off-ice training than those starting at a later age and participated in little off-ice training. Comparably, Fraser-Thomas et al. (2008) reported Canadian competitive age-group swimmers that had dropped out of participation were involved in training camp and dryland training at an earlier age than those who did not drop out. Many factors influence an athlete's decision to quit; more research is needed to identify how dissatisfaction, increased pressure to win, and isolation contributes to their choice.

### **Why Athletes Specialize**

It is impossible to isolate one specific reason youth athletes decide to SS. Identifying key indicators such as adult pressure, increased commercialization, and a desire to compete beyond high school helps increase understanding of the mechanics of the decision to specialize in one sport. Adults have an impact on youth. Several studies (Baxter-Jones & Maffulli, 2003; DeKnop et al., 1996; Hill & Simons, 1989; & Jayanthi et al., 2013) have identified parents and coaches as strong influencers over when to begin sport participation and when to specialize in one sport. Parents unknowingly apply pressure on their children to excel by paying for sports summer camps, clinics, private lessons, and providing specialized sports equipment in their homes (Carnwell, 1987).

Another factor affecting youth athletes' perception of the importance of SS is the commercialization of youth sport. Anderson & Mayo (2015) argue that "increasing privatization and corporatization of sports have contributed to a push toward early specialization in a single

sport” (p. 230). Youth sports are a multibillion-dollar industry; it benefits companies to encourage youth athletes to participate in specialized sports training. It often requires large amounts of equipment and several different coaches who focus on various aspects of the sport (Wagner et al., 2010). More youth programs are structured (Ewing et al., 1996 & Luckstead & Grevdanus, 1993), leading to an increase of travel teams, often promoting year-round participation in the sport. These travel teams are starting for athletes as young as ten years old (Malina, 2010). The prevalence of travel teams may force youth to choose what sport they want to participate in at an earlier age. The rise in the attention of successful young athletes is another outcome of youth sport commercialization. The Hoop Scoop nationally ranks players in sixth to twelfth grades (Farrey, 2008). The Football University broadcasts games of talented sixth to ninth-grade players (Evan & Thamel, 2009). Additionally, there is the enticement of potential financial rewards and stardom if the youth athlete becomes successful in their sport (Smith, 2015). With increased media attention on young standout athletes, many youths chose to specialize in one sport with the hopes of being noticed.

A third factor impacting the decision to specialize in one sport is the desire to increase skills and performance sufficiently to compete at the collegiate, professional, or Olympic level (Bell et al., 2018; Brooks et al., 2018; Malina, 2010; Mostafavifar et al., 2013; & Post et al., 2018). The pressure to excel comes from the athletes internally and externally from parents and coaches (Gould et al., 2009; Myer et al., 2015; & Padaki et al., 2017). There is limited research supporting ESS to reach a competitive level beyond high school. More information is needed to understand youth’s complex decisions about SS fully.

### **Trends in Sport Specialization**

As early as the 1980s, there was a noticeable trend in athletes specializing in a single sport (Smith, 2015). Since then, experts in the field have reported that the trend of SS has

continued to rise, and there has been a decrease in the age of sport specialization (Coakley, 2009; Hill & Simon, 1989; Jayanthi et al., 2013; Landers et al., 2010; Lloyd et al., 2016; Mostafavifar et al., 2013; Myer et al., 2015; Tenforde et al., 2022; & Wiersma, 2000). In contrast, though more youth specialize in one sport at an early age, youth stop participating in sport every year (Ewing et al., 1990; Durant et al., 1991; & Petlichkoff, 1992). O'Sullivan (2013) reported that 70% of youth drop out of organized sport by age 13. Consequently, many youths quit participating in sports before they leave high school.

### **Sport Specialization Recommendations**

Several medical organizations and sports governing bodies have published recommendations and statements regarding youth SS. The American Academy of Pediatrics (2000) discourages youth from specializing before adolescence (age 12) to avoid psychological and physical harm. The American Medical Society for Sport Medicine (DiFiori et al., 2014) acknowledges that ESS (at or before age 12) may increase the risk of overuse injuries and burnout. The American Orthopaedic Society for Sports Medicine (LaPrade et al., 2016) states that ESS is not required for the highest levels of success and believes it to be unhealthy, both physically and mentally, for young athletes. The National Athletic Trainer's Association (Valovich et al., 2011) indicates ESS has the potential for repetitive microtrauma and overuse injuries; it may be associated with psychological and socialization issues, possibly even burnout. The National Strength and Conditioning Association, USA Hockey, USA Basketball, USA Swimming, and the US Olympic and Paralympic Committee all recommend youth participate in early sport sampling and refrain from ESS (Lloyd et al., 2016; USA Basketball; USA Hockey; USA Swimming; & US Olympic & Paralympic Committee). Despite these recommendations, it is clear from the research about the trends in youth sport specialization that there is an increase in SS.

## Youth Athlete Training Models

In contrast to ESS and to possibly combat its negative consequences, several athlete developmental programs have been created to provide a framework for coaches and youth athletes to follow. Three common models are the Long-Term Athlete Development Model, the American Development Model, and the Developmental Model of Sport Participation. Each model is different, but all are foundationally based on early sport sampling and late SS.

### *Long-Term Athlete Development Model*

In the 1990s, Istvan Balyi designed a framework to develop elite athletes and physical literacy for the British Columbian and Canadian sport systems named the long-term athlete development model (LTAD) (Balyi, 2001). The model is based on five stages and is grounded in the theory that fundamental movement skill development occurs best between nine and twelve years old (Russhall, 1989 & Viru et al., 1998). Each governing sports body is recommended to develop its own specific plan (Balyi, 2001). A summary of the stages is found in Table 1.

**Table 1.**

### *Summary of Long-Term Athlete Development Model Stages*

Stage	Description
FUNdamentals	<ul style="list-style-type: none"><li>• Develop fundamental movement skills</li><li>• Enjoy being active</li><li>• Boys ages 6 – 9 yrs., Girls ages 6 – 8 yrs.</li><li>• Emphasis on participation and FUN</li><li>• Activities should develop agility, balance, coordination, &amp; speed (ABCs)</li><li>• Focus on fair play and respect</li><li>• Simple rules and etiquette of the sport</li><li>• Competition should be informal, not record of results</li><li>• 50% free play, 35% adult-led play, 15% instruction</li></ul>
Learn to Train	<ul style="list-style-type: none"><li>• Learn a wide range of foundational sports skills</li><li>• Boys ages 9 to &amp; girls 8 to the onset of the adolescent growth spurt</li><li>• Wide range of sports</li><li>• Build up physical capacities</li></ul>



	<ul style="list-style-type: none"> <li>• Introduce warm-up/cool down, nutrition, hydration, &amp; recovery</li> <li>• Introduce formal local competitions, emphasis on fair play, opportunities to try different positions</li> <li>• Sport-specific training 3x week, plus other sports/activities 3x week</li> <li>• Three or more sports divided equally during the year</li> <li>• Technical skills, tactical skills, physical capacity, life skills, &amp; mental skills</li> <li>• 70% training, 30% competition/competition-specific training</li> </ul>
Train to Train	<ul style="list-style-type: none"> <li>• Early adolescence – boys 12 – 16, girls 11-15</li> <li>• Skill refinement</li> <li>• Greater position/event specialization</li> <li>• Introduce free weight, emphasis on correct technique</li> <li>• Develop respect, fair play</li> <li>• Single or double periodization</li> <li>• 60% training, 40% competition/competition-specific training</li> <li>• 66% of the year for main sport, other sport 33%</li> <li>• Technical skills, tactical skills, physical capacity, mental skills, life skills</li> <li>• Podium ID &amp; development</li> </ul>
Podium pathway	
Train to Compete	<ul style="list-style-type: none"> <li>• Beyond the end of the adolescent growth spurt</li> <li>• Specialization in sport, position, or event</li> <li>• Training to maximize development</li> <li>• Selected sport 100% of the year</li> <li>• 60 % competition/competition-specific training, 40% training</li> </ul>
Train to Win	<ul style="list-style-type: none"> <li>• Specialized coaching in a specialized training environment</li> <li>• Podium performances at the highest level, international events</li> <li>• 70% competition/competition-specific training &amp; 30% training</li> </ul>
Active for Life	
Competitive for Life	<ul style="list-style-type: none"> <li>• Compete withing formal structure of sport, but not elite level</li> <li>• Striving to improve and win</li> <li>• Train accordingly</li> </ul>
Fit for Life	<ul style="list-style-type: none"> <li>• Participate for the satisfaction</li> <li>• Recreational competition from time to time, but not the primary purpose</li> </ul>

Higgs et al., 2019

## *American Development Model*

USA Hockey first developed and implemented the American Development Model in 2009 (USA Hockey & US Olympic and Paralympic Committee), influenced by Balyi's LTAD model (2001). The National Governing Bodies of Sport (NGBs) partnered with the US Olympic & Paralympic Committee to adopt the model. Five fundamental principles guide quality sports experiences (US Olympic & Paralympic Committee).

1. There should be universal access to create opportunities for all athletes
2. Provide developmentally appropriate activities that emphasize motor and foundational skills
3. Encourage multisport or multi-activity participation
4. The atmosphere should be fun, engaging, and progressively challenging
5. There should be quality coaching at all age levels

A summary of the five stages is found in Table 2.

**Table 2.**

### *Summary of American Development Model Stages*

Stage	Description
Discover, learn & play (ages 0 -12)	<ul style="list-style-type: none"><li>• Have fun</li><li>• Unstructured play is used to sample multiple sports</li><li>• Develop transferable motor skills</li><li>• Develop a passion for an active life and sport</li><li>• Learn to socialize with others</li><li>• Learn fundamental movements</li><li>• Use size and age-appropriate equipment</li><li>• Learn rules of games</li></ul>
Develop and challenge (ages 10-16)	<ul style="list-style-type: none"><li>• Learn rules and techniques of the sport</li><li>• Participate in multiple sports</li><li>• Compete at local/regional level</li><li>• Emphasis on practice and skill development over competing</li><li>• Develop speed, agility, balance, endurance, strength, and coordination</li></ul>

	<ul style="list-style-type: none"> <li>• Develop teamwork communication skills, and learn how to adapt to the challenges of sports</li> <li>• Identify areas to improve, with emphasis on correct mechanics</li> </ul>
Train and compete (ages 13-19)	<ul style="list-style-type: none"> <li>• Begin to focus on particular sports</li> <li>• Cross-sport development through multisport play</li> <li>• It should be a fun, structured, ongoing training program</li> <li>• Focused training through coaching</li> <li>• Maintain a consistent training schedule</li> <li>• Increase sport-specific training</li> <li>• Emphasize competition skills</li> <li>• Participate in development camps</li> <li>• Compete at the club, middle school, high school, local, regional, and national level (the level of competition should match athlete skill level)</li> </ul>
Excel for high performance (ages 15+)	<ul style="list-style-type: none"> <li>• Maximize athletic potential</li> <li>• Maintain ongoing and/or long-term training program</li> <li>• Master and/or elite-level coaching</li> <li>• High-performance focus</li> <li>• Elite national and international competitions (level of competition should match athlete skill level)</li> </ul>
Participate and succeed (ages 15+)	<ul style="list-style-type: none"> <li>• Participate in sports to have fun</li> <li>• Cross-sport development through multisport play</li> <li>• Focus on enjoyment and health benefits of sports participation</li> <li>• Be active and involved</li> <li>• Compete for challenge and fun</li> <li>• Local, regional, or sports club competition to meet the needs of the athlete</li> </ul>
Mentor and thrive (active for life)	<ul style="list-style-type: none"> <li>• The transition from participant to coach or advocate</li> <li>• Remain involved in sport</li> <li>• Maintain a physically active, healthy lifestyle</li> <li>• Be involved as a certified coach, sports club manager, official, or as a member of an NGB</li> <li>• Support local and national sports programs</li> <li>• Maintain regular exercise</li> <li>• Compete recreationally</li> </ul>

<https://www.teamusa.org/About-the-USOPC/Coaching-Education/American-Development->

Model/Stages

### *Developmental Model of Sport Participation*

The developmental model of sports participation (Côté, 1999 & Côté & Vierimaa, 2014) identifies two pathways an athlete may follow. These are early sampling characterized by participating in various sports, and deliberate play or ESS focused on a high volume of deliberate practice in one sport, focusing on performance as early as six years old. Although the model recognizes the two pathways, it focuses on the importance of early sport sampling. Seven postulates provide a framework for the model (Côté, 1999 & Côté & Vierimaa, 2014).

1. Early sampling does not hinder elite sport participation in sports where peak performance is reached after maturation
2. Early sampling is linked to a longer sports career and has positive implications for long-term sports involvement.
3. Early sampling allows participation in various contexts that most favorably affect positive youth development.
4. During the sampling years, high amounts of deliberate play build a solid foundation of intrinsic motivation through enjoyable activities and promote inherent regulation.
5. During the sampling years, a high amount of deliberate play creates a range of motor and cognitive experiences children can bring to their principal sport of interest.
6. Around the age of 13, children should have the opportunity to either specialize in their favorite sport or continue in sport at a recreational level.
7. Around the age of 16, youth have developed the physical, cognitive, social, emotional, and motor skills needed to devote their effort to highly specialized training in one sport.

## **Performance and Sport Specialization**

Research has shown the possibility of physical and psychological negative consequences when youth specialize in sport and even more with ESS (Bell et al., 2016; Boyd et al., 1996; Brenner, 2007; DiFiori et al., 2014; Jayanthi et al., 2013; Jayanthi et al., 2015; Law et al., 2007; Malina, 2010; McFadden et al., 2016; Strachan et al., 2009; Wiersma, 2000; & Wilhelm et al., 2017). Medical organizations have recommended against ESS (American Academy of Pediatrics, 2000; DiFiori, 2014; LaPrade et al., 2016; & Valovich et al., 2011), and sport governing bodies have encouraged early sport sampling (USA Basketball, USA Hockey, US Olympic and Paralympic Committee, & USA Swimming). Youth athlete development models are designed to provide a framework whereby coaches, parents, and athletes can make sports participation and training decisions (Balyi, 2001; Côté 1999; & US Olympic & Paralympic Committee). Although much of the literature contraindicates the use of SS, there is still a trend of increasing youth SS (Jayanthi et al., 2013; Hill & Simons, 1989; & Mostafavifar et al., 2013).

A desire for successful athletic performance may indicate why youth specialize in one sport despite the overwhelming evidence this strategy may actually be detrimental to long-term athletic potential. After reviewing the literature in youth SS, Hecimovich (2004) concluded that no data currently exists to confirm or deny the effects of sport specialization on athletes who reached levels of greatness. Since then, Jayanthi et al. (2013) determined there is no evidence that ESS is necessary; in fact, it may be detrimental to sports performance. Delaying SS until late adolescence (15 – 16 years) could minimize risks and may increase the athletes' chance of success (Coakley et al., 2010; DiFiori et al., 2014; Jayanthi et al., 2013; Jayanthi et al., 2015; Malina, 2010; & Mostafavifar et al., 2013). Tucker and Collins (2012) indicate that athletic success is dependent on multiple factors, genetics being one of them, which is not determined by the number of hours an athlete trains. Recent mainstream media has added to the argument for early sport sampling by highlighting the success of multisport athletes (Cary, 2004; Geier, 2015;

Hong, 2014; & Wagner et al., 2010). While the research mentioned in this section is not an exhaustive list indicating whether athletes who specialize in one sport are more successful, it warrants further investigation of athletes who have experienced achievement in their sport.

### **Collegiate Athletes' Prevalence of Sport Specialization**

One of the main reasons youth athletes give as to why they specialize in one sport is to improve their skills enough to play beyond high school (Brooks et al., 2018; Gould et al., 2009; Myer et al., 2015; Padaki et al., 2017; & Post et al., 2018). According to the research (Coakley et al., 2015; DiFiori et al., 2014; Jayanthi et al., 2013; Jayanthi et al., 2015; Malina, 2010; & Mostafavifar et al., 2013), there is inconclusive evidence that ESS precludes successful athletic careers. Identifying the prevalence of SS in collegiate athletes strengthens the understanding ESS has on long-term athletic performance. The following six articles (Black et al., 2019; Buckley et al., 2017; DiFiori et al., 2019; Martin et al., 2017; Post et al., 2017; & Swindell et al., 2019) are reviewed in four categories (1) age of competitive sports initiation, (2) age of sport specialization, (3) differences between sports classifications, and (4) motivation to specialize.

#### ***Age of Competitive Sport Initiation***

It is hypothesized that athletes who start their sport at a younger age will reach a higher level of performance than those who begin at a later age, even with similar training intensities (Helsen et al., 1998 & Henschen, 1998). Starting sport participation at a young age allows the athlete to accumulate the assumed hours to achieve expertise (Deakin, 2003; Helsen et al., 1998; Starkes et al., 1996; & Ward et al., 2007). Age of sports initiation is analyzed to ascertain if it could contribute to improved athletic performance.

DiFiori et al. (2019) compared student-athletes ( $n = 273$ ; female = 138; male = 135) to non-student athletes ( $n = 155$ ; female = 78; male = 77) from one DI university. All subjects in this research had previously participated in US youth sports programs. The student-athletes

represented all nineteen NCAA sports offered at the university. These sports included the following: football ( $n = 33$ ), track and field (female  $n = 27$ , male  $n = 18$ ), women's swimming and diving ( $n = 26$ ), water polo (female  $n = 10$ , male  $n = 19$ ), baseball ( $n = 17$ ), soccer (female  $n = 9$ , male  $n = 17$ ), softball ( $n = 17$ ), women's gymnastics ( $n = 15$ ), volleyball (female  $n = 10$ , male  $n = 15$ ), tennis (female  $n = 12$ , male  $n = 4$ ), basketball (female  $n = 1$ , male  $n = 10$ ), and golf (female  $n = 7$ , male  $n = 6$ ). No differences were discovered in age of sport initiation between the student-athletes ( $7.2 \pm 2.6$  yrs.) and non-student athletes ( $7.7 \pm 3.5$  yrs.). However, a larger percentage of student-athletes (80%) began sports participation before the age of 10 yrs. compared to non-student athletes (63%). Based on these results, starting sport participation at a young age may be a factor in assisting athletes to compete beyond high school.

Buckley et al. (2017) found similar results surveying DI and DII student-athletes ( $n = 856$ ; female = 339; male = 517). Seventeen sports were represented, including baseball, basketball, cheerleading, field hockey, football, ice hockey, lacrosse, soccer, softball, volleyball, water polo, cross-country, bowling, swimming and diving, golf, tennis, and track and field. The mean age for sport initiation of these athletes in their chosen sport was  $7.6 \pm 3.2$  yrs.

Black et al. (2019) only surveyed ice hockey players at one DI ( $n = 25$ ) and one DIII ( $n = 24$ ) university. The mean age of sports initiation for the DI athletes was 4.4 yrs. The mean age of sports initiation for the DIII athletes was 4.3 yrs.

Martin et al. (2017) surveyed 1036 athletes (female  $n = 466$ , male  $n = 559$ , not specified  $n = 11$ ) from three DI universities. Seventeen sports were represented in this study. These sports included baseball ( $n = 65$ ), basketball ( $n = 51$ ), cross-country ( $n = 73$ ), field hockey ( $n = 27$ ), figure skating ( $n = 11$ ), football ( $n = 20$ ), golf ( $n = 46$ ), gymnastics ( $n = 37$ ), ice hockey ( $n = 21$ ), not specified ( $n = 9$ ), rowing ( $n = 39$ ), soccer ( $n = 110$ ), softball ( $n = 20$ ), swimming and diving ( $n = 72$ ), tennis ( $n = 42$ ), track and field ( $n = 114$ ), volleyball ( $n = 31$ ), wrestling ( $n = 64$ ).

Only sports with thirty-five or more responses were included in the final analysis. After initial review, no differences in mean ages of sports initiation were found between the sexes; therefore, sports representing males and females were treated as a single sport. It was discovered that the mean age of sports initiation for the athletes was  $9.10 \pm 3.83$  yrs. Soccer, baseball, wrestling, tennis, and gymnastics athletes started participating in their sport at a significantly younger age than football, track and field, cross-country, swimming and diving, basketball, golf, and rowing athletes.

The age of sports initiation ranged from four to nine years old. The ice hockey players began participating in sport at the youngest age. Although the age of sports participation may not indicate successfully competing beyond high school, further research identifying if a correlation exists between the age of sports initiation and participating in collegiate sports may imply the importance of commencing sports participation at a young age.

### ***Age of Sport Specialization***

Based on recommendations from several medical organizations (American Academy of Pediatrics, 2000; DiFiori et al., 2014; LaPrade et al., 2016; & Valovich et al., 2011), SS should not occur at or before the age of twelve. Athletes have indicated that they decide to specialize in one sport to be skilled enough to compete at the collegiate or professional level (Gould et al., 2009; Myer et al., 2015; & Padaki et al., 2017). It is essential to survey current collegiate athletes to identify the age of their SS to confirm or refute the belief that it is necessary to specialize in one sport to play at that level.

Swindell et al. (2019) surveyed 303 NCAA DI athletes (female = 174; male = 129) participating in 19 different sports from two different institutions. The sports included archery ( $n = 2$ ), rowing ( $n = 42$ ), water polo ( $n = 1$ ), wrestling ( $n = 4$ ), squash ( $n = 6$ ), cross-country ( $n = 6$ ), golf ( $n = 7$ ), tennis ( $n = 7$ ), volleyball ( $n = 8$ ), lacrosse ( $n = 10$ ), softball ( $n = 11$ ), fencing ( $n =$



12), field hockey ( $n = 13$ ), basketball ( $n = 13$ ), baseball ( $n = 14$ ), soccer ( $n = 23$ ), swimming and diving ( $n = 24$ ), football ( $n = 36$ ), and track and field ( $n = 42$ ). Of the 303 athletes, the researchers classified 281 (92.7%) as specialized in one sport (“year-round training and participation in a single sport at the exclusion of other sports,” p. 2). The overall mean age of SS was  $14.9 \pm 3.06$  yrs. It was reported that females specialized in one sport at a younger mean age ( $14.7 \pm 3.14$  yrs.) compared to males ( $15.1 \pm 2.93$  yrs.). Three sports reported a mean age of SS meeting ESS classification (at or younger than 12 yrs.). Tennis athletes specialized in their sport at the youngest mean age of  $11.6 \pm 3.60$  yrs. The next two youngest reported mean ages of SS were in swimming and diving ( $12.4 \pm 3.36$  yrs.) followed by fencing ( $12.8 \pm 1.82$  yrs.). The two sports that reported the oldest mean age of SS were water polo ( $18.0 \pm 0$  yrs.) and archery ( $18.5 \pm 0.71$  yrs.). Furthermore, Swindell et al. (2019) looked at the percentage of athletes classified as early sport specialists. It was discovered that 17.4% of athletes specialized in one sport before age twelve across all sports. The low percentage of athletes specializing in their sport at or below 12-years indicates most athletes were early sport samplers.

DiFiori et al. (2019) found that the DI student-athletes specialized in one sport at a significantly ( $p = 0.002$ ) later age ( $15.4 \pm 2.7$  yrs.) compared to non-student athletes ( $14.3 \pm 2.6$  yrs.) from the same school.

Black et al. (2019) reported a mean age of SS of the DI ice hockey athletes as 14.5 yrs. Of the twenty-five athletes, 12% ( $n = 3$ ) indicated they specialized in ice hockey before 12 yrs. The DIII ice hockey athletes specialized in one sport at a mean age of 14.6 yrs. Of the twenty-four athletes, 12% ( $n = 3$ ) specialized in ice hockey before 12 yrs.

Martin et al. (2017) reported that 41.70% ( $n = 432$ ) of the athletes indicated they specialized in one sport before college. The mean age of those specializing in one sport was  $12.43 \pm 3.78$  yrs. According to the definition of ESS (Balyi, 2001; Côté et al., 2014; LaPrade et al.,

2016; Malina, 2010; Mendes et al., 2018; Moseid et al., 2019; Mostafavifar et al., 2013; Santos et al., 2017; & Strom et al., 2012), the athletes of this study are classified as early sport specialists. Of the sports analyzed ( $n > 35$ ), gymnastics ( $n = 37$ ), tennis ( $n = 42$ ), wrestling ( $n = 64$ ), and soccer ( $n = 110$ ) all reported mean ages of SS below 12 yrs. ( $8.41 \pm 3.33$  yrs.,  $10.04 \pm 3.38$  yrs.,  $11.10 \pm 4.37$  yrs., &  $11.30 \pm 4.32$  yrs.). Track and field ( $n = 114$ ) and baseball ( $n = 65$ ) reported the oldest mean age of SS ( $14.78 \pm 2.26$  yrs. &  $15.44 \pm 1.46$  yrs.).

Buckley et al. (2017) reported that 67.7% ( $n = 580$ ) of athletes quit other sports to focus on one sport. The mean age of SS was  $14.8 \pm 2.5$  yrs.

Post et al. (2017) surveyed 343 NCAA DI athletes (female  $n = 115$ , male  $n = 228$ ) from nine different sports including basketball (female  $n = 17$ , male  $n = 13$ ), golf (female  $n = 5$ , male  $n = 7$ ), ice hockey (female  $n = 25$ , male  $n = 27$ ), soccer (female  $n = 23$ , male  $n = 26$ ), tennis (female  $n = 12$ , male  $n = 2$ ), football ( $n = 115$ ), softball ( $n = 19$ ), wrestling (male  $n = 38$ ), and volleyball (female  $n = 14$ ). The researchers did not report a specific mean age of SS. The researchers used a 3-point scale (Jayanthi et al., 2013) based on the following questions: (1) Have you quit another sport to focus on your primary sport? (2) Do you consider your primary sport more important than your other sports? And (3) Do you train more than eight months a year in your primary sport? One point is given to each affirmative answer and athletes are classified as low (score = 0-1), moderate (score = 2), or high (score = 3) SS. The researchers reported that scores on the SS scale significantly increased as athletes progressed from freshman to senior year in high school. Additionally, there was no difference in the SS scale between sexes at any grade level. The non-football athletes reported a higher SS score than the football athletes.

Most of the research studies (Black et al., 2019; Buckley et al., 2017; DiFiori et al., 2019; & Swindell et al., 2019) reported a mean age of SS older than twelve years old, indicating most of the collegiate athletes surveyed did not specialize early in their chosen sport. Martin et al. (2017)

was the only study whose mean age of SS classified the athletes as early sport specialists. However, Martin et al. (2017) surveyed more individual-based sports which have lower SS ages. Identifying collegiate athletes' SS age is vital since competing beyond high school is one of the main reasons youth decide to specialize in one sport (Bell et al., 2018; Brooks et al., 2018; & Post et al., 2018). Since most collegiate athletes do not participate in ESS, the reason to wait to specialize in one sport until late adolescence strengthened.

### ***Differences Between Type of Sports***

Sports that require athletes to compete as a team are classified as team sports, whereas individual sports are characterized by athletes competing individually (Lorimer & Jowett, 2009). Team-based sports include baseball, basketball, field hockey, football, ice hockey, lacrosse, soccer, softball, volleyball, and water polo. Individual-based sports include cross-country, bowling, swimming and diving, golf, tennis, and track and field. Outcomes of individual sports rely solely on the athlete, whereas the whole team is responsible for the result of a team sport (Mroczkowska, 1997). The added pressure of an individual sport athlete to be successful may elicit a stronger desire for an athlete to focus earlier on their chosen sport. Individual sport athletes have been found to have higher conscientiousness, autonomy, and ego orientation (Hanrahan & Cerin, 2009; Nia & Besharat, 2010), which may, in turn, increase their desire to specialize in their chosen sport earlier in their youth than team-based sports athletes. Although Allen and Laborde (2014) postulate that sports participation may influence personality development, it is possible that personality may affect the type of sport the athlete selects. Therefore, it is difficult to determine whether athletes specialize in one sport during youth early because they compete in an individual sport. Identifying differences between team-based and individual-based sports athletes' SS age adds to the knowledge of SS patterns of collegiate athletes.

Swindell et al. (2019) reported that 39.1% ( $n = 110$ ) of individual-based sports athletes specialized in their chosen sport at a mean age of  $14.0 \pm 1.98$  yrs. Of those that specialized, 21% ( $n = 23$ ) specialized in their respective sport at, or younger than, 12 yrs. of age. Team-based sports athletes reported 60.9% ( $n = 172$ ) specialization in their chosen sport at a mean age of  $15.5 \pm 1.52$  yrs. Of those athletes, only 13.1% ( $n = 23$ ) did so at or before 12 yrs. of age. These findings revealed significant differences in the mean age of SS across all team-based sport and individual-based sports athletes. Individual-based athletes specialized in one sport at a younger mean age than the team-based sports athletes did. Additionally, male individual-based sports athletes specialized in one sport at a significantly younger age ( $14.0 \pm 3.01$  yrs.) than team-based athletes ( $16.1 \pm 2.52$  yrs.). In contrast, there was no significant difference between the mean female ages of SS for team-based ( $15.0 \pm 2.78$  yrs.) and individual-based ( $14.5 \pm 3.35$  yrs.) sports athletes.

Buckley et al. (2017) reported that 159 individual-based athletes and 657 team-based athletes were classified as sport specialists. There was a significant ( $p = .004$ ) difference in the number of athletes who specialized in one sport between individual-based and team-based sports. Of the athletes who specialized in one sport, 81% ( $n = 129$ ) were individual-based athletes, and 66% ( $n = 436$ ) were team-based sports athletes. Moreover, the individual-based athletes specialized in one sport at a significantly ( $p = .031$ ) younger mean age ( $14.3 \pm 2.63$  yrs.) than the team-based athletes ( $14.9 \pm 2.39$  yrs.).

There was a significant difference in the mean age of SS between the team- and individual-based sports athletes. Individual-based sports athletes specialized in one sport earlier than team-based sports athletes. This may indicate a need for youth athletes involved in individual-based sports to consider an earlier SS age. Nevertheless, it should be noted that the mean age of SS was older than twelve years old, indicating they did not specialize in one sport early.

### *Motivation to Specialize*

Understanding why athletes specialize in one sport as a youth can help inform parents and coaches' decisions in guiding youth to specialize in one sport or not. There is anecdotal evidence that young athletes are pushed into ESS by parents/guardians and coaches to help them excel in the sport of their choice. Nevertheless, this review found that a small percentage of collegiate student-athletes specialized early in the sport they were currently competing in. Most athletes decided to specialize in their chosen sport during youth based on their desire to improve their skills or love their sport. Youth athletes' desire to improve may underlie the expectation of a higher chance to play beyond high school if they are the best on their team. Further research needs to focus on why athletes desire to improve their sports skills and from where that desire stems.

Swindell et al. (2019) asked athletes to identify the most compelling reason they specialized in one sport; overall, the top four answers were:

- Personal interest to only participate in one sport
- An increased skill level in one sport
- Time constraints of participating in more than one sport
- The desire to improve their chances of earning a scholarship to play beyond high school

When responses were separated into the team- and individual-based sports, athletes indicated similar influences on their decisions to specialize in one sport, except individual-based sports athletes. They also indicated coach and parental impact as a factor in their choice. Individual-based sport athletes were significantly influenced more by time constraints ( $p = .019$ ), a desire for a college scholarship ( $p < .001$ ), and professional aspirations ( $p < .001$ ) than were team-based sport athletes. While the researchers' result suggests personal interest, high skill level, and time constraints as more important to athletes than earning a scholarship, they acknowledge that

aspirations to compete at a high level may be more important to individual-based athletes. This could indicate that the motivation for SS differs depending on the athlete's sport.

Post et al. (2017) identified the three most important reasons athletes specialize in one sport: the enjoyment of one sport more than another, a desire to earn a college scholarship, and a desire to be the best at their chosen sport. Only 9.9% of the athletes in this research ( $n = 34$ ) identified parental influences as their most important reason to specialize in one sport. The researchers reported that the majority of athletes they surveyed did not indicate the influence of parents and coaches as the reason to specialize in one sport, even though this is thought to be the driving force behind the increasing trend of youth SS (Bergeron et al., 2015 & Myer et al., 2015).

Black et al. (2019) reported a difference between DI and DIII athletes' reason they decided to specialize in ice hockey. Twenty-four (96%) of the 25 DI athletes reported intrinsic motivation as the reason to specialize in ice hockey. The additional athlete identified their parent as the most significant influence on their SS decision. Similarly, twenty-one (87%) of the 24 DIII athletes identified intrinsic motivation as the reason to specialize in ice hockey. The remaining three athletes listed peer, parent, and coach as the reason for SS. Unfortunately, the researchers of this article did not elaborate on the reasons for their SS; therefore, it is difficult to know what aspect of internal motivation, parents, peers, and coaches influenced the athlete to specialize in ice hockey.

Martin et al. (2017) did not ask athletes their motivation for SS; instead, they used a Likert-like scale to determine athlete perceptions regarding the importance of SS before freshman year in high school and at any time during high school. Across all sports, the perceived importance of specializing in one sport before high school was close to the mid-point of the 9-point scale ( $M = 4.95 \pm 2.76$ ), indicating athletes viewed SS as neither important nor unimportant. The researchers found no difference in perception of the importance of SS before freshman year

or at any point during high school. There was a trend of the increased importance of SS from freshman to senior year. The rise in perception of the importance of SS during high school may be attributed to the presence of college recruiters and coaches' attention on athletes in the later years of high school, focusing on the potential to compete at a higher level. The study identified differences between the various sports. Baseball and football athletes showed low importance of specializing in one sport before high school. In contrast, gymnasts and soccer athletes attributed high importance to specializing in one sport before high school. The difference in perception of SS importance may be credited to the variations of the sports. Gymnasts tend to peak at an earlier age (Strachan et al., 2009), which is why they may view specializing in one sport earlier as important.

Athletes from these six studies (Black et al., 2019; Buckley et al., 2017; DiFiori et al., 2019; Martin et al., 2017; Post et al., 2017; & Swindell et al., 2019) began participating in sports between the ages of four and nine. The ice hockey athletes (Buckley et al., 2017) were the youngest to initiate sports participation. The average age of SS was greater than twelve years, indicating collegiate athletes do not specialize in one sport early. Individual-based sports athletes tend to specialize in their chosen sport at early mean ages than team-based sports athletes. Although there is the perception that parents and coaches are the strongest influencers on an athletes' decision to specialize in one sport, these studies indicate that personal interest, enjoyment, and intrinsic motivation are the top reasons. A limitation of the current research is the strong focus on DI athletes. Only a part of the collegiate athlete population has been studied, providing an incomplete understanding of SS patterns. Additional school classifications should be investigated to add to the already gathered information.

## CHAPTER III

### METHODS

The primary purpose of this study was to identify if significant differences exist in sport specialization age among collegiate athletes by sex, university classification, and sport type. Before the commencement of this study, approval was obtained from the Oklahoma State University's Institution Review Board (Appendix A). Due to the nature of this research, exempt status was granted for this investigation.

#### *Participants*

Participants included current athletes from NAIA (N=431) and NCAA DII (N=518) institutions. Additionally, archival data gathered from NCAA DIII (N=661) athletes' survey responses were used in this analysis. A total of 1094 female and 516 male surveys were analyzed. Twenty sports represented were baseball (n = 166), basketball (n = 155), cross country (n = 118), field hockey (n = 34), football (n = 39), golf (n = 80), gymnastics (n = 11), ice hockey (n = 4), lacrosse (n = 122), rowing (n = 9), soccer (n = 182), softball (n = 177), swimming/diving (n = 108), tennis (n = 36), track and field (n = 73), volleyball (n = 288), and wrestling (18). Bowling (n = 7), fencing (n = 10) and skiing (n = 3) were the additional sports athletes wrote in under the other category. Of the 1610 surveys, 1160 were from team-based sports and 430 from individual-based sports.



## ***Procedures***

Emails for coaches belonging to NAIA and NCAA sanctioned sports were gathered from all NAIA and NCAA DII institution athletic websites. Once this list was completed, a recruitment letter with a survey link was sent via email to each coach. If the coach agreed to participate, they were asked to electronically share the survey link with their athletes. Once athletes received notification from their coach, they clicked on the survey link, read the consent form, and clicked on the link to complete the anonymous survey if they agreed to participate. This survey took approximately five minutes to complete. For comparative purposes, archival data previously from NCAA DIII athletes completing the survey were also included in this analysis. Identical procedures were followed to obtain the archived survey data collected from the NCAA DIII athletes used in this analysis.

## **Survey Instrument**

The survey used in this study was a researcher-developed nineteen-item questionnaire (Appendix 2) administered electronically via an internet link [https://okstatecoe.az1.qualtrics.com/jfe/form/SV\\_00L9f2x8UpwdLUx](https://okstatecoe.az1.qualtrics.com/jfe/form/SV_00L9f2x8UpwdLUx) (Qualtrics, Provo, UT). Prior to using this instrument, it was reviewed by an expert in youth athlete development (I. J.), a researcher familiar with using online surveys, and piloted with a class of undergraduate students. Individuals in the field reviewed the survey. The survey asked the athlete to recall their participation in sports prior to their collegiate experience. Questions included information related to their sex, university classification, current sport, age of competitive sport initiation, whether the athlete specialized, age of specialization, size of high school, and reason for specialization. There is a concern of data reliability when asking participants to recall information from previous experiences. Data is more reliable and accurate when participants recall habitual experiences (Ericsson & Simon, 1993 & Dex, 1995). Studies have also validated the effectiveness of physical activity recall (Falkner et al., 1999 & Slattery & Jacob Jr., 1995). Friedenreich and colleagues (1998) suggest sports participation is both habitual and significant, which increases recall

accuracy. Additionally, parents and children have answered questions about past sports participation with similar results (Felfe et al., 2016). Based on the before mentioned studies, the researcher is confident that answers provided by the athletes are reliable and accurate.

### *Statistical Analysis*

Incomplete responses were removed from the final analysis. Before statistical analysis was completed, this data was checked for factorial MANOVA assumptions (normality, linearity, and multicollinearity). This data did not meet the required assumptions; therefore, two three-way mixed factorial ANOVAs were used to compare the main effect of the sex, school classification, and the type of sport on the mean age of competition initiation and mean age of sport specialization. Additionally, the interaction effect between sex, school classification, and the type of sport on the mean age of competitive sport initiation and mean age of sport specialization were analyzed. Sex included two levels (male and female), school classification comprised of three levels (NAIA, DII, and DIII), and type of sport contained two levels (team and individual). Mean age of competitive sports initiation data did not meet the assumption of equal variances ( $F(11,1598) = 4.446, p < 0.001$ ), but met the assumption of normality (skewness = 0.533, kurtosis = -0.696). Bonferroni Post Hoc tests were performed to identify differences between the groups. Interactions were identified through a simple effects analysis. In addition, two one-way ANOVAs analyzed the differences between the mean age of competitive sport initiation or mean age of sport specialization and size of high school. There were three categories for the size of high schools: small < 900 students, medium 900 – 2000 students, and large > 2000 students. Sports with male and female participants were analyzed using one-way ANOVAs split by sport to determine a difference ( $p < 0.05$ ) between the sexes of competitive sport initiation age and sport specialization. There were no significant differences; therefore, all sports were analyzed by combining males and females.

Moreover, two one-way ANOVAs were used to analyze the differences between the mean age of competitive sport initiation or mean age of sport specialization by sport. Fencing,

bowling, and skiing were write-in answers; therefore, they were not included in the statistical analysis by sport. Gymnastics, ice hockey, and rowing had sample sizes less than 18; therefore, they were not included in the analysis. The statistical significance was set at  $p < 0.05$  for all analyses. The statistical program SPSS (version 27.0, Armonk, NY) was used for all calculations.

## CHAPTER IV

### RESULTS

#### **Demographics**

A total of 1610 completed surveys were analyzed. All three school classifications were represented (NAIA = 431, DIII = 661, & DII = 518). Sixty-seven percent of respondents were female (n = 1094) and 33% were male (n = 516). Athletes from twenty-one different sports completed the survey, and almost three-quarters of the athletes participated in a team sport. A summary of the survey demographics is found in Table 3

**Table 3.*****Summary of Survey Demographics***

	N
Total	1610
Sex	
Male	516
Female	1094
School	
NAIA	431
NCAA DIII	661
NCAA DII	518
Type of Sports	
Team	1160
Individual	450
High School Size	
Small	601
Medium	527
Large	360
Sports	
Baseball	166
Basketball	155
Cross Country	118
Field Hockey	33
Football	39
Golf	80
Gymnastics	11
Ice Hockey	4
Lacrosse	122
Rowing	9
Soccer	181
Softball	179
Swimming/Diving	107
Tennis	35
Track and Field	73
Volleyball	288
Wrestling	18
Other (bowling, fencing, skiing)	20

### Age of competitive sport initiation

A mixed factorial ANOVA was used to analyze the mean age of competitive sports initiation by sex, type of sport, and school classification. Interaction effects between sex and school classification, sex and type of sport, school classification and type of sport and sex, school classification and type of sport were analyzed. Summary of the factorial ANOVA statistical results are found in Table 4.

**Table 4.**

*Age of competitive sport initiation compared to sex, school classification, and type of sport (N = 1610)*

Variable	df	F statistic	p-value
Sex	1	20.90**	< 0.001
School classification	2	1.34	0.262
Type of sport	1	25.80**	< 0.001
Sex * school classification	2	4.87*	0.008
Sex * type of sport	1	2.48	0.116
School classification * type of sport	2	5.18*	0.006
Sex * school classification * type of sport	2	0.52	0.598

\*Significance at  $p < 0.05$

\*\*Significance at  $p < 0.001$

### *Hypothesis #1*

When exploring the main effect of sex on the mean age of competitive sport initiation, a significant difference ( $F(1, 1598) = 20.90, p < 0.001$ ) was discovered between males and females. It was discovered that male athletes initiated competitive sports participation at an earlier mean age ( $7.36 \pm 3.05$  yrs.) compared to the female athletes ( $8.14 \pm 3.10$  yrs.); therefore, null hypothesis 1 was rejected.

### ***Hypothesis #2***

No significant differences in the mean age of competitive sports initiation by school classifications ( $F(2, 1598) = 1.34, p = 0.262$ ) were observed. Hence, the null hypothesis 2 was accepted.

### ***Hypothesis #3***

When comparing team and individual-based sports, a significant difference in the mean age of competitive sport initiation ( $F(1, 1598) = 25.80, p < 0.001$ ) was observed between these two classifications. Team-based athletes initiated their competitive sports participation at a mean age of  $7.63 \pm 2.9$  yrs. However, individual-based athletes began at a mean age of  $8.56 \pm 3.3$  yrs. As a result, the null hypothesis was rejected.

### ***Hypothesis #4***

Prior to the statistical analysis, the assumption of equal variances was not met; therefore, Welch's statistic was used to interpret the one-way ANOVA between the mean age of competitive sports initiation and sport. There was a significant difference of ages between the sports ( $F(14, 282.706) = 10.05, p < 0.001$ ). A Tamhane Post Hoc for unequal variances revealed significantly different ages for competitive sports initiation. Baseball athletes started at a younger age than cross-country, golf, swimming/diving, track & field, and volleyball athletes. Basketball athletes started at a younger age than cross-country and volleyball athletes. Football athletes started at a younger age than cross-country, swimming/diving, track & field, and volleyball athletes. Lacrosse athletes started at a younger age than volleyball athletes. Soccer athletes started at a younger age than cross-country, track & field, and volleyball athletes. Finally, softball athletes started at a younger age than volleyball athletes. A summary is found in Table 5 and Figure 1. Consequently, the null hypothesis was rejected.

**Table 5.**

*Mean age of competitive sport initiation by sport*

Sport	N	Age (yrs.)
Baseball	166	6.46 ± 2.31
Basketball	155	7.35 ± 3.03
Cross Country <sup>abce</sup>	118	8.81 ± 3.40
Field Hockey	34	7.56 ± 2.99
Football	39	6.46 ± 2.26
Golf <sup>a</sup>	80	8.26 ± 3.43
Lacrosse	122	7.57 ± 3.23
Soccer	182	7.15 ± 2.85
Softball <sup>a</sup>	177	7.71 ± 2.65
Swimming/Diving <sup>ac</sup>	108	8.23 ± 2.89
Tennis	36	8.78 ± 3.55
Track and Field <sup>ace</sup>	73	8.77 ± 3.33
Volleyball <sup>abcdef</sup>	288	8.89 ± 3.11
Wrestling	18	7.72 ± 3.43
Other (bowling, fencing, & skiing)	20	9.80 ± 3.78

*Baseball has a mean age significantly younger (a)*

*Baseball has a mean age significantly younger (b)*

*Football has a mean age significantly younger (c)*

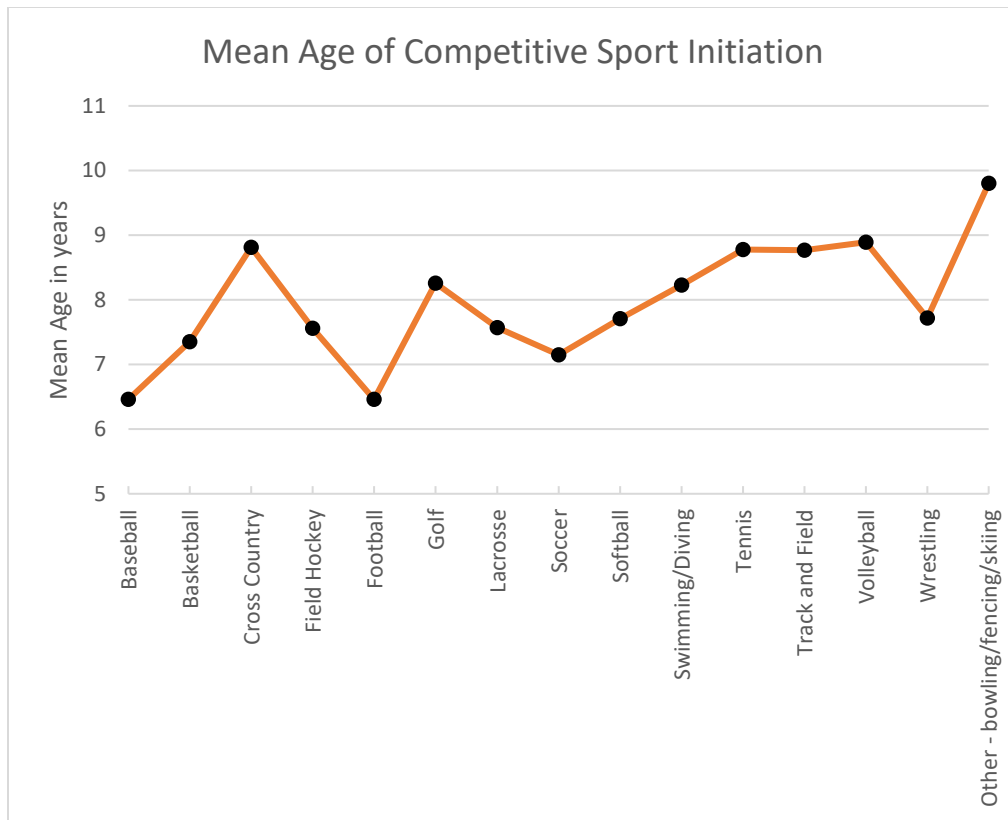
*Lacrosse has a mean age significantly younger (d)*

*Soccer has a mean age significantly younger (e)*

*Softball has a mean age significantly younger (f)*

*Significance at  $p < 0.05$*





**Figure 1.** Mean age of competitive sport initiation by sport.

***Hypothesis #5***

A univariate ANOVA follow-up indicated no difference between the mean age of competitive sports initiation and high school size ( $F(2, 2587) = 0.609, p = 0.544$ ). Therefore, the null hypothesis 5 was accepted.

***Hypothesis #6***

When analyzed by sex and school classification, a univariate ANOVA showed a significant interaction effect in the mean age of competitive sports initiation ( $F(2, 1598) = 4.87, p = 0.008$ ). (Table 4). There were differences between males and females of NAIA and DII school classifications (Table 6). Among NAIA athletes, competitive sports initiation occurred earlier in males ( $M = 6.66 \pm 2.65$  yrs.) than females ( $M = 8.34 \pm 3.04$  yrs.). Similar differences were

identified between male ( $M = 7.53 \pm 3.09$  yrs.) and female ( $M = 8.60 \pm 3.07$  yrs.) athletes of DII schools. Consequently, the null hypothesis was rejected.

**Table 6.**

***Interaction effect of sex and school classification on the mean age of competitive sports initiation***

Variable	df	F Statistic	p-value
NAIA	1	10.10*	0.002
DIII	1	0.238	0.626
DII	1	16.14**	< 0.001

\*Significance at  $p < 0.05$

\*\*Significance at  $p < 0.001$

***Hypothesis #7***

A univariate ANOVA designated a significant difference in the interaction effect between school classification and type of sport ( $F(2, 1598) = 5.18, p = 0.006$ ). See Table 4. Further analysis using a one-way ANOVA identified a difference in the mean age of competitive sports initiation at the team sport level ( $F(2, 1598) = 5.78, p = 0.003$ ). See Table 7. A Bonferroni Post Hoc analysis identified differences at the team sport level between athletes from DIII and DII schools (Table 8). DIII school team-based athletes initiated sports competitions earlier ( $M = 7.15 \pm 2.84$  yrs.) than DII school team athletes ( $M = 8.13 \pm 3.13$  yrs.). The null hypothesis is rejected.

**Table 7.**

***Interaction effect of school classification and type of sport on the mean age of competitive sport initiation***

Variable	df	F Statistic	p-value
Team sport	2	5.780*	0.003
Individual sport	2	1.419	0.242

\*Significance at  $p < 0.05$

**Table 8.*****Team sport and school classification comparison on the mean age of competitive sport initiation***

Type of sport	School classification	School classification	p-value
Team	NAIA	DIII	0.312
		DII	0.218
	DIII	NAIA	0.312
		DII	0.002*
	DII	NAIA	0.218
		DIII	0.002*

\*Significant at  $p < 0.05$

***Hypothesis #8***

According to the univariate ANOVA results, there was no difference in the mean age of competitive sports initiation among the type of sport (team- vs. individual-based) and sex ( $F(1, 1598) = 2.48, p = 0.116$ ). We fail to reject the null hypothesis.

**Age of Sport Specialization**

The summary of characteristics of the age of sport specialization is found in Table 9. An overview of the factorial ANOVA statistics is found in Table 10.

**Table 9.*****Summary of the characteristics of the age of sport specialization***

Variable	N	% Specialized	Age (yrs.)
Total	1022	63.5	14.33 ± 2.27
Sex			
Male	321	62.2	14.61 ± 2.11
Female	701	64.1	14.21 ± 2.33
School			

NAIA	279	64.7	14.41 ± 2.37
DIII	407	61.6	14.41 ± 2.35
DII	336	64.9	14.16 ± 2.08
<hr/>			
Type of Sport			
Team	726	62.6	14.35 ± 2.39
Individual	296	65.8	14.27 ± 2.14
<hr/>			
High School Size			
Small	336	55.9	14.66 ± 2.28
Medium	353	67.0	14.30 ± 2.22
Large	255	70.8	13.93 ± 2.27
<hr/>			
Sport			
Baseball	103	62.0	14.81 ± 2.18
Basketball	85	54.8	14.68 ± 1.96
Cross Country	80	67.8	14.63 ± 1.67
Field Hockey	20	60.6	15.06 ± 2.07
Football	20	51.3	14.53 ± 1.87
Golf	66	82.5	14.25 ± 1.92
Lacrosse	74	60.7	14.87 ± 2.09
Soccer <sup>a</sup>	117	64.6	13.66 ± 2.66
Softball	108	61.4	14.09 ± 2.63
Swimming/Diving <sup>a</sup>	71	66.4	13.59 ± 2.47
Tennis <sup>a</sup>	17	48.6	12.69 ± 2.24
Track and Field	39	53.4	15.57 ± 1.96
Volleyball	199	69.1	14.21 ± 2.20
Wrestling	13	72.2	14.25 ± 1.96

Others (bowling, fencing, skiing)	10	52.6	14.00 ± 2.62
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*Track and Field has a mean age significantly older (a)*

**Table 10.**

*Age of sport specialization compared to sex, school classification, and type of sport (N = 939)*

Variable	df	F statistic	p-value
Sex	1	6.41*	0.012
School classification	2	0.99	0.369
Type of sport	1	0.32	0.574
Sex * school classification	2	0.27	0.762
Sex * type of sport	1	0.17	0.683
School classification * type of sport	2	0.07	0.931
Sex * school classification * type of sport	2	0.21	0.814

*\*Significant at  $p < 0.05$*

***Hypothesis #9***

The factorial ANOVA main effect results of sex identified an F ratio of  $F(1, 927) = 6.41$ ,  $p = 0.012$ . There is a significant difference in the mean age of sport specialization between sexes. Female athletes specialized in their sport at a younger mean age ( $14.20 \pm 2.32$  yrs.) than male athletes ( $14.61 \pm 2.11$  yrs.) did. Therefore, the null hypothesis is rejected.

***Hypothesis #10***

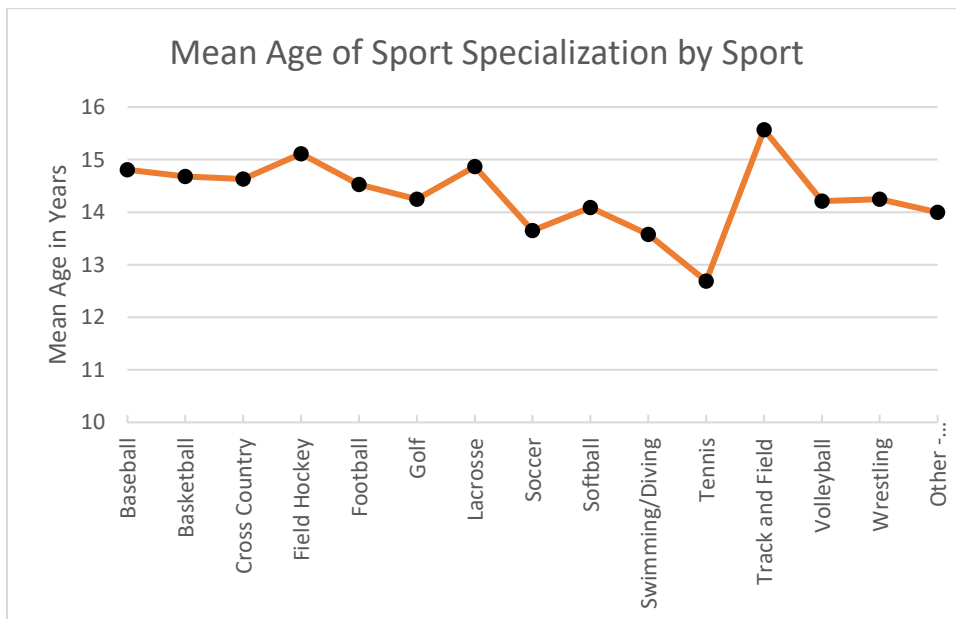
There was no difference in the mean age of sport specialization among athletes from DII, DIII, or NAIA schools (Table 10). We fail to reject the null hypothesis.

### ***Hypothesis #11***

There was no difference in the mean age of sport specialization among athletes who participate in team-based versus individual-based sports (Table 10). We fail to reject the null hypothesis.

### ***Hypothesis #12***

Prior to the statistical analysis, the assumption of equal variances was not met; therefore, Welch's statistic was used to interpret the one-way ANOVA between the mean age of sport specialization and sport. There was a significant difference in mean age of sport specialization between sports ( $F(14, 141.393) = 3.44, p < 0.001$ ). The Tamhane Post Hoc test was performed to identify the differences in specific sports. Track and field athletes specialized later than athletes competing in soccer, swimming/diving, and tennis (Table 9 and Figure 2). The null hypothesis is rejected.



**Figure 2.** Mean age of sport specialization by sport

### ***Hypothesis #13***

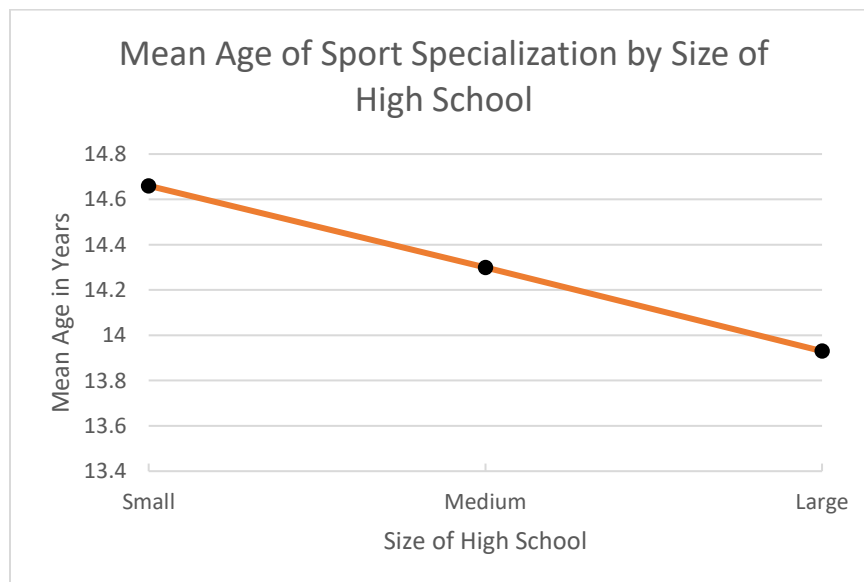
The one-way ANOVA analysis of the mean age of sport specialization and size of high school generated an F ratio of  $F(2, 934) = 7.61$ ,  $p = 0.001$ . There is a significant difference in the mean age of sport specialization between high school sizes. A Bonferroni Post Hoc test revealed the significance between small and large-sized high schools ( $p < 0.001$ ). Athletes at small high schools specialized at a later age ( $M = 14.66 \pm 2.28$  yrs.) than large high schools ( $M = 13.93 \pm 2.27$  yrs.). See Table 11 and Figure 3. The null hypothesis is rejected.

**Table 11.**

#### ***Age of sport specialization and size of high school***

School size	School size	p-value
Small	Medium	0.115
	Large	< 0.001**
Medium	Small	0.115
	Large	0.137
Large	Small	< 0.001**
	Medium	0.137

**\*\*Significant at  $p < 0.001$**



**Figure 3.** *Mean age of sport specialization by the size of high school*

#### ***Hypothesis #14***

There were no significant differences between the interaction effects of sex and school classification for the mean age of sport specialization (Table 8). Therefore, the null hypothesis was retained.

#### ***Hypothesis #15***

There were no significant differences between the interaction effects of the mean age of sport specialization among school classification and type of sport (team vs. individual). See Table 10. Thus, the null hypothesis was retained.

#### ***Hypothesis #16***

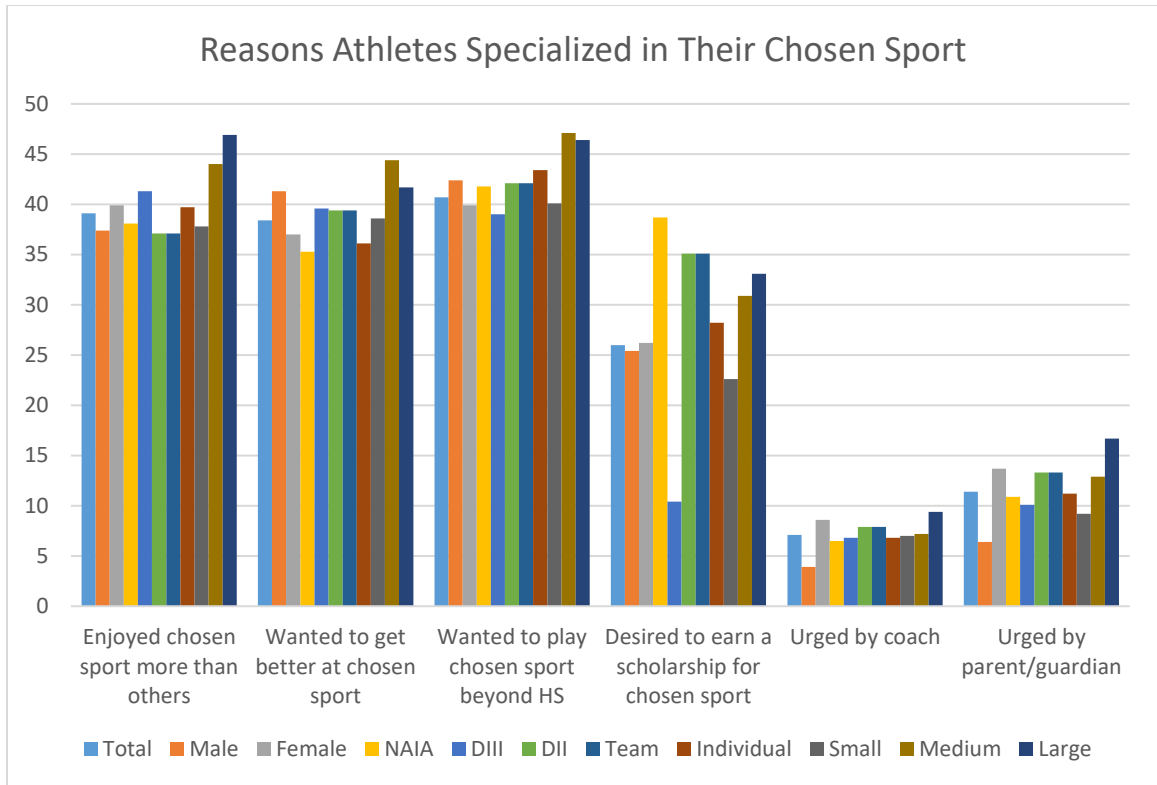
There were no significant differences between the interaction effects of the mean age of sport specialization among sex and type of sport (team vs. individual). See Table 10. Thus the null hypothesis was retained.

#### **Motivation for Sport Specialization**

Athletes were able to select multiple reasons why they chose to specialize. The nature of the question construction prevented the ability to analyze the results statistically. From six choices, the top three reasons athletes reported the reason they specialized were (Figure 4):

- they enjoyed their chosen sport more than the others they were participating in
- they wanted to get better at their chosen sport
- they wanted to play their chosen sport beyond high school





**Figure 4.** *Reasons athletes specialized in their chosen sport*

## CHAPTER V

### DISCUSSION

The primary purpose of this study was to analyze the SS age of current collegiate athletes among different school classifications, sex, and type of sport (team-based and individual-based). A secondary purpose was to identify underlying athlete motivations to specialize in their chosen sport. To the best of the researcher's knowledge, this was the first research to compare the SS age among current athletes from different school classifications. The survey results indicate that male athletes began participating in their primary sport at a younger age, but female athletes specialized in their sport of choice earlier. Additionally, athletes of team-based sports started participating at an earlier age than individual-based sports. Nevertheless, there was no difference in the mean SS age between the two types of sports. Furthermore, there was no difference in age of competitive sport initiation between athletes at different sized high schools. However, athletes in large-sized high schools specialized in their primary sport at a younger age than athletes from smaller-sized high schools. Overall, current collegiate athletes specialized in their competitive sport at a mean age of  $14.33 \pm 2.27$  yrs. These results may indicate that ESS is not essential to compete at the collegiate level.

Previous studies (Black et al., 2019; Buckley et al., 2017; DiFiori et al., 2019; Martin et al., 2017; Post et al., 2017; & Swindell et al., 2019) have investigated the age of sports initiation but have not separated the results by sex. Results from this study revealed males began their sports involvement earlier than females. Although males began participating earlier, females reported an earlier SS age. The female athletes in the surveys analyzed by Swindell et al. (2019) and Buckley et al. (2017) indicated an earlier mean SS age compared to male athletes, which corresponds with this study's findings. A possible reason female athletes may specialize in their chosen sport earlier may be due to their maturation age—female youth experience puberty at a younger age than males. Many of the medical organizations (American Academy of Pediatrics, 2000; DiFiori et al., 2014; LaPrade et al., 2016; & Valovich et al., 2011) and sports governing bodies (National Strength and Conditioning Association, USA Hockey, USA Basketball, US Olympic & Paralympic Committee, & USA Swimming) indicate that specialization should not occur before the onset of puberty. Because of the earlier age of commencement of puberty in females, it may not be a concern that females specialized in their chosen sport at an earlier mean age than the male athletes. Coaches, parents, and athletes may consider this when deciding if or when female athletes should specialize in one sport.

Several studies (Buckley et al., 2017; Martin et al., 2017; & Swindell et al., 2019) have analyzed the mean SS age between the team- and individual-based sports but have not investigated the difference in the mean age of sport participation initiation. The current study discovered that team-based athletes began their sports participation earlier than individual-based sports athletes. Many team sports such as soccer, baseball, basketball, softball, and football have well-established youth leagues that may be more available and well known than individual-based sports. The familiarity and accessibility of team sports provide an environment where it is easier to participate, which may explain why team athletes are involved in their sport at a younger age.

This study revealed no difference in the mean SS age between the team and individual sports, which is contrary to the current research of collegiate athletes (Buckley et al., 2017; Martin et al., 2017; & Swindell et al., 2019). Previous studies reported that individual athletes specialize in their sport earlier than team athletes. However, it is important to note that most athletes competed at the DI level in the earlier studies (Buckley et al., 2017; Martin et al., 2017; & Swindell et al., 2019). The current study included athletes from DII, DIII, and NAIA programs. The differences in the mean SS age for individual athletes may be related to the school classification. This study suggests that team sports youth starting their participation at a younger age than individual sports youth does not indicate the team-based sports athletes will specialize in their chosen sport earlier. More youth should be encouraged to participate in a variety of sports activities (Bayli, 2001; Côté, 1999; US Olympic & Paralympic Committee). Sampling a variety of sports increases the opportunity for youth to learn and become competent in fundamental movement skills, such as balancing, running, hopping, jumping, kicking, catching, throwing, and striking an object. Proficiency in fundamental movement skills is positively related to increased activity participation (Luban et al., 2010). Additionally, youth exhibiting proper fundamental movement skills may reduce the risk of injury and lower the rates of sports burnout (Bergeron et al., 2015; Bridge & Toms, 2013; Côté et al., 2003; LaPrade et al., 2016; & Wright & Côté, 2003).

Several studies have investigated the age of SS in relation to the size of high school an athlete attended. The results of this study are similar to those previously reported (Bell et al., 2016 & Bell et al., 2018). Athletes who attended a large-sized high school indicated they specialized in their sport earlier than those who attended a smaller-sized high school. Smaller schools may have fewer athletes to fill athletic team rosters; therefore, it may be necessary for athletes to participate in multiple sports to complete the teams. Whereas larger schools have many athletes, consequently creating an environment where athletes must compete for a roster spot. The competition between athletes may encourage SS practices to improve skills allowing them to

outperform potential team members. Resources may not be available to parents and youth to decide what size of high school they attend, but it is helpful to be aware of the influence the high school size may have while determining if SS is right for them. Irrespective of SS age, there was no difference in age of sports initiation between high school sizes. These results are encouraging because they suggest that they had access to sports programs regardless of where athletes grew up.

A majority of studies related to SS in collegiate athletes have not identified the sport initiation age of individual sports. Martin et al. (2017) is the only other study of collegiate sports, the researcher found, identifying when athletes began participating in a specific sport and at what age they specialized in it. Other than gymnastics, Martin and colleagues (2017) identified team sports as having a younger age of sports initiation than individual sports. The current research results confirm what has been previously reported. Athletes from team-based sports typically started participating in their chosen sport at a younger age than individual-based sports athletes. Once again, the difference between the team- and individual-based sports may be attributed to the availability and level of establishment many team-based sports experience; therefore, making it easier and more accessible for younger athletes to join.

Sport initiation age can be identified for each sport but knowing the SS age of each sport is more critical since ESS has been linked to negative physiological and psychosocial consequences (Ahlquist et al., 2020; Bell et al., 2016; Boyd et al., 1996; Brenner, 2007; Bush et al., 2021; DiFiori et al., 2014; Jayanthi et al., 2013; Law et al., 2007; McFadden et al., 2016; McGuine et al., 2017; Strachan et al., 2009; & Valovich et al., 2022). Results of the current study indicate that track and field athletes were significantly older than other athletes' SS age. Many athletes may participate in track and field as a secondary sport per the recommendation of the primary sports coach. This secondary sport status could indicate why track and field athletes do not specialize in their sport until later.

Until now, many studies (DiFiori et al., 2019; Martin et al., 2017; Post et al., 2017; & Swindell et al., 2019) only investigated the SS age of DI athletes. Buckley et al. (2017) and Black et al. (2019) surveyed athletes from both DI and DIII universities. Buckley et al. (2017) did not delineate the results by school classification; therefore, differences between DI & DIII athletes were not identified. Black et al. (2019) did separate results by DI and DIII athletes. However, they only surveyed ice hockey athletes, providing a narrow understanding of the differences between school classifications and other sports. To the researchers' knowledge, this was the first study to analyze the mean SS age among different school classifications for a variety of sports. There was no difference in the mean SS age among any school classifications. Because of the perceived variances of athletic ability amongst DI, DII, and DIII athletes, it was surprising that there was not a difference in the mean SS age. The current and previous research reports that athletes competing at the collegiate level have a mean SS age older than 12 years, indicating they did not specialize early in their chosen sport. This information may help coaches, parents, and athletes weigh the costs and benefits of specializing early in one sport.

In the present study, the top three motivational reasons athletes gave for deciding to specialize in one sport was (a) their enjoyment of the sport, (b) they wanted to get better at their chosen sport, and (c) they wanted to play their chosen sport beyond high school. These three reasons were the same across sex, school classification, type of sport, and high school size. Compared to the previous investigations of collegiate athletes' SS patterns, similar motivational reasons were given (Black et al., 2019; Post et al., 2017; & Swindell et al., 2019). In contrast, earlier studies (Bergeron et al., 2015; DeKnop et al., 1996; Malina, 2010; Myer et al., 2015; & Mostafavifar et al., 2013) identified coaches and parents as the most substantial influence on a youth's decision to specialize in one sport. There are many facets underlying the processes of decision-making. More research needs to be performed to investigate the nuances taken into consideration when youth decide to specialize in their chosen sport. Coaches and parents need to

give special attention to conversations with youth athletes about SS. The decision to specialize should be based on the athlete's wants and needs rather than the adults' desire for the youth to improve and excel in the sport sufficient to compete beyond high school or earn a collegiate athletic scholarship.

### **Limitations**

To the best of the researcher's knowledge, this study is the first to compare SS age of three different university classifications. While it is a novel approach, it is not without limitations. The first limitation is that this is a self-reporting survey. As a cross-sectional study, results are depended on the accurate recall of past athletic experiences. Even though research (Friedenreich et al., 1998) has indicated sports participation is significant and habitual, thereby increasing recall accuracy, a more valid and reliable measurement of SS age would be to conduct a longitudinal study. An effective data collection method would follow a cohort of youth and record participation rates and ages over several years, therefore eliminating the need to recall the age the athlete ceased involvement in all but their chosen sport. A second limitation is that this research was exclusive to athletes currently competing at the collegiate level in the United States. Future studies could compare athletes from different parts of the world from other athlete development programs. A third limitation is that only current collegiate athletes were surveyed. Data from former college athletes could provide a clearer picture of the increasing trend of SS among youth. A fourth limitation was associated with how the survey was distributed. Athletes indirectly received the survey link from their coach. Coaches' emails were obtained from the universities' athletic websites. To prevent incorrect email addresses, phone calls to the athletic department for correct email addresses would overcome this issue. Since the coach was responsible for passing the survey link on to their athletes, the receipt of the survey depended on the coach's actions. If the coach decided not to pass it on or forgot, the athletes were never given a chance to complete

the survey. Future research methods may consider contacting a limited number of schools and working directly with the athletes to ensure they completed the survey.

### **Conclusion**

Based on the results from this study, the mean SS age of current DII, DIII, and NAIA athletes is  $14.33 \pm 2.27$  yrs. This age indicates that athletes competing beyond high school did not specialize early in their chosen sport. This present research supports what has been previously identified in DI athletes (Black et al., 2019; Buckley et al., 2017; DiFiori et al., 2019; Post et al., 2017; & Swindell et al., 2019). The significance of this study adds to the body of knowledge regarding the necessity not to specialize early in one sport to compete beyond high school. Coaches, parents, and athletes can take this information to expand their understanding that it may not be necessary to specialize early as they decide together the course of action concerning if and when the youth should focus on one sport.



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## APPENDICES

### APPENDIX #1



#### Oklahoma State University Institutional Review Board

Date: 03/10/2020  
Application Number: IRB-20-140  
Proposal Title: Early Sport Specialization of Professional and Collegiate Athletes

Principal Investigator: Melissa Jensen  
Co-Investigator(s):  
Faculty Adviser: Jay Dawes  
Project Coordinator:  
Research Assistant(s):

Processed as: Exempt  
Exempt Category:

#### Status Recommended by Reviewer(s): Approved

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in 45CFR46.

This study meets criteria in the Revised Common Rule, as well as, one or more of the circumstances for which continuing review is not required. As Principal Investigator of this research, you will be required to submit a status report to the IRB triennially.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 405-744-3377 or irb@okstate.edu.

Sincerely,  
Oklahoma State University IRB

## APPENDIX #2

### Sport Specialization Survey

Each question is optional to answer

Adapted from Jayanthi, N. A., LaBella, C. R., Fischer, D., Pasulka, J., & Dugas, L. R. (2015). Sports-specialized intensive training and the risk of injury in young athletes: a clinical case-control study. *The American Journal of Sports Medicine*, 43(4), 794-801.

1. Sex
  - a. Female
  - b. Male
  - c. Other
  - d. Prefer not to answer
  
2. Which category best describes you?
  - a. American Indian or Alaska Native
  - b. Asian
  - c. Black or African American
  - d. Hispanic, Latino, or Spanish origin
  - e. Middle Eastern or North African
  - f. Native Hawaiian or Other Pacific Islander
  - g. White
  - h. Other:
  
3. Type of school you attend.
  - a. Community College
  - b. Junior College
  - c. NAIA classification – National Association for Intercollegiate Athletics
  - d. NCAA DIII
  - e. NCAA DII
  - f. NCAA DI
  
4. Are you on an athletic scholarship?
  - a. Yes
  - b. No
  
5. What sport do you compete in?
  - a. Basketball
  - b. Cheerleading
  - c. Cross Country
  - d. Field Hockey
  - e. Football
  - f. Golf
  - g. Gymnastics
  - h. Ice Hockey
  - i. Lacrosse
  - j. Rowing
  - k. Rugby

- l. Soccer
  - m. Softball
  - n. Swimming/diving
  - o. Tennis
  - p. Track and Field
  - q. Volleyball
  - r. Wrestling
  - s. Other (please list):
6. Are you currently a dual athlete?
- a. Yes
  - b. No – skip to question #8 (Qualtrics will automatically move the participant forward)
7. What is your secondary sport?
- a. Baseball
  - b. Basketball
  - c. Cheerleading
  - d. Cross Country
  - e. Field Hockey
  - f. Football
  - g. Golf
  - h. Gymnastics
  - i. Ice Hockey
  - j. Lacrosse
  - k. Rowing
  - l. Rugby
  - m. Soccer
  - n. Softball
  - o. Swimming/diving
  - p. Tennis
  - q. Track and Field
  - r. Volleyball
  - s. Wrestling
  - t. Other (please list)
8. How old were you when you started participating in competitive sports? A competitive sport is defined as striving for excellence in a contest situation (Shields & Bredemier, 2001)
- a. 4
  - b. 5
  - c. 6
  - d. 7
  - e. 8
  - f. 9
  - g. 10
  - h. 11
  - i. 12
  - j. 13
  - k. 14
  - l. 15

- m. 16
- n. 17
- o. 18
- p. 19
- q. 20

9. Did you quit other sports to focus only on one sport?
- a. Yes
  - b. No (skip to question #15 (Qualtrics will automatically move the participant forward))

10. If you quit other sports to focus only on one sport, what sport did you focus on?

- a. Baseball
- b. Basketball
- c. Cheerleading
- d. Cross Country
- e. Field Hockey
- f. Football
- g. Golf
- h. Gymnastics
- i. Ice Hockey
- j. Lacrosse
- k. Rowing
- l. Rugby
- m. Soccer
- n. Softball
- o. Swimming/diving
- p. Tennis
- q. Track and Field
- r. Volleyball
- s. Wrestling
- t. Other (please specify)

11. If you quit sports to focus only on one main sport, how old were you when you quit the other sports?

- a. 5
- b. 6
- c. 7
- d. 8
- e. 9
- f. 10
- g. 11
- h. 12
- i. 13
- j. 14
- k. 15
- l. 16
- m. 17
- n. 18
- o. 19
- p. 20

12. If you quit other sports to focus only on one, how many sports did you quit to do that?
- 1
  - 2
  - 3
  - 4
  - 5
13. If you quit other sports to focus only on one, were you involved competitively in the other sports you quit?
- Yes
  - No
14. If you quit other sports to focus only on one main sport, why did you choose to focus only on one sport? Select all that apply.
- I enjoyed it more than other sports
  - I wanted to get better in my chosen sport
  - I wanted to play my chosen sport beyond high school
  - I wanted to earn a scholarship in my chosen sport
  - I was urged by a coach to focus on one sport
  - I was urged by my parents/guardians to focus on one sport
  - Other (please specify)
15. How many months per year did you participate in focused, sport-specific training for your chosen sport?
- 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
  - 11
  - 12
16. In what state did you attend high school?
17. How would you classify the size of your high school?
- Small (less than 900 students)
  - Medium (900 – 2000 students)
  - Larger (over 2000 students)
18. For each sport you participated in, identify the grade you started and stopped participating.

<b>Sport</b>	<b>Grade Started (5<sup>th</sup> – 12<sup>th</sup>)</b>	<b>Grade Stopped (5<sup>th</sup> – 12<sup>th</sup>)</b>
Baseball		
Basketball		

Cheerleading		
Cross Country		
Field Hockey		
Football		
Golf		
Gymnastics		
Ice Hockey		
Lacrosse		
Rowing		
Rugby		
Soccer		
Softball		
Swimming/Diving		
Tennis		
Track and Field		
Volleyball		
Wrestling		
Other (please list)		

19. If you had a break in your sports participation, please indicate the sport, the grade stopped and the grade you resumed.

VITA

Melissa Jensen

Candidate for the Degree of

Doctor of Philosophy

Dissertation: AN ANALYSIS OF SPORT SPECIALIZATION AMONG CURRENT  
NCAA DII, DIII, AND NAIA COLLEGIATE ATHLETES

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Biographical:

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Oklahoma Association for Health, Physical Education, Recreation, and Dance