

THE RELATIONSHIP BETWEEN PHYSICAL FITNESS AND ACADEMIC  
PERFORMANCE IN COLLEGE CLUB SPORTS STUDENTS

by

Jonathan Chung

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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## ABSTRACT

Pursuing innovative strategies to improve academic performance is an ongoing priority for many higher education institutions. One area that evidence has shown to further enhance cognitive ability, memory, and focus, but also, enhance the emotional and social well-being of students is through regular physical fitness. The importance of this study was to explore whether the benefits of physical fitness would have a similar impact on academic performance in college club sports students as it does on children as literature is limited concerning this relationship surrounding the college-aged population. The purpose of this study was to determine whether there was a relationship between Just Jump System® scores and Grade Point Averages in college club sports students. This study used a quantitative correlational design to address the research questions and test the hypotheses. Archival data consisting of 122 college club sports students among nine club sports teams from a private higher education institution was used for this study. The Pearson Product Moment Correlation was conducted to analyze the archival data. The analyses revealed that there was no significant relationship between the two variables for the cumulative 2019-2020 academic year, the fall 2019, and spring 2020 semesters. The findings indicate that although no significant relationship was found, the overall mean for fitness scores were all above average or higher and the overall mean for grade point averages were all greater than a 3.0. Therefore, further research is recommended in order to determine whether there is a relationship between physical fitness and academic performance within the general college population.

*Keywords:* academic performance, college club sports, Just Jump System®, physical fitness.

## **Dedication**

This manuscript is dedicated to my family and friends for their continual support and patience over the years. To my entire family, who have all made individual sacrifices to financially, emotionally, and spiritually support me throughout my entire academic journey. To my father, Samuel, for instilling the importance of education and for encouraging me to always strive for excellence. To my mother and sister, Jenny and Min, who provided nutritious recipes and meals that helped me replenish my mind and body to get me through many chaotic weeks. To both of my dogs, Winston and Dillinger, one of which who recently passed away, for always being by my side throughout the many late nights. To my closest friends, mentors, and coaches, who not only provided guidance but also, memorable times to celebrate all of the small victories along the way- I love and thank each and everyone of you as I could not have accomplished this lifelong goal without you.

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### **List of Abbreviations**

Grade Point Average (GPA)

National Association for Sport and Physical Education (NASPE)

National Collegiate Athletic Association (NCAA)

National Intramural-Recreational Sports Association (NIRSA)

Self-Determination Theory (SDT)

Southern Association of Colleges and Schools Commission on Colleges (SACSCOC)

World Health Organization (WHO)

## **CHAPTER ONE: INTRODUCTION**

### **Overview**

Chapter one presents a summary of the overall health and wellness benefits that stem from engaging in regular physical activity, fitness, and sports as well as the potential relationship it has on academic performance in college-aged students. The following section will include background information, problem statement, purpose statement, significance of the study, identification of a gap in the literature, research questions, and definitions to aid in identifying opportunities to improve academic performance in students at the higher education level.

### **Background**

Currently, one of the most severe health concerns that often lead to life altering ailments such as diabetes, cardiovascular disease, and various forms of cancer is known as obesity. (Aly, 2014; Zhang, Schumann, Huang, Tormakangas, & Cheng, 2018). In 2015, research estimated that 107.7 million children and 603.7 million adults were classified as obese, contributing to approximately 4 million deaths as well as 120 million disability-adjusted life years worldwide (Afshin, Forouzanfar, Reitsma, Sur, Estep, & Lee, 2017). As young adulthood and adult obesity can be a delayed consequence of severe psychological distress experienced during childhood, studies have predicted a continued rise in obesity rates (Quilliot, Brunaud, Mathieu, Quenot, Sirveaux, Kahn, Ziegler, & Witkowski, 2019). Between 1975 and 2016, from a population-based study, children and adolescent females from over 200 countries and territories classified as obese increased from 0.7% (5 million) to 5.6% (50 million) while males increased from 0.9% (6 million) to 7.8% (74 million) (Farham, 2017). As of 2016, 17% of all children and adolescents evaluated across the United States were considered obese (95<sup>th</sup> percentile or greater or 30 kg/m<sup>2</sup> or higher for Body Mass Index) and another 15% were considered overweight (85<sup>th</sup> to 95<sup>th</sup>

percentile or 25 to  $<30 \text{ kg/m}^2$  for Body Mass Index) (Dhar & Robinson, 2016). Pertaining to the young adulthood and adult population, the Center for Disease Control and Prevention (2020) indicated that the prevalence of obesity was 30.5% in 1999-2000 and 42.4% in 2017-2018 while the prevalence of severe obesity increased from 4.7% to 9.2% within the same timeframe. The future projections have illustrated that by 2030, nearly 1 in 2 adults in America alone will probably become obese and that the prevalence of obesity will approach 60% in some states and not below 35% in any state (Ward, Bleich, Craddock, Barrett, Giles, Flax, Long, & Gortmaker, 2019). Not only is physical inactivity a contributing factor pertaining to preventable health diseases such as obesity and other cardiovascular disorders but equally important, physical inactivity is also associated with mood changes, lack of focus and disruptive behavior, which all can impact the overall performance of students in terms of academics (Kayani, Kiyani, Wang, Zagalaz Sanchez, Kayani, & Qurban, 2018).

Despite the educational system in the United States attempting to reform education through teacher preparation programs and additional focus on instructional practices, studies have shown minimal improvement in student achievement as research suggested that the education-specific approaches are not addressing health-related barriers to learning (Michael, Merlo, Basch, Wentzel, & Wechsler, 2015). According to the World Health Organization, one area that schools may be falling short of is in the practice of developing physical health as research has shown that as student's progress higher in grade level, the level of engagement in physical activities lessens (Kim, Lee, Kim, Lee, Cho, Lee, Kim, McCreary, & Kim, 2015; de Luna Filho, da Silva, da Cruz Santos, do Nascimento, Rabay, Dantas, de Lima, & Brasileiro-Santos, 2015). The World Health Organization recommends young adults to participate in at least 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity

aerobic activity or an equivalent combination of the two (Evenson & Porter, 2018). Though studies highlighted the added health benefits physically, mentally, emotionally, and socially from partaking in a total minimum of 150 minutes per week, literature expressed that between 31% and 51% of those who participate in physical activity do so insufficiently (Chung, Abdulrahman, Khan, Sathik, & Rashid, 2018; de Luna Filho et al., 2015). Furthermore, growing evidence indicated that prolonged sitting and other sedentary behavior that result in physical inactivity for young adults can be detrimental to cognitive operations associated with academic performance (Felez-Nobrega, Hillman, Dowd, Cirera, & Puig-Ribera, 2018; Chung et al., 2018).

With the increased pressures from administration for educational programs to improve academic outcomes, institutions have begun to reduce and eliminate physical education or activity-based programs that encourage physical fitness (Joubert, Kilgas, Riley, Gautam, Donath, & Drum, 2017; Schneller, Schipperijn, Nielsen, & Bentsen, 2017; Babbitt, Franke, & Lee, 2015). In addition, the transition from high school to college already posing greater risks in adopting unwanted behaviors, adding further factors such as screen time, sleep habits, academic rigor, diet, and other extracurricular non-movement based activities, the lack of physical activity that is seen in college students worldwide continues to rise (Hou, Mei, Liu, & Xu, 2020; Sa, Heimdal, Sbrocco, Seo, & Nelson, 2016). Minimized time and the declining levels of physical activity have not only increased the risk of college students becoming overweight and obese but also, it has led to a multitude of poorly influenced lifelong habits impacting regular daily functioning (Joubert et al., 2017). Furthermore, health-related issues and inadequate fitness levels have been shown in research to limit students' motivation and ability to learn as health problems and poor health behaviors can be linked to academic outcomes through five casual pathways: sensory

perceptions, cognition, connectedness and engagement with school, absenteeism, and dropping out (Belanger & Patrick, 2018; Srikanth, Petrie, Greenleaf, & Martin, 2015; Basch, 2011).

At the college level, student recreational centers, intramural sports, clubs, and athletics have been for many years, an outlet for college students to engage in a wide variety of physical movement activities that aid in and help serve many lifelong healthy and social benefits. Physical activity and fitness opportunities whether in small or large groups and formal or informal settings supports the growth of physical skills by aiding in the development of three critical learning areas: cognitive, psychomotor, and affective (Klein & Hollingshead, 2015). Regular physical activity has shown to develop critical learning areas by improving students' motor skills, attention, concentration, memory, and space perception (Zach, Shoval, & Lidor, 2017; Joubert et al., 2017). Literature indicated that students reported enhanced positive affect, increased energy, and reduced negative affect after structured exercise tasks (Haas, Schmid, Stadler, Reuter, & Gawrilow, 2017; Klein & Hollingshead, 2015). According to the National Association for Sport and Physical Education, any student of any age group who partakes in regular physical activity throughout the day will reap many health advantages including increased blood flow to the brain, increased mental alertness, increased positive attitude, and increased ability for the heart to maintain efficiency and prevent illnesses (Klein & Hollingshead, 2015). Each avenue of health that stems from physical activity and fitness will not only instill fruitful habits in terms of academic performance, which plays a critical role in future employability value, but also the healthy lifestyle will continue to pour beyond the college years where focus, mood, and overall wellness will transition positively into any career (Felez-Nobrega et al., 2018)

Along with the simple fundamental importance of physical activity and fitness, it is also vital to comprehend the motivation behind engaging in and strictly following health-conducive

behaviors for the maintenance and improvement in overall and total health (Johan, Ntoumanis, Thogersen-Ntoumani, Deci, Ryan, Duda, & Williams, 2012; Matthews, Moore, Sampson, Blair, Xiao, Keadle, & Park, 2015). In physical activity, physical fitness, or athletics, one common framework that focuses around intrinsic motivation and one that has been specifically applied to the study of human motivation is the self-determination theory. Self-determination theory is a common theory found in literature pertaining to motivation, sport, club athletes, education, and healthcare (Keshtidar & Behzadnia, 2017; Deci & Ryan, 2008). Self-determination theory is the concept of human motivation and the basic needs that surround it which include the need for competence (Harter, 1978; White, 1963), relatedness (Baumeister & Leary, 1995, Reis, 1994), and autonomy (deCharms, 1968; Deci, 1985). All three basic human needs are essential for optimal growth, integration, for constructive social development, and for personal well-being (Deci & Ryan, 2000). Self-determination theory is an empirically based theory that focuses on human motivation, development, behavioral regulation, and wellness (Deci & Ryan, 2008; Sun, Li, & Shen, 2017). Self-determination theory focuses more on the different types of motivation versus amount of motivation, specifically in autonomous motivation, controlled motivation, and amotivation as predictors of performance, relational, and well-being outcomes (Deci & Ryan, 2000; Deci & Ryan, 2008).

As the goal in self-determination theory is to create a productive environment, it is important to seek motivating factors that yield a sense of reward and enjoyment within a setting that is supportive for students to want to learn and want to engage in activities. Concerning physical activity and fitness, one motivating factor may directly stem from the effects of physically moving and the impact that it has on emotional and mental health. Physical activity and fitness have shown to produce positive emotions by increasing levels of endorphins or brain



chemicals, while reducing immune system chemicals that aid in decreasing depression and insanity (Kayani, Kiyani, Wang, Zagalaz Sanchez, Kayani, & Qurban, 2018). Physical activity and fitness have been proven to build self-esteem, decrease anxiety, build cooperative peer relationships, and help remove and expend excess energy that often times leads to hyperactivity and externalizing problems (Zhang, Zhang, Niu, Ip, Ho, Jiang, & Zhu, 2019). In addition, individuals who partake in physical activity and fitness have demonstrated beneficial effects on physical and mental health, including the feeling of hopelessness and academic achievement (Chae, Kang, & Ra, 2017).

Although the self-determination theory has expanded to the theory that people are able to become self-determined when their needs for competence, connection, and autonomy are fulfilled, the basic principle or theory on people having a tendency to be driven by a need to grow and gain fulfillment has remained constant (Deci & Ryan, 2008). Specific to the realm of physical activity, sport, and education, motivation was found to be a key fundamental component because of its consequences; motivation produces (Deci & Ryan, 2000). Classes, teams, sports, and competitions where students are able to have the opportunity to engage in physical activity may naturally help students learn the foundational methods of healthy active living. In order to create an advantageous learning environment, it is important that all students are motivated to want to learn. In the realm of physical activity and sports there have been numerous studies conducted to investigate the effect of various types of motivation in relation to positive and negative outcomes (Keshtidar & Behzadnia, 2017; Sun et al., 2017; Whitehead, Rhoades, Walch, Lundberg, & Southard, 2016). Literature emphasized that more self-determined motivation is positively associated to performance measures in a structured environment such as physical education based programs and sports (Kirby, Byra, Readdy, & Wallhead, 2015), strength and

conditioning knowledge (Shen, McCaughtry, Martin, & Fahlman, 2009), intent to continue to be physically active in the future (Baena-Extremera, Gomez-Lopez, Granero-Gallegos, & Ortiz-Camacho, 2015), concentration (Standage, Duda, & Ntoumanis, 2005), and fundamental movement skills (Kalaja, Jaakkola, Watt, Liukkonen, & Ommundsen, 2009). Self-determination theory has become a commonly used framework to seek student's motivation due to self-determination theory constructs being highly relatable to physical activity (Sun et al., 2017; Deci & Ryan, 2000).

Physical activity has played and should play a pivotal role in and amongst the adolescent, young adult, and adulthood stages of life. Physical activity not only has the ability to reduce and eliminate a variety of health-related diseases that lead to mortality rates, but engaging in regular physical activity can also improve physical, mental, emotional, and social health, which may directly influence academic performance. Therefore, additional research is warranted to investigate the associations between various modes, durations, types of physical activity or sport and academic performance in college-aged students.

### **Problem Statement**

One of the greatest challenges for many college students is the transition from adolescence to adulthood or more specifically, the transition period from high school to college (Yang & Tsao, 2020). During this transition, numerous students will undergo several major developmental changes in various facets of life including adjustments to a new learning and social environment, a new program of study, a new schedule, new teaching practices, adjustment in academic rigor, and new institutional expectations and norms (Larose, Duchesne, Litalien, Denault, & Bolvin, 2019). With numerous physical, psycho-social, and developmental changes occurring in a constricted period of time, often in a new environment, students may find

themselves struggling to make the appropriate adjustments in one or many areas that may lead to mental, emotional, physical, and social difficulties possibly resulting in poor academic performance and overall stability (Larose et al., 2019). Furthermore, as college students begin to learn to take control and form healthy lifestyle habits, prior research highlighted the importance of associating modifiable health behaviors such as physical fitness, with not only chronic diseases but also cognitive growth as many estimate their own future risk as below average (Traxler, Morgan, Kiss, & Ludy, 2020; Pilcher, Morris, Bryant, Merritt, & Feigl, 2017).

In terms of stress and overall health, researchers have posited that many college students find themselves in a vulnerable position that may not only hinder academic performance but also, lead to several lifelong health-related diseases (Larose et al., 2019; Sa et al., 2016). One factor that has the ability to minimize, reduce, and reverse various health-related diseases as well as improve academic performance is through regular physical activity and fitness. Recent studies have shown that physical activity and fitness improved brain structure and function joined with both increased performance on tasks of executive function and cognitive capacity in a wide range of individuals (Yang & Tsao, 2020; Scott, De Souza, Koehler, & Murray-Kolb, 2017). Despite the abundance of literature examining the relationship between physical activity and fitness and academic performance in students, the problem is that there is limited research pertaining to the relationship between physical fitness levels, in terms of relative strength and academic performance, in terms of Grade Point Averages in college club sports students (Felez-Nobrega et al., 2018; Calestine, Bopp, & Papalia, 2017; Kim et al., 2015).

### **Purpose Statement**

The purpose of this quantitative correlational study was to determine if there is a relationship between physical fitness and academic performance of college club sports students.

Archival data consisting of scores from college club sports students from a higher education institution located in central Virginia during the 2019-2020 academic calendar school year was used. The researcher used archival data associated with student Just Jump System® scores and grade point averages.

The predictor variable was physical fitness and is defined as a physiological state of well-being that reduces the risk of hypokinetic disease through participating in various vigorous-intensity physical activities that emphasize aerobic endurance, muscular strength, flexibility and body composition (Donnelly, Hillman, Castelli, Etnier, Lee, Tomporowski, Lambourne, & Szabo-Reed, 2016) The Just Jump System® by Probotics was used to measure physical fitness. The Just Jump System® is a device that measures jump height, sprints, explosive leg power, anaerobic capacity, and contact time by calculating from flight time, which is measured via interruption of an electrical circuit when the participant's feet are not in contact with the mat (Pueo, Lipinska, Jimenez-Olmedo, Zmijewski, & Hopkins, 2017). The Just Jump System® aided in measuring physical fitness by assessing relative strength, which is defined as the total load of weight lifted or amount of strength associated with the body weight and size of the individual (Monteiro, Brown, Bigio, Palma, Dos Santos, Cavanaugh, Behm, & Neto, 2016).

The criterion variable was academic performance and is defined as the net result of students' cognitive and non-cognitive attributes as well as the measurement of student achievement across various academic subjects (Liem, 2019). To measure academic performance, both semester-by-semester as well as cumulative collegiate Grade Point Averages were examined on a 4.0 scale where the top grade was equivalent to an A letter grade. At the collegiate level, the industry standard and most commonly used indicator to measure and define academic student achievement as it reflects a multitude of course assessments throughout a

student's academic journey, represents an objective and reliable measure, and is economical in terms of data collection is Grade Point Averages (Mould & DeLoach, 2017; Stadler, Aust, Becker, Niepel, & Greiff, 2016). Program majors and cognates will vary both at the undergraduate and graduate levels from a higher education institution accredited by the Southern Association of Colleges and Schools Commission on Colleges.

### **Significance of the Study**

Throughout literature, there is a large body of evidence that indicate regular and consistent participation in physical activity and fitness is proven to enhance the physical, emotional, mental, and social well-being and overall quality of life (Kolt, George, Rebar, Duncan, Vandelanotte, Caperchione, Maeder, Tague, Savage, Van Itallie, Mawella, Hsu, Memmery, & Rosenkranz, 2017). Although there are numerous studies that expressed several cognitive benefits and improved academic performance associated with regular physical activity and fitness in youth and children, there are limited studies that highlight the same relationship in college students (Keating, Shangguan, Xiao, Gao, Sheehan, Wang, Colburn, Fan, & Wu, 2019; McPherson, Mackay, Kunkel, & Duncan, 2018; Cosgrove & Castelli, 2018; Jaakkola, Hillman, Kalaja, & Liukkonen, 2015). Specifically, this study will provide results showing the relationship between physical fitness in terms of relative strength and academic performance of college club sports students. In addition, understanding that fitness levels is related to both genetics and physical activity, future research needs to examine these inter-relationships more closely to determine the type and amount of regular physical activity and fitness required to improve overall strength and ultimately, cognitive function in college students as this plays a significant role in academic performance (Daniels, 2016). With the results of this study, it will not only help determine whether overall fitness is vital to academic performance with college club sports

students but also, this study will provide insight for the future development of campus-based recreational, club, and athletics health initiatives to have a shared focus of academic outcomes and physical activity and fitness.

### **Research Question(s)**

The research questions for this study include:

**RQ1:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the 2019-2020 academic year?

**RQ2:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the fall 2019 semester?

**RQ3:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the spring 2020 semester?

### **Definitions**

1. *Academic Performance* – a net result of cognitive and non-cognitive attributes (Liem, 2019).
2. *Cardiorespiratory Fitness* – the ability to transport oxygen from the lung to the mitochondria to perform physical exercise, thus considered a reflection of total body health (Laukkanen & Kujala, 2018).
3. *Cognition* – the set of mental processes that contribute to perception, memory, intellect, and action (Donnelly et al., 2016).

4. *Executive Function* – a set of cognitive operations underlying the selection, scheduling, coordination, and monitoring of complex, goal-directed processes involved in perception, memory, and action (Donnelly et al., 2016).
5. *Obesity* – the result of an energy imbalance (calories). When a person consumes more calories than that person's body uses, those extra calories are stored as fat. Obesity affects not just physical health but mental health as well. Individuals that are classified as obese are more likely to have low self-esteem and a negative body image (Thompson, 2015).
6. *Physical Activity* – fosters normal growth and development and can make people feel, function, and sleep better and reduce risk of many chronic diseases (Piercy, Troiano, Ballard, Carlson, Fulton, Galuska, & Olson, 2018).
7. *Physical Fitness* – a physiological state of well-being that reduces the risk of hypokinetic disease through participating in various physical activities that emphasize several health components, which include cardiorespiratory endurance, muscle strength endurance, flexibility and body composition (Donnelly et al., 2016).
8. *Relative Strength* – the total load of weight lifted or amount of strength of an individual compared to body weight and size (Monteiro et al., 2016).

## **CHAPTER TWO: LITERATURE REVIEW**

### **Overview**

A review of the literature was conducted to further explore various research studies that focused on the relationship between physical activity and fitness levels and academic performance in college students. In this chapter, an overview on the existing literature will be provided highlighting key aspects that relate to the study. In the first section, an explanation on the theory that helped form the framework will be discussed in further detail. In the second section, an in-depth look at the related literature reviewing the Just Jump System® device and its association with measuring physical fitness levels, the impact physical activity and fitness has on college-aged students, the definition of club sports at the collegiate level and background information on the club sports teams associated with the study will be synthesized. Lastly, the review will provide a narrative summary discussing the role and benefits that regular participation in physical activity and fitness may play regarding academic performance in college club sports students. Proceeding the review of the literature, a gap in the literature will form and provide a clear direction and focus for this study, which is to see if there is a relationship between physical fitness levels and academic performance of college club sports students?

### **Theoretical Framework**

A theory is often provided to help explain, predict, and challenge existing knowledge or phenomena that occurs in the world. A theoretical framework is the foundation that holds or supports the theory pertaining to a research study as it describes why the research problem exists (Creswell, 2018). In this literature review, the main theory that will help shape the theoretical framework that revolve around the realm of physical activity, fitness, health, physical education, and sport is the self-determination theory.



Reviews of chronic health problems in and around the world, particularly the United States is on the rise and continues to rise across all ages, socioeconomic backgrounds, ethnicities, and sex groups (De Lorenzo, Gratteri, Gualtieri, Cammarano, Bertucci, & Di Renzo, 2019; Hajat & Stein, 2018). Chronic diseases are among the most prevalent and costly health conditions in the United States where approximately 45% or 133 million of all Americans suffer from at least one chronic disease (Raghupathi & Raghupathi, 2018). A majority of these health issues such as Type II diabetes, cancer, arthritis, cardiovascular disease, and obesity may be preventable and treated with appropriate lifestyle changes (Padek, Mazzucca, Allen, Weno, Tsai, Luke, & Brownson, 2021). Eating a healthy balanced diet, minimizing screen time, and most importantly, participating in regular physical activities and fitness may not only aid in brain function and growth but also, it will help reverse health-related diseases and significantly lower the risks of obtaining future non-communicable diseases that will positively improve the overall quality of life (Romagnolo & Selmin, 2017; Shiue, 2016; Daskalopoulou, Stubbs, Kralj, Koukounari, Prince, & Prina, 2017). Therefore, it is critical to understand the motivation and inspiration behind engaging in and adhering to health-conducive behaviors such as regular physical activity and fitness to enhance relative strength for the maintenance and improvement in overall and total health (Johan et al., 2012; Matthews et al., 2015).

Self-determination theory (SDT) is one common theory found in literature in relation to motivation, sport, club athletes, education, and healthcare (Keshtidar & Behzadnia, 2017; Deci & Ryan, 2008). SDT is the only theory of motivation that identifies autonomy as a human need that when supported, enables more autonomous forms of behavior regulation (Johan et al., 2012). SDT originates from the concept of human motivation and the basic needs that surround it which include the need for competence (Harter, 1978; White, 1963), relatedness (Baumeister & Leary,

1995; Reis, 1994), and autonomy (deCharms, 1968; Deci, 1975). Competence may be referred to a feeling of mastery with regard to an individual's ability to be effective in a given context; relatedness may be seen as an individual's perceptions of feeling connected with others; and autonomy refers to feeling a sense of self-governed behavior or freewill (Symonds & Russell, 2018; Johan et al., 2012). Each basic human need appears to be essential for optimal functioning for growth and integration, for constructive social development and for personal well-being (Deci & Ryan, 2000). Literature has shown that additional support and subsequent satisfaction of the three basic human needs provided a higher quality of psychological energy that was projected to motivate the initiation and long-term maintenance of various health behaviors (Prentice, Jayawickreme, & Fleeson, 2019; Johan et al., 2012). One study revealed that satisfaction of the three psychological needs was related to behaviors favorable to dental or physical health such as flossing and routine dental appointments (Halvari, Halvari, Bjornebekk, & Deci, 2010) while another study highlighted that the satisfaction of all three needs were associated with life fulfillment, subjective vitality, positive affect, and increased levels of physical activity and fitness among overweight and obese individuals (Edmunds, Ntoumanis, & Duda, 2007). In addition, autonomy, competence, and relatedness are argued to foster the most volitional forms of motivation and engagement for activities that include enhanced performance, persistence, and creativity however, when the three psychological needs are not met or unsupported in a social context, it will result in detrimental impact on wellness in that setting (Deci & Ryan, 1985; Deci & Ryan, 2000). Psychological needs can also become thwarted by a hostile environment leading to defensiveness or self-protective accommodations as the individual believes that his or her psychological needs are being actively obstructed through the actions of others (Cuevas, García-López, & Serra-Olivares, 2016; Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-

Ntoumani, 2011). In the health, physical education, physical fitness, and sport domain, an individual's need can be thwarted when a coach or teacher does not provide opportunities for the student or athlete to demonstrate their skills and proficiencies leading to a range of possible negative outcomes on health and well-being (Cuevas et al., 2016).

SDT is an empirically based theory that focuses on human motivation, development, behavioral regulation, and wellness (Deci & Ryan, 2008; Sun et al., 2017). SDT focuses more on types of motivation versus amount of motivation, specifically in autonomous motivation, controlled motivation, and amotivation as predictors of performance, relational, and well-being outcomes (Deci & Ryan, 2000; Deci & Ryan, 2008). Behavioral engagement is more likely to occur from both autonomous motivation and controlled motivation as autonomous motivation focuses on engaging in behaviors for personally endorsed reasons that is consistent with personal values and controlled motivation reflects engaging in behavior that are self-endorsed (Mallia, Lucidi, Zelli, Chirico, & Hagger, 2019). Autonomous motivation and controlled motivation are both considered intentional while amotivation involves a lack of intention and motivation (Gagne & Deci, 2005). Autonomous motivation also tends to be related to both adaptive outcomes and behavioral persistence as it is related to self-endorsed reasons while controlled motivation is less adaptive because it is viewed as externally referenced and only to occur when the external contingencies are present (Mallia et al., 2019). In contrast, amotivation is known to be systematically and positively related to strictly maladaptive outcomes (Vallerand, Pelletier, & Koestner, 2008).

Previous research has not only indicated a positive relationship between goal orientation and participation in sports but also, SDT seeks an individual's general life goals highlighting the different aspects of intrinsic versus extrinsic goals to performance and psychological health

(Deci & Ryan, 2000; Deci & Ryan 2008; Keshtidar & Behzadnia, 2017). Over the past number of years, the self-determination theory has gone through several refinements (Deci, 1975; Deci & Ryan, 2000; Deci & Ryan, 2008) however; the fundamental concept that remains constant is the satisfaction of the major psychological needs that comes from the interaction between individual and the environment (Vallerand et al., 2008). SDT is considered an orgasmic dialectical approach where the theory begins with the assumption that humans are active organisms with the ability to evolve, grow, master various challenges, and integrate new experiences into a coherent sense of self (Deci & Ryan, 1985; Deci & Ryan, 2000). With this said, the developmental tendencies do not function by themselves, but instead it heavily relies upon the social environment and support therefore, it is the interaction between the active organism and the social context that is the foundation for SDT's predictions about behavior, experience, and development (Deci & Ryan, 1985; Deci & Ryan, 2000). In SDT, there are two main types of motivation that can control or regulate an individual's behavior. The first type is intrinsic motivation, which is completing an activity or a set of activities because of its inherent satisfactions or because of the experiences, personal accomplishment, excitement, and enjoyment that the task may bring (Deci, 1975; Teixeira, Carraca, Markland, Silva, & Ryan, 2012). Intrinsic motivation is the most self-determined type of regulation and therefore, those who are intrinsically motivated to exercise do so for the enjoyment that is experienced during the exercise bout (Wininger & Desena, 2012). The second type of or in contrast to intrinsic motivation is extrinsic motivation, which refers to behavior that is driven for external reasons that may arise from outside the individual or completing an activity for instrumental reasons such as rewards and praises (Teixeira et al., 2012). Extrinsic motivation includes four types of regulation: external, introjected, identified, and integrated. External regulation is most similar to operant

conditioning and is the least self-determined form of extrinsic motivation as an individual high in external regulation would partake in exercise to gain a desired outcome or tangible reward from others (Wininger & Desena, 2012). Introjected regulation is described as motivation that is internalized where the behavior is driven by self-approval, pride or feelings of guilt when not fully performing the behavior (Gagne & Deci, 2005; Teixeira et al., 2012). Identified regulation is relatively self-determined as some goals may not be consistent with one's general values and lastly, integrated regulation is the most self-determined type where an individual would exercise because of the value they place on being healthy as exercise is seen to be an important aspect of self-concept (Wininger & Desena, 2012). Additionally, specific to physical education and physical fitness, studies have shown associations between intrinsic motivation and positive outcomes, increased levels of effort, interest, and self-esteem while motives based on introjected regulations have shown negative outcomes such as unhappiness and boredom (Cuevas et al., 2016; Ntoumanis & Standage, 2009).

One goal in the physical fitness, education, and sports domain is to help individuals learn the foundational methods of healthy living through physical activity. In order to create a productive learning environment, it is vital that all students possess a form of motivation or desire to want to learn. In the realm of sports where the main foundation is based around the concepts of physical activity and fitness; there have been numerous studies conducted to investigate the effect of various types of motivation in relation to positive and negative outcomes (Sun et al., 2017). Research has shown that more self-determined motivation is positively associated to performance measures in strength and conditioning knowledge (Shen et al., 2009), intent to continue to be physically active in the future (Baena-Extremera et al., 2015), concentration (Standage et al., 2005), and fundamental movement skills (Kalaja et al., 2009). In

the field of health and wellness, empirical work grounded in SDT has often examined relationships between SDT-based constructs and outcome variables related to physical or mental health. Experimental field studies and clinical trials have shown healthcare professionals trained to support the patients' psychological needs and have documented significant changes in behavioral adherence, motivation, and well-being (Johan et al., 2012). Furthermore, key figures in sports or fitness such as coaches that work in an autonomously supportive manner, have the ability to provide opportunities for athletes to make their own choices, to take initiative, and to offer constructive feedback in which, aids in promoting prosocial behaviors (sportsmanship and fair play) while impeding antisocial behaviors (cheating) for continual growth (Mallia et al., 2019). Due to SDT's constructs being highly relatable to health education and exercise, SDT has become a commonly used framework to seek student's motivation regarding physical activity, fitness, and sports (Sun et al., 2017; Deci & Ryan, 2000).

### **Related Literature**

Though self-determination theory dates back to the 1970's, over the past decade research on SDT has significantly emerged where emphasis on the impact of social environments on motivation, affect, behavior, and well-being have been tested and confirmed (Deci & Ryan, 2008). Specific to the realm of sport, education, and the college years, "motivation is highly valued because of its consequences: Motivation produces" (Deci & Ryan, 2000, p. 69). As motivation plays a major role in college students concerning physical fitness and academic performance, an examination of literature on the Just Jump System® and its association with measuring relative strength and fitness levels, the impact of physical activity and fitness on total health, the definition of club sports at the collegiate level and background information on the specific sports involved will be investigated.

### **Just Jump System® and Relative Strength**

An outcome that is frequently pursued in the world of physical activity, fitness, and in sports is the desire to feel a sense of gain or improvement in terms of overall health and performance. Regarding how an individual, researcher, athlete, coach, or teacher measures improvement or performance can come in various forms and methods. One method to measure the development of muscle strength and power in terms of physical fitness is relative strength (Suchomel, Nimphius, & Stone, 2016). Relative strength is not only a suitable indicator of overall muscular strength in relation to body weight but it is also a good indicator of an individual's ability to control and move their body through space (Monteiro et al., 2016). Research has shown that a common instrument associated with assessing relative strength in the fitness and sports domain that many coaches and researchers rely on is a jump mat device (Pueo, Jimenez-Olmedo, Lipinska, Busko, & Penichet-Tomas, 2018).

### **Just Jump System®**

In the realm of physical fitness and sport science, it is vital for the teacher, coach or researcher to obtain accurate and precise measurements of strength and power under conditions delimited by human posture, movement pattern, and muscular contraction type (Pueo et al., 2018). An area that research has associated higher fitness levels, greater functional movement, overall health, and academic performance is lower limb muscular strength (Molina-Garcia, Migueles, Cadenas-Sanchez, Esteban-Cornejo, Mora-Gonzalez, Rodriguez-Ayllon, Plaza-Florido, Molina-Molina, Garcia-Delgado, D'Hondt, Vanrenterghem, & Ortega, 2019; Adelantado-Renau, Jimenez-Pavon, Beltran-Valls, Ponce-Gonzalez, Chiva-Bartoll, & Moliner-Urdiales, 2018). Lower limb strength and power has been widely established in literature as a popular non-invasive indicator of athletic ability, a detection tool for high-risk elderly adults that

are susceptible to injuries caused by falling and an efficient means to monitoring responses to various therapeutic interventions (Rantalainen, Hesketh, Rodda, & Duckham, 2018). Lower limb power and strength can be measured using isometric tests, maximum lifting load tests, and isokinetic tests, all of which are often times performed in advance biomechanics laboratories (Santos-Lozano, Navarro, Lopez, & Vallejo, 2014). Alternatively, another more cost- and time-effective option that measures and evaluates improvement in lower limb strength, power, speed, general fitness, and athletic performance is the vertical jump height test (Pueo et al., 2018). Jump height performance may be regarded as one of the most important basic functional parameters in fitness and sports as jump tests are used to measure both lower limb muscle power and the coordination of lower and upper extremities as maximal height is achieved when flexion of the hips, knees, and ankles are properly executed (Whitmer, Fry, Forsythe, Andre, Lane, Hudy, & Honnold, 2015; Pueo et al., 2017). In addition, research highlights that vertical jumping is not only a fundamental aspect of many sports but also, jump height may be predictive of performance in other sports in which vertical jumping may not be the primary component (Sozbir, 2016). Due to its versatility in identifying and measuring general lower-limb functionality, vertical jump height is also commonly used within the non-athletic populations (Nuzzo, Anning, & Scharfenberg, 2011). Jump height performance can be evaluated through one or a combination of several tools including force plates, multiple-camera video motion sensors, and flight time measurements. Due to the accessibility, portability, simplicity, and low cost, professionals in the health, fitness, and sports industries will often select a jump mat device when tracking vertical jump height or lower limb strength (Rantalainen et al., 2018; Pueo et al., 2018, Pueo et al., 2017).



The Just Jump System® is a device comprised of a contact mat made of two parallel, isolated metallic plates where each plate functions as an electric switch that closes when the subject is on the mat and opens when the subject is in the air and no pressure is applied over the mat (Pueo et al., 2018). A jump mat can be found attached to a hand-held microcontroller or computer that provides an estimate of jump height, which is calculated from flight time measured via an interruption of an electrical circuit when the subject's feet are not in contact with the mat (Pueo et al., 2017; Whitmer et al., 2015; Nuzzo et al., 2011). Similar to the more expensive force plates that also calculates vertical jump height, the jump mat's ability to conduct assessments indoors and outdoors among various athletic population groups while also having the ability to receive instantaneous feedback makes the Just Jump System® one of the most convenient and commonly used instruments in the field when assessing lower limb and relative strength (Pueo et al., 2018; McMahon, Jones, & Comfort, 2016).

### **Relative strength**

Literature indicates that cardiorespiratory fitness, muscular strength, and agility are three key components of physical fitness most closely related with an individual's health status (Molina-Garcia et al., 2019). In fitness and sports, it is not only important to understand each category and concept in terms of how they both independently and collaboratively enhance overall health but also, it is equally important to understand how to physically train and target each area in order to develop more power, speed, endurance, and strength. One form of strength that is seen as highly important due to its ability to apply to both athletics as well as the general population regarding everyday activities is relative strength. Relative strength is defined as the total load of weight lifted or amount of strength of an individual compared to their body weight and size (Monteiro et al., 2016). Studies revealed that relative strength is shown to strongly

correlate with both sprint speed and change of direction speed among athletes in a variety of sports at all playing levels (Andersen, Lockie, & Dawes, 2018). One study that examined Division II collegiate women's volleyball players via repeat jump tests found that developing and training relative lower body strength can improve measures of power and agility (Tramel, Lockie, Lindsay, & Dawes, 2019). Another study that examined maximum strength, jump squats, sprints, and change of direction in female softball players from the Australian Institute of Sport discovered significant relationships between relative strength and measures of linear speed and change of direction over the course of one season (Nimphius, McGuigan, & Newton, 2010). A third study that examined vertical jump tests, back squats, agility, and a series of sprint tests found a significant correlation between relative strength and change of direction in a group of Division II collegiate women's soccer players (Andersen et al., 2018). Furthermore, developing relative strength is key as those who demonstrate higher levels of relative strength are often times less fatigued and in greater physical and muscular health, which translates to more efficient kinesthetic movement in and through space (De Lira, Vargas, Silva, Bachi, Vancini, & Andrade, 2019). As relative strength can be assessed by vertical jump height on one of the most common and accessible instruments, the Just Jump System®, researchers and coaches in the physical fitness and sports fields continue to apply this form of measurement as increased strength may yield greater power capabilities, enhanced speed performance, and improved overall total health (Andersen et al., 2018).

### **Impact of Physical Activity and Fitness on Total Health**

The importance of physical health and fitness has become minimal or nonexistent for many individuals as the World Health Organization has revealed that insufficient physical activity is the fourth leading underlying cause of premature mortality contributing to over 3

million deaths each year (Brymer & Davids, 2016). One common theme that can be found throughout literature is the beneficial impact physical activity and fitness has on total health. Extensive evidence indicated that regular physical activity and fitness can be an effective preventive and rehabilitative intervention for over 30 health diseases and over 25 chronic medical conditions (Warburton & Bredin, 2017; Brymer & Davids, 2016). Whether physical activity and fitness is fulfilled through exercise at a recreational level or through sports at the more competitive level, individuals who partake in regular kinesthetic activities may not only benefit widely in terms of physical health but also, may benefit and experience a positive ripple effect onto all other facets of life. In order to achieve any health benefits, physical activity and fitness guidelines worldwide have suggested that individuals partake in a minimum of 150 minutes per week of moderate-to-vigorous intensity physical activity (Warburton & Bredin, 2017). Previous research has indicated that physical activity and fitness may specifically enhance cardiovascular, functional, social, and mental health while reducing risk factors for metabolic syndrome, concomitantly improving overall fitness levels, relationships with others, work satisfaction, and mood (Genin, Dessenne, Finaud, Pereira, Thivel, & Duclos, 2018). Studies also implied that the healthier or more fit an individual is classified, not only would it delay the potential comorbidities related to the aging process but also, being physically fit was found to increase both cognitive and executive functioning leading to improved academic performance (Kawagoe, Onoda, & Yamaguchi, 2017; Lee, Lim, Lee, Kim, & Yoon, 2017).

### **Improved emotional and mental health and physical activity and fitness**

Similar to the idea behind the self-determination theory, it is important to help find motivating factors for students to want to learn and want to engage in kinesthetic-based activities. One significant motivating factor that stems from physical activity and fitness may be

attributed to the additional benefits that are associated with improved emotional and mental health (Williams & Hardie, 2019). Research found that human emotions provide the principal currency as the motivational force leading toward our best or worst behaviors (Bhochhibhoya, Branscum, Taylor, & Hofford, 2014). When participating in physical activity and fitness, particularly activities that emphasize cardiorespiratory fitness, studies discovered that emotional and mental improvements began to occur such as mood levels, lowered blood pressure, reduced perceived exertion, enhanced self-esteem, and reduced anxiety (Yeh, Stone, Churchill, Brymer, & Davids, 2017; ). Existing evidence revealed that an acute bout of aerobic training enhanced mood for at least 30 minutes, cycling for 15 minutes increased positive affect in both younger and older adults, and college students showed reduced levels of anxiety after an acute bout of walking at 50% maximal heart rate or running at 60-90% maximal heart rate (Chan, Liu, Liang, Deng, Wu, & Yan, 2019).

A second aspect that physical activity and fitness has shown associations with emotional experiences and information is emotional intelligence. Emotional intelligence can be defined as how people effectively deal with emotions to regulate social and emotional behaviors (Pekaar, Bakker, Van der Linden, & Born, 2018). In fitness, more specifically sport competitions where individuals are induced with high pressure situations and a wide range of emotional responses that can influence performance- emotional and mental health or emotional intelligence can play a vital role towards an individual's success. Studies have shown that individuals high in emotional intelligence, tend to be more physically active and fit thus, are more inclined to cope with stress, resist overwhelming emotions, and handle frustration better than those with low emotional intelligence or those who are less physically active and fit (Zysberg & Hemmel, 2018; Campo, Laborde, & Mosley, 2016). Another study conducted at the University of Oklahoma revealed

that college students that were in the high physical activity and fitness group reported better or more stable mental health compared to the moderate and low physical activity and fitness groups supporting existing literature that increased participation in physical activity and fitness can enhance overall health and wellness (Bhochhibhoya et al., 2014).

Interventions that focus on healthy behaviors such as physical activity and fitness can also have substantial impact on cognitive development, serve as important contributors to optimal health, and protect against the development of chronic diseases and both mental and neurological disorders (Williams & Hardie, 2019; Kayani, Kiyani, Wang, Zagalaz Sanchez, Kayani, & Qurban, 2018; Yeh, Stone, Churchill, Wheat, Brymer, and Davids, 2016). One major mental health or mood disorder that is not only commonly known and can be seen in individuals that are prone to a sedentary lifestyle but also the most common mental disorder among college students is depression (Ebert, Buntrock, Mortier, Auerbach, Weisel, Kessler, Cuijpers, Green, Kiekens, Nock, Demyttenaere, & Bruffaerts, 2018). Depression is a neuropsychiatric disorder with both genetic and environmental contributing factors that can impact college students in the form of lower academic performance (Mihăilescu, Diaconescu, Ciobanu, Donisan, & Mihailescu, 2016), increased risk for college dropout (Boyratz, Horne, Owens, & Armstrong, 2016), increased levels of anxiety (Dalky & Gharaibeh, 2019), physical illness (Coughenour, Gakh, Pharr, Bungum, & Jalene, 2020), decreased physical activity (Chellaiyan, Ali, & Maruthappandian, 2018), unsafe sexual behavior (Burke, Katz-Wise, Spalding, & Shrier, 2018), increased levels of smoking (Cai, Xu, Cheng, Zhan, Xie, Ye, Xiong, McCarthy, & He, 2017), alcohol and drug dependency (Kenney, Anderson, & Stein, 2018), poorer quality of life (Alsubale, Stain, Webster, & Wadman, 2019), self-harming behaviors (Whitlock, Prussien, & Pietrusza, 2015), and an increased risk of suicide (Hayes, Petrovich, Janis, Yang, Castonguay, &

Locke, 2020; Zhang, Zhang, & You, 2018; Ebert et al., 2018). Conti & Ramos (2018) described that the greater amount of physical activity and fitness the greater the impact on the prefrontal and hippocampal areas as routine exercise can positively influence neuropsychiatric disorders as it is linked to less cortical atrophy, improved brain function, and increased cognitive function.

Physical activity and fitness will not only aid in combating emotional and mental disorders such as depression, hopelessness, insanity, self-isolation, eating disorders, and low self-efficacy, but also, the social emotional benefits that stem from exercise may assist with improved academic performance (Fraser, Chapman, Brown, Whiteford, & Burton, 2015; Zhang et al., 2019; Williams & Hardie, 2019). A Cochrane review of 32 randomized controlled trials (RCTs) concluded that prescribed physical exercise has been proposed by many as an effective alternative treatment for reducing the symptoms of depression as regular exercise helps regulate core body temperature, increases serotonin levels and hippocampal cell proliferation, and helps reduce levels of proinflammatory cytokines (Hallgren, Kraepelien, Ojehagen, Lindefors, Zeebari, Kaldo, & Forsell, 2015). In addition, participating in physical activity and fitness has shown to aid in promoting cooperative peer relationships while helping to remove and expend excess energy that often times leads to a lack of focus, hyperactivity, and externalizing problems (Zhang et al., 2019). Literature on the effects of physical activity and fitness levels on emotional and mental health determined that exercise in general is an adjunctive therapy of depression, can be used for prevention, and has the ability to enhance the overall emotional state and status of university students (Fónai, Makai, Boncz, Ács, Molics, Gyuró, & Járomi, 2016).

### **Improved cognitive development and physical activity and fitness**

Along with physical activity and fitness influencing emotional and mental wellness, another domain that regular fitness-related activities may positively affect college students is in

regards to cognitive health. Cognitive health or cognition, a term that is often times referred to academic performance or brain-based skills, is a mental function that involves gaining knowledge and comprehension through perception, memory, and experiences (Donnelly et al., 2016; Esteban-Cornejo et al., 2015). In terms of anatomy and physiology, the brain is capable of both functional and structural changes in response to various internal and external demands allowing for a range of adaptability and diverse functionality (Ludyga, Gerber, Brand, Puhse, & Colledge, 2018). Throughout research, regular physical activity and fitness is recognized to have a wide spectrum of benefits and is considered one of the most effective strategies to promote physical and cognitive development (Dupuy, Gauthier, Fraser, Desjardins-Crepeau, le Desjardins, Mekary, Lesage, Hoge, Pouliou, & Bherer, 2015). Advances in neuroscience have highlighted substantial progress in linking physical activity and fitness to cognitive performance as well as brain structure and development due to its ability to increase both cortical thickness and brain blood flow (Yang & Tsao, 2020; Donnelly et al., 2016). Regular engagement in physical activity, fitness, and sports is not only associated with improved brain function and cognition but as a result, it can also be translated and linked to executive functioning and academic performance (Marques, Santos, Hillman, & Sardinha, 2018; Nayak, Miranda, Fitzrol, Anthony, Rao, & Aithal, 2016). Executive function or control processes are responsible for the planning, initiating, and monitoring of complex goal-directed behavior (Wilckens, Erickson, & Wheeler, 2018). As cognitive executive functions of inhibition, working memory, and cognitive flexibility are found to be key indicators for academic performance, research has indicated that physical activity and fitness can activate physiological processes that improve attention, learning, and memory (Dunsky, Abu-Rukun, Tsuk, Dwolatzky, Carasso & Netz, 2017; Kvalo, Bru, Bronnick, & Dyrstad, 2017; Fedewa, Fettrow, Erwin, Ahn, & Farook, 2018; Dupuy et al., 2015).

Furthermore, research demonstrates that bouts of physical activity and fitness optimizes brain networks by stimulating neurological changes in the hippocampus that are linked to memory consolidation and skilled actions creating a reserve of precursor cells that influence individuals' learning capabilities throughout the life span (Marques et al., 2018; Donnelly et al., 2016).

Similar to developing any other skill, executive function may also be improved with consistent practice as well-developed executive functions is known to be a prerequisite for academic performance (De Bruijn, Harman, Kostons, Visscher, & Bosker, 2018; Kvalo et al., 2017). In order to achieve the strongest effects of executive functioning, researchers suggest that students should partake in cardiovascular fitness related activities that are not only moderate-to-vigorous in intensity levels but also, activities that are cognitively demanding (Bruijn et al., 2018). This claim was further examined and confirmed by a study that revealed that physical fitness is a moderator of the interactive relationships between exercise and cognition thus, highly active and physically fit individuals will benefit most from regular aerobic exercise sessions in terms of cognitive development and executive functioning (Ludyga et al., 2018).

### **Improved social development and physical activity and fitness**

Alongside improvements in emotional, mental, and cognitive development, literature indicated that participating in regular physical activity and fitness may also enhance the social development or health of an individual. Helliwell and Putnam (2004) stated that, “a large and growing literature suggests that physical health itself is strongly conditioned by social factors, so it is plausible to conjecture that health constitutes one pathway through which social factors influence subjective well-being” (p. 1435). Often times, networking for friendship and developing a supportive peer system can be challenging or can be stressful for many college students especially when invited to a new environment or setting. Engaging in physical activity



in a group setting provides a positive socializing effect as it not only aids in motivating individuals toward regular fitness but also, research has reported that exercising in a group may be beneficial in improving and shaping overall cardiovascular health (Laukkanen, 2018).

Participating in physical activity and sports will induce life satisfaction, happiness, subjective well-being, and mental health of students resulting in improved social interactions and prosocial behaviors (Di Bartolomeo & Papa, 2019). In particular, physical activity in a group setting or team environment has the ability to promote and increase the levels of trust and further drive participation as the exercise behavior and mindset is likely to be the group norm (Stevens, Rees, & Polman, 2018; Anderson and Ramos, 2018). In a study, Seippel (2006) found that being a part of a voluntary sports organization or club had shown a positive link to social trust, while Delaney and Kearney (2005) also revealed that sports participation is closely linked to the frequency of socializing and meeting with friends. In addition, physical activity in the form of sports participation was found to be a strong predictor of trust, network connections, and reciprocity as being involved in team sports or group activities produced feelings of belonging and community (Di Bartolomeo & Papa, 2019). Li and Zizzi (2018), shared a qualitative study that resulted in participants reporting that the enjoyment gained through exercising with others and interacting socially and positively with people around them aided in building friendships, feeling a sense of purpose, and reduced social anxiety (Li & Zizzi, 2018). In a group of over 800 collegiate athletes, a study that used social network analyses derived from teammates' reports of connections with one another computing for outdegree centrality, indegree centrality, and group-level density, resulted in a positive relationship between all three variables indicating that athletes who have greater social connections with teammates may form a stronger sense of social identification (Graupensperger, Panza, & Evans, 2020). Furthermore, literature has also shown

that team oriented sport activities seem to be more intrinsically motivating to the participants due to its ability to emphasize positive social interaction and play (Nielsen, Wikman, Jensen, Schmidt, Gilemann, & Andersen, 2014). Li and Zizzi (2018) concluded, “Companionship, friendship, and social support can boost both physical and mental health and increase all areas of life satisfaction” (p. 389).

## **Club Sports and Higher Education**

### **Club Sports**

The transition to college is a time where many students will physically move away from home and begin to experience independent, parent-free living for the first time. This new chapter in life can bring forth highly anticipated excitement, fear, or both as students will face many new challenges and changes physiologically, emotionally, socially, and mentally. Research has shown that during the late adolescence to early adulthood transition or the college years as well as with increasing age, physical activity and fitness levels will rapidly decline causing other facets of health to also regress (Vashold, Deere, & Pivarnik, 2019). As a result, colleges and universities are both an appropriate and ideal setting to endorse healthy active living to the young adult population as they have the ability to engage large numbers of students in behavior change interventions. With higher education institutions being regarded as organizations that follow high standards of evidence-based practices as well as having a range of facilities, resources and qualified staff commonly including health professionals and coaches, colleges and universities are ideal for implementing initiatives to target lifestyle-related health changes (Plotnikoff, Costigan, Williams, Hutchesson, Kennedy, Robards, Allen, Collins, Callister, & Germov, 2015). One health initiative or program that may encourage college students to participate in, resume

and continue throughout a lifespan pertaining to physical activity and fitness is through college and university club sports.

The National Intramural-Recreational Sports Association defines club sports as student-led groups that are voluntarily organized to further students' common interests in an activity through participation and competition (Lifschutz, 2012). Although there are no known exact figures of collegiate club sports annual participation, high school sport participation numbers continue to grow each year with over 7 million participants as of 2015 of which only 6.2% are offered the opportunity to compete at the National Collegiate Athletic Association (NCAA) level (Beidler, Bretzin, Hanock, & Covassin, 2018). This would leave millions of students an option to participate in a collegiate club sport team and continue an athletic career while remaining physically active and fit. Club sports at the collegiate level can be an avenue and a powerful influence on many students who wish to improve or sustain overall health and well-being through the regular participation of sports (Anderson & Ramos, 2018).

Club sports at the college and university levels are often times organized outside of the traditional school athletic departments requiring funds to mainly be supported through member dues; however, similar to athletics, a few club sports teams may still require students to train throughout the year (Dahab, Potter, Provance, Albright, & Howell, 2019). Club sports programs are also known to be competitive in nature and may involve local, regional, or national interinstitutional competition (Weaver, Forte, & McFadden, 2017). College and university students may be attracted to club sports for those who not only previously participated in traditional high school sports such as basketball, football, and soccer but also, to those who wish to pursue nontraditional avenues of physical activity such as cycling, martial arts, and crew (Beidler et al., 2018). With various club sports options and teams for students to participate in, it

is essential for higher education institutions to understand what a club sport is and how it may differ from other physical activity, fitness, and sporting avenues that are more popular such as intramural recreational sports or garner more exposure and prestige such as varsity athletics (Lifshutz, 2012). Though popularity and prestige may not be linked to club sports, one area or positive outcome that club sports offers college and university programs derives from teams aligning, supporting, and representing the educational mission of higher education institutions leading to its role in playing an integral part in student success and retention (Roberts, Miller, & Wells, 2003). A study conducted by the National Intramural-Recreational Sports Association reported that 40% of students conveyed that higher education institutions that offered club sports programs played a significant role in their decision to select and obtain a degree at the institution (National Intramural-Recreational Sports Association, 2010). Kampf and Teske (2013) also reported that students who participated in club sports were more than twice as likely to enroll at the university the proceeding year than non club sports students. In addition, club sports programs can develop experiential educational opportunities that enhance what is taught in the classroom such as leadership, communication, conflict resolution, and time management all of which are skills necessary for both academic performance and future job related success (Weaver et al., 2017).

### **Beach Volleyball**

Beach volleyball is a sport that began as a form of family fun that quickly escalated and gained attraction especially during the Great Depression as hundreds of Americans turned to the beaches to play a no-cost, entertaining, physically engaging activity. The first non-official competition was held in California during the 1950's, the first professional beach volleyball tour was organized in the 1970's, the International Volleyball Federation recognized beach volleyball

as a sport in 1986, and in 1996, beach volleyball made its first official Olympic debut at the 1996 games in Atlanta (Next College Student Athlete, 2020). As the sport continues to grow, beach volleyball is now found being played at the recreational, high school, college, and professional levels. Beach volleyball is a team sport characterized by its intermittent nature where intensity levels of play may fluctuate randomly from brief periods of maximal or near maximal intensity to longer periods of moderate and low intensity activities (Medeiros, Marcelino, Mesquita, & Palao, 2014). Beach volleyball is played on a beach court with teams consisting of two players defending an area of 8x8 meters and a game format that includes each match being played over the best of three sets where the first two sets is played to 21 points and the third, if necessary is played up to 15 points (Next College Student Athlete, 2020). In order to perform successfully with excess ball speeds of 80 km/hr to 130 km/hr crossing the net at any given time, players must be able to react quickly, obtain well developed cognitive skills, anticipate often partial information about an opponent's next action, and require a high level of perceptual skills (Schläppi-Lienhard & Hossner, 2015).

### **Crew**

Crew or rowing is one of the oldest sports in the world where it has not only been referenced in ancient Egyptian carvings but also, the Harvard-Yale Regatta remains as the oldest active college sporting event in the United States dating back to 1852 (Next College Student Athlete, 2020). Rowing became the first organized collegiate sport in the United States with its own governing body and continued to grow internationally forming the Federation International des Societas d'Aviron which now governs all international championships (Rockford Rowing, 2020). The sport of crew and rowing involves propelling a boat or shell on water by generating force with oars to move the boat (Woodlands Crew, 2020). Crew or rowing is considered a

rhythmic whole-body exercise that uses every major muscle group in the body including legs, abdomen, chest, back, and arms, is divided into either the sweep discipline where each oarsman handles one oar or the sculling discipline where the oarsman uses two smaller oars and is competed at the standardized 2000 meters for international and collegiate races (Rockford Rowing, 2020). Crew or rowing is a paddle sport that requires explosive power, stamina, balance, flexibility, and coordination in order for the rower to perform successfully (Liu, Yang, Hou, Ma, Jiang, Wang, Zhang, & Yuan, 2019).

### **Figure Skating**

The history of figure skating began in 1850 by two Americans named Edward Bushnell and Jackson Haines who revolutionized skating by not only introducing steel-bladed skates that allowed for complex maneuvers and turns but also, by adding elements of grace through ballet and dance (Olympics, 2020). As a result, figure skating transitioned as an art form that slowly evolved into the athletic sport that is seen today. Not only has the sport evolved in training types from figures, freestyle, and jumping but also, judging criteria has also shifted to reward more points for technically demanding jumps, spins, and overall programs (Bruening, Reynolds, Adair, Zapalo, & Ridge, 2018; Han, Geminiani, & Mitchell. 2018). Figure skaters today are seen competing at all levels, at all ages, and at all stages including the collegiate and Olympic levels. The United States Figure Skating is the national governing body for the sport of figure skating in America and has nearly doubled in participants from 102,647 in 1991-1992 to 184,200 members in 2016-2017 including more than 750 member clubs, collegiate clubs, and school-affiliated clubs (Han et al., 2018). At the collegiate or competitive level where the skating motions are fast and dynamic, skaters train extensively engaging in several hours daily of both on-ice and off-ice workouts in order to help them perform the roughly estimated 50 to 100 jumps each day (Yu,

Park, & Lee, 2019; Bruening et al., 2018). Male skaters are seen today routinely performing 5 different quadruple jumps (4 revolutions in the air) while female skaters are routinely performing triple axels (3.5 revolutions in the air) and attempting quadruple jumps (Han et al., 2018).

### **Ice Hockey**

Ice hockey is categorized as one of the most popular and notable sports in the twenty-first-century world that was first introduced by the Micmac Indians of Nova Scotia in the mid-1800's (Next College Student Athlete, 2020). In 2016, the United States alone recorded over 350,000 registered youth hockey players while averaging over a million registered players in performing leagues worldwide (Black, Black, Dhawan, Onks, Seidenberg, & Silvis, 2019; Encyclopedia Britannica, n.d.). The modern game of ice hockey is played at every level from amateur, collegiate, international, and professional all being influenced by the National Hockey League, which is considered the premier league of the sport. Ice hockey is a sport where players compete on an ice rink wearing skates, full body protective equipment, and uses a stick to strategically hit a round vulcanized rubber puck into the opposing teams net. The sport is described as intermittent, high intensity bouts of skating that requires rapid acceleration and changes in velocity and direction, flexibility, the potential for high-impact body contact, and the execution of various highly technical skilled maneuvers (Roczniok, Stanula, Maszczyk, Mostowik, Kowalczyk, Fidos-Czuba, O., & Zając, 2016; Runner, Lehnhard, Butterfield, Tu, & O'Neill, 2016). At the competitive, college, and professional level, the game is characterized as intense repetitive bouts of high energy output that lasts approximately 30-80 seconds in duration or shift lengths and a sport in which total body fitness is necessary as players required to develop fitness in anaerobic sprint ability (69% anaerobic glycolysis), muscular strength, power, and endurance (Roczniok et al., 2016).

## **Synchronized Skating**

Similar to figures, freestyle, and jumping, synchronized skating is another category that falls under the discipline of figure skating. Synchronized skating is described as a blend of team athletics with aesthetics where the best teams are eligible to compete both at the national and international levels (Hall, 2013). Synchronized skating, also known as precision skating, is the newest addition and fastest growing skating sport consisting of a team of 8 or more skaters that perform various movements in unison across the ice (Encyclopedia Britannica, n.d.). At the collegiate level, in order to qualify and participate in official competitions, each team must consist of 12-20 skaters, each member of the team must be enrolled in a university or college as a full-time student, and each member must have passed the U.S. Figure Skating juvenile moves in the field test (U.S Figure Skating, 2020). The skating involved consists of formations in such configurations as a circle, line, block, and wheel where spirals are allowed, but lifts and jumps of more than one revolution are prohibited in programs (Encyclopedia Britannica, n.d.). Synchronized skating emphasizes meticulousness and the unison of movements performed by a group of individuals that requires strength and endurance in order to mask the physical demands by feigning effortless and visually appealing performances (Herrick, Rocchi, & Couture, 2020). As routines and programs may be complex and require the ability to work in a team environment, synchronized skating provides skaters an opportunity to engage with peers in a competitive manner, develop lifelong skills such as resilience, cooperation, and drive, which hold value both on the ice and off (U.S. Figure Skating, 2020).

## **Swimming**

The history of swimming can be dated back to the Stone Age when prehistoric man learned to swim simply as a means to cross rivers and lakes (Olympics, 2020). Swimming was



not widely practiced or officially organized and declared a sport until the early 19<sup>th</sup> century where swimming was not only used for entertainment and leisure, but also, it was used for instructional and training purposes such as lifesaving and interval training (Encyclopedia Britannica, n.d.). Swimming can be characterized by an aquatic locomotion technique defined by intermittent actions of both the upper and lower limbs to overcome the drag force and propel the body in a forward motion (Bartolomeu, Costa, & Barbosa, 2018). In the sport of swimming, there are four competitive swimming strokes which include the front-crawl, backstroke, breaststroke, and the butterfly (Bartolomeu et al., 2018). Currently, swimming is a sport that is seen at both the recreational and instructional levels for all age groups as well as the competitive, collegiate, and Olympic levels for the more advanced. At the college level, students have the option to compete at the NCAA Division I, II, and III levels as well as the club level where applicable (Next College Student Athlete, 2020). For a better level of swimming training and a higher chance for success, muscular strength development is essential for performance swimming (Vaneckova, Kabesova, Kracmar, Balogova, & Bacakova, 2018). Due to the density of water adding additional resistance to swimmers than land based sports, competitive swimmers are expected to not only have specific anthropometrical features but also, focus on cardiovascular endurance training in order to increase lung volume and enhance pulmonary functioning (Hakked, Balakrishnan, & Krishnamurthy, 2017). Furthermore, swimming is often times synonymous with various health benefits as studies indicate that swimming is a form of aerobic exercise that encompasses low weight-bearing stress and both upper and lower body exercise that has been shown to improve both vascular function and muscular strength in adults (Cugusi, Manca, Bergamin, Di Blasio, Monticone, Deriu, & Mercurio, 2019; Alkatan, Machin, Baker, Akkari, Park, & Tanaka, 2016).

## **Volleyball**

William G. Morgan was an American who invented the sport of volleyball, otherwise known as mintonette in 1895 that combined various components and skills from basketball, baseball, tennis, and handball (Olympics, 2020). The idea behind volleyball was that it would involve no physical contact, which naturally catered to a broader range of ages and physical abilities, but also, would hold the same athletic impulse that was demonstrated throughout many other similar well-known sports (International Volleyball Hall of Fame, 2020). Today, volleyball is played by more than 800 million people worldwide, is considered one of the big five international sports, is played on all levels from recreational, collegiate, and the Olympics, and has evolved into becoming a highly competitive sport requiring higher physical and technical performance (Olympics, 2020). Volleyball is a sport that consists of quick bursts of powerful and multidirectional court movements that occur continuously throughout a match. Volleyball players are required to execute maximal effort jumps, short sprints, and must be swift to ensure that they are in the appropriate positions when responding to or setting up for an attack (Tramel et al., 2019). Volleyball is a game played by two teams, six players on a side, first to 25 points except in the fifth set, which is 15 points, where players use their hands to hit a ball back and forth over a net trying to make the ball touch the court within the opponents' playing area (Encyclopedia Britannica, n.d.). At the college level, volleyball requires both technical skills and individual physical performance capacities as the emphasis to enhance overall lower limb strength for improved vertical jump is necessary in order to perform essential but foundational skills at optimal levels such as the spike, block, and jumping serves (Ikeda, Sasaki, & Hamano, 2018). Along with the emphasis on lower limb strength, volleyball players at the collegiate and professional level must be able to maintain sufficient power output for the full duration of

matches thus, the speed of recovery proceeding a bout of high-intensity exercise is equally important and vital towards the players success (Reeser & Bahr, 2017).

### **Summary**

Transitioning from adolescence to adulthood or high school to college can often be one of the most challenging times for many college students. In combination of learning to become self-sufficient, having to acclimate to the academic rigor of higher education standards, and learning to adjust to new teaching practices and institutional expectations, one major issue or trend that may be seen in college students is the gradual development of unhealthy habits and lifestyle behaviors (Kim et al., 2015). As the unhealthy habits and behaviors begin to become the new norm, the overall well-being of the students may become compromised resulting in poor health and academic performance (Larose et al., 2019; Felez-Nobrega et al., 2018). With the college and university setting being an appropriate place to instill and promote lifelong healthy living, it is important to support and provide outlets and opportunities for students to engage in and establish positive behavioral patterns that will enhance overall health (Belanger & Patrick, 2018; Plotnikoff et al., 2015). One avenue that higher education institutions can aid in encouraging, supporting, and shaping students in respects to improving health and wellness is through physical activity, fitness, and sports. Research highlighted that campus recreational sport activities such as intramural sports and club sports where participant groups come together in an organized manner and exercise or engage in competitive sports, may be a very powerful influence on overall student health and wellness for millions across the United States (Anderson & Ramos, 2018; Kavosi, Saadati, Movahedi, Farahnia, Mohammadi, Aghababayan, Asghari, & Assari, 2015). The benefits associated with physical activity, fitness, and sports may not only prevent the onset of obesity and other chronic health-related diseases, but also, it may have a greater impact on the

overall quality and continued development of life (Belanger & Patrick, 2018). In addition, literature has also shown the effects of physical activity, fitness, and sports on emotional, social, physical, and mental health where if students engage in regular aerobic activity; behavior, focus, mood, and self-esteem will increase leading to positive academic outcomes (Evenson & Porter, 2018; Kavosi et al., 2015). As a result and considering the ease of implementation, it is important for college students to be proactive and avoid developing unhealthy habits by ensuring that engaging in regular physical activity, fitness and sports becomes a priority as the benefits that will result may positively filter into and affect other areas such as academics.

Though there are many benefits to physical activity and fitness specifically pertaining to academic performance, a gap in the literature still exists. There is little to no study within the literature regarding whether physical fitness and activity is associated with academic performance specifically in college or university students. There is also little to no studies within the literature that specifically investigates the Just Jump System® and jump scores to measure physical fitness in relation to semester and yearly grade point averages in college or university students. Lastly, there is little to no study within the literature that uses club sports college or university students and the respective sports teams that the students are involved in to assess whether there is a relationship between physical fitness and academic performance.

Thus, this study is imperative to provide all educators, administrators, coaches, and health professionals with relevant information. This study aims to discover valuable information pertaining to whether there is a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by grade point averages of college club sports students.

## **CHAPTER THREE: METHODS**

### **Overview**

Chapter 3 includes a quantitative correlational design to examine the relationship between physical fitness levels and academic performance of college club sports students. Physical fitness levels were determined by measuring overall relative strength utilizing scores obtained by the Just Jump System®. Academic performance was determined by both semester-by-semester as well as the yearly cumulative Grade Point Averages (GPA) from the 2019-2020 academic calendar year. This chapter will further address the research questions, the hypotheses, review the participants and setting, instrumentation, procedures, and data analysis in full detail.

### **Design**

This research study was a quantitative correlational design. This approach was employed in order to address the research questions and test the hypotheses. Correlational research is a type of investigation that seeks to uncover the direction and magnitude of the relationship among variables using correlational statistics (Gall, Gall, & Borg, 2007). The rationale for this design is that a correlational study is needed to determine whether a relationship exists between two variables: physical fitness levels (predictor variable) and academic performance (criterion variable) in college club sports students. In addition, a correlational design is used because the research investigated did not imply causation and was non-experimental. The data collected was obtained by a naturally occurring variable that had not undergone any manipulation (Warner, 2013). As the study aimed to seek a form of relationship, positive or negative, between physical fitness measured by jump mat scores and academic performance measured by Grade Point Averages, a correlational design was the most effective method in determining whether a relationship existed.

The predictor variable for this study was based on the physical fitness levels of college club sports students. Fitness levels of club sports students was measured by obtaining scores from the Just Jump System® throughout each semester from the 2019-2020 academic calendar year. Physical fitness is related to numerous physiological systems encompassing several components including cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, speed, and agility, all of which is widely considered a reflection of whole-body health and function (Imboden, Harber, Whaley, Finch, Bishop, & Kaminsky, 2018; de la Motte, Gribbin, Lisman, Murphy, & Deuster-Patricia, 2017). Relative strength is one method that helps determine physical fitness levels as relative strength indicates the overall power an individual possesses based upon their body weight and size (Monteiro et al., 2016). The instrument that was used to reveal overall physical fitness levels of club sports students was the Just Jump System®. The Just Jump System® is an electronic device that measures the vertical height of a jump by recording the flight time of the jump (Whitmer et al., 2015).

The criterion variable for this study was based on academic performance of college club sports students. Grade Point Average is the average of grades across all coursework and is commonly used as a valid comparison in terms of academic achievement and performance in college students (Latvala, Alho, Raisamo, & Salonen, 2019; Bailey, Rosenthal, & Yoon, 2016). To measure academic performance, a cumulative grade point average for the 2019-2020 academic year, the fall 2019 semester, and the spring 2020 semester across all majors was collected and assessed.

### **Research Questions**

The research questions for this study include:

**RQ1:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the 2019-2020 academic year?

**RQ2:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the fall 2019 semester?

**RQ3:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the spring 2020 semester?

### **Hypotheses**

The null hypotheses for this study include:

**H<sub>01</sub>:** There is no relationship between Just Jump System® scores and Grade Point Averages for the cumulative 2019-2020 academic year in college club sports students.

**H<sub>02</sub>:** There is no relationship between Just Jump System® scores and Grade Point Averages for the fall 2019 semester in college club sports students.

**H<sub>03</sub>:** There is no relationship between Just Jump System® scores and Grade Point Averages for the spring 2020 semester in college club sports students.

### **Participants and Setting**

The participants for the study were drawn from archival data of college club sports students from a private higher education institution located in Central Virginia during the 2019-2020 academic year. The university offers a variety of colleges, schools, programs, and athletics. The Southern Association of Colleges and Schools Commission on Colleges accredits the institution and awards degrees at the associate, bachelor's, master's, specialist, and doctoral

levels. The institution also fields a prominent athletics department fielding 20 NCAA Division I athletic teams and over 40 club sports teams providing students an engaging college sports experience. Similar to the NCAA department, club sports houses programs that are individual-based sports, team-based sports, men's sports, women's sports, and co-ed sports. However, unlike NCAA athletics, each club sports team differs in regards to training levels, demands, intensity, competition, and overall commitment as both structure and funding for each team may vary due to institutional and sport specific support and requirements (Dahab et al., 2019). The club sports department's mission for the institution is to enrich the students' collegiate experience by providing the administrative structure, academic integration, and spiritual initiatives necessary to develop successful, Christ-centered teams. In 2019-2020, the club sports program included men, women's, and co-ed sports in: archery, beach volleyball, crew, cycling, disc golf, equestrian, figure skating, gymnastics, D1 hockey, D2 hockey, D3 hockey, lacrosse, paintball, racquetball, rock climbing, shooting, ski and snowboard, swimming, synchronized skating, taekwondo, triathlon, ultimate Frisbee, volleyball, and wrestling.

This study included college club sports students from the beach volleyball team, crew team, men's DI and DIII hockey teams, men's swimming team, men's volleyball team, synchronized skating team, figure skating team, and the women's DI hockey team. The nine teams selected were the only teams that had opted to utilize the club sports strength and conditioning staff and therefore, were the only teams that had data to measure physical fitness levels and relative strength through jump mat scores. The number of participants sampled for this study were 122 college students 18 to 26 years of age, which according to Gall et al. (2007) exceeds the minimum sample size of 66 participants for a medium effect size with statistical power of 0.7 at .05 alpha level. The median age of the sample was 21 years of age. Refer to



Tables 1 through 4 for demographics of participants.

Table 1

*Participant's Ethnic Groups*

<b>Ethnic Group</b>	<b>Number of Participants</b>
American Indian/Alaska Native	1
Asian	2
Hispanic/Latino	2
Nonresident Alien	23
Two or More Races	2
White	75
Unknown (No ethnicity reported)	17

Table 2

*Participant's Gender and Classifications*

<b>Group</b>	<b>Number of Participants</b>
Male	73
Female	49
Freshman	12
Sophomore	20
Junior	21
Senior	64
Graduate	5

Table 3

*Participants Declared Programs of Study*

<b>Program of Study</b>	<b>Number of Participants</b>
Accounting	3
Aeronautics	5
Athletic Training	1
Biology	2
Biomedical Sciences	5
Business Administration	27
Business Administration (Masters)	2
Communications	2
Computer Engineering	1
Computer Science	3
Criminal Justice	8
Digital Media	1
Electrical Engineering	1
Elementary Education	1
Environmental Biology	1
Exercise Science	12
Forensic Science	1
History	1
Industrial/Systems Engineering	1
Interdisciplinary Studies	1
Kinesiology/Physical Education and Health	2
Law and Policy	1

Masters of Arts: Public Policy	1
Masters of Public Health: Nutrition	1
Mathematics	3
Mechanical Engineering	5
Masters of Science: Human Performance	1
Nursing	7
Pastoral Leadership	1
Psychology	4
Public Health: Pre Clinical	1
Religious Studies	1
Social Work	1
Special Education	1
Sports Management	3
Strategic Communications	5
Studio and Digital Arts	2
Undecided	2
Zoo and Wildlife Biology	1

Table 4

*Club Sports Teams and Participants Per Team*

<b>Club Sports Team</b>	<b>Number of Participants</b>
Beach Volleyball	8
Crew	9

Figure Skating	9
Men's DI Hockey	21
Men's D3 Hockey	18
Men's Swimming	13
Men's Volleyball	17
Synchronized Skating	7 (5 also Figure Skate)
Women's DI Hockey	20

### **Instrumentation**

The purpose of this quantitative correlational study was to determine if there is a relationship between physical fitness and academic performance of college club sports students. The study used the Just Jump System® by Probotics to measure physical fitness and relative strength levels by the club sports strength and conditioning staff and grade point averages was used to measure academic performance for the cumulative 2019-2020 year, fall 2019, and spring 2020 semesters provided by the club sports academic department. The Just Jump System® is an electronic device that measures physical fitness levels, in terms of relative strength, by assessing vertical jump height and lower limb strength. Grade point averages is a common instrument that is used at the college level to measure student academic achievement in education (Keating et al., 2019).

**Just Jump System®.** The device that was used to measure the predictor variable, physical fitness, was the Just Jump System®. The purpose of the Just Jump System® is to measure vertical jump height calculated from flight time as vertical jump is considered an essential component and a good predictor of various performance factors such as speed, agility, and explosive power (Whitmer et al., 2015). The jump mat was employed to evaluate lower-limb

muscle power and coordination of lower and upper extremities providing health-related professionals an opportunity to study neuromuscular fitness levels and variations in functional performance (Pueo, Lopez, Jimenez-Olmedo, & Sensors, 2019). Jump mats were the first instruments consisting of a mat operating on electric microswitches that activated by pressure or an individual's weight resulting in a time that monitored the interval between liftoff and landing (Pueo et al., 2019; Garcia-Lopez, Morante, Ogueta-Alday, & Rodriguez-Marroyo, 2013). The mat is attached to a hand-held battery operated computer device that records flight time and measures vertical jump height. The Jump Mat displays height (cm/inches), hang time (milliseconds) for 1 jump, average height plus ground time for 4 jumps, calculates explosive leg power rating, and uses a basic kinematic equation or formula: height of body COM =  $(t^2 \times g)/8$  where the  $g = 9.81 \text{ m} \cdot \text{s}^{-2}$  and  $t$  is the flight time (Whitmer et al., 2015). A ranking scale for adult persons vertical jump height include a range from: Excellent >28 inches to Very Poor <8 inches in males and Excellent >24 inches to <4 inches for females (See Appendix C). Jump Mats may be similar and compare to a force platform, which is commonly used in a laboratory setting as it offers an indirect measure of jump height derived from ground-reaction force during the jump (Pueo et al., 2017). The Just Jump System® was selected to assess physical fitness levels for its portability, ease of use, ability to accommodate larger subject numbers in shorter periods, and low cost of equipment as it was an effective option to assess improvement in lower limb strength, power, speed, general fitness, and athletic performance (Pueo et al., 2018; Kenny, Caireallain, Comyns, 2012).

**Reliability and validity.** The Just Jump System® has been used in numerous studies over the last 40 years and continues to be used in the physical activity, fitness, and sports realm as it ensures scientific validity (Pueo et al., 2019; Annino, Federici, Gabrieli, Ranavolo, Silvaggi,

& Bonaiuto, 2016; Rogan, Radlinger, Imhasly, Kneubuehler, & Hilfiker, 2015; Kenny et al., 2012). The Just Jump System® is a valid device that determines vertical jump height and is a commonly used instrument amongst strength and conditioning professionals and sport coaches due to its low cost and versatility for assessing vertical jump height especially for college-aged men and women (Whitmer et al., 2015). One study that measured vertical jump height using a jump mat device in healthy college-aged men that were all physical education majors showed a very high value for the intraclass correlation coefficient for validity equaling to- 0.99 for flight time values while the same coefficient was 0.97 for ground contact time values (Annino et al., 2016). In another study that compared the validity of a jump mat device to the gold or reference standard force plate indicated high consistency or linear relationship between the two devices as the Pearson correlation coefficient for jump height was 0.99 (95% CI: 0.99 – 0.995) and ground contact time was 0.98 (95% CI: 0.97- 0.99) (Rogan et al., 2015). Lastly, a study that aimed to analyze the criterion validity and reliability of the jump mat device for assessing vertical jump height revealed: intraclass correlation coefficient between jump mat and force plates were very high (0.997 for countermovement jumps and 0.998 for squat jumps) and the Bland-Altman biased displayed by the mat in relation to the force plate was very low (-0.08 for countermovement jumps and -0.11 for squat jumps); a very strong coefficients of determination ( $R^2 = 0.99$ ) indicating high level of criterion validity; and together, overall results of the study suggested that the Jump Mat was a valid and reliable system for assessing vertical jump height in athletes (Loturco, Pereira, Kobal, Kitamura, Cal Abad, Marques, Guerriero, Moraes, & Nakamura, 2017).

**Grade Point Averages.** The instrument that was used to measure the criterion variable, academic performance, was college grade point averages for the overall cumulative 2019-2020

year, fall 2019 semester, and spring 2020 semester. Grade point averages is one of the salient indicators of student's achievement and success in education (Latvala et al., 2019). College grade point averages is often used in personnel selection because it reflects the important work-related constructs of cognitive ability and motivation (Roth & Bobko, 2000). Higher grade point averages are often associated with cognitive ability and personality characteristics that college recruiters consider important for the prediction of applicant's future job performance (Sulastrri, Handoko, & Janssens, 2015). College grade point averages are typically requested and obtained from university records and consists of both theoretical and all subjects (Latvala et al., 2019). The grading system that was used was based on a 4.0 quality-point scale where specific letter grades will associate to a certain number of quality points awarded per semester hour completed: A = 4.0 B = 3.0, C = 2.0, D = 1.0, and F = 0 (Starke & Bear, 1988). To determine the cumulative grade point average, the total number of quality points earned was divided by the total number of semester hours completed. College grade point averages was selected to assess the dependent variable as it is a standard academic measurement tool, it may impact future employment, and grade point average is a popular valid instrument that has been in numerous studies that compare academic performance to health-related fitness (Keating et al., 2019; Joubert et al., 2017; Stephens, Dong, & Durning, 2015).

**Reliability and validity.** Grade point average is a highly used measure at the higher education level in terms of indicating student success and scholastic efforts. As a result, many studies have used and continue to use grade point averages as a standard due to its reliability and validity especially in studies pertaining to health and fitness (Insler & Karam, 2019; Keating et al., 2019; Scott et al., 2017). One study that investigated the reliability of first-year grade point averages as well as the reliability of cumulative grade point averages using intraclass correlation

from over 40 institutions and over 160,000 students revealed first-year grade point averages ranging between .84 to .87 and cumulative grade point averages at .93 (Beatty, Walmsley, Sackett, Kuncel, & Koch, 2015). Another study also indicated intraclass correlation reliability for fourth-year cumulative grade point averages at .89 to .92, which were similar to published reliability estimates of standardized admission tests for graduate and professional school admissions that ranged from .82 on individual test sections to .95 for total test scores (Westrick, 2017). Lastly, a study that explored cumulative grade point averages for a freshman class estimated internal consistency reliabilities where data showed an increase from semester one (.72), to semester two (.84), to semester four (.86), to semester eight or near final undergraduate grade point average (.91), which were similar values and trends found at other higher education institutions (Saupe & Eimers, 2013).

### **Procedures**

Formal approval was obtained through the Institutional Review Board (See Appendix A) as well as permission from the athletic director of club sports (See Appendix B) in order to conduct the analysis. Once approval was received, the researcher requested archival data for the predictor variable (Just Jump System®) from the head club sports strength and conditioning coach. Jump mat scores was collected through a Microsoft Excel document separated by teams, date of jumps, and scores for each participant. The researcher requested archival data for the criterion variable (college grade point averages) from the club sports Director of Academic Advancement for the fall 2019, spring 2020, and cumulative 2019-2020 year for each of the participants. The data obtained was coded by the researcher and scanned for any incomplete information or outliers. The following sections will review the specific procedures for each variable.



### **Just Jump System® Scores (Predictor Variable)**

The predictor variable was Just Jump System® scores from college club sports students. Just Jump System® scores is a product of vertical jump height, which is a measure of overall physical fitness and relative strength. For the purpose of this study, physical fitness is defined as a physiological state of well-being that reduces the risk of chronic health diseases through participating in various physical activities that emphasize cardiorespiratory endurance, muscular strength, flexibility and body composition (Donnelly et al., 2016). Relative strength is defined as the total load of weight lifted or amount of overall strength of an individual compared to their body weight and size (Monteiro et al., 2016). The Just Jump System® operates off microswitches fixed to the mat timing the interval between the participant's liftoff and landing through a hand-held computer resulting in records of flight time (milliseconds) and jump height (inches) (Whitmer et al., 2015).

One week prior to the beginning of the academic year, the head club sports strength and conditioning coach conducted a mandatory training session with all strength and conditioning staff to review Just Jump System® protocols and procedures to ensure that all coaches score club sports students accurately and consistently. Within the nine teams that participated in the study, each strength and conditioning coach managed three teams that they monitored and administered the Just Jump System® test to over the course of the year. The procedure that was followed for conducting the Just Jump System® test included:

- 1-3 jump mat devices were placed inside the workout facility prior to team workouts
- Participants lined up behind the jump mat devices
- Participants stepped onto the jump mat device when instructed by the coach

- Once permitted, the participant placed both hands on hips and performed a counter movement jump (starting standing upright, make a downward movement flexing at knees and hips, then with no pause, immediately extend the knees and hips to jump vertically off the ground) landing on the mat without tucking knees
- The jump mat device recorded the jump
- The participants rested for 0:45-0:60 seconds between jumps
- The participants executed 3 jumps where the highest was recorded on the Excel sheet
- The jump mat device informed the coach when the participant could step on the mat, when the participant should perform the jump, displayed the score, and when it was an appropriate time to step off the mat

Though the Just Jump System® protocol was conducted following the same procedures for all teams, each team followed a slightly different pre-jump procedure as weight room times for each team varied. The men's and women's division I hockey team performed a stretch and warm up prior to jumping. The stretch and warm up included diaphragmatic breathing for 0:45 seconds, supine hip twists for 8 repetitions, thoracic spine stretching for 0:32 seconds each side, a hip flexor stretch for 0:25 seconds each leg, 10 Cossack squats, and 0:30 seconds of bear crawls. All other teams performed jumps immediately upon entering the weight room. Each team and club sport students was tested one to three times a semester and during or as close to the middle of the month as possible as days varied due to the game, competition, and practice schedules. The average between highest jump score and lowest jump score for each student was calculated for each semester. Once recordings were logged onto a spreadsheet by the strength and conditioning staff, the head strength and conditioning coach collectively recorded all data onto one master Microsoft Excel document separated by tabs for each team with dates of jumps. The researcher

coded and scanned for any incomplete information or outliers. The researcher saved and protected the Excel file for confidentiality purposes and to ensure only clean data remained.

### **Grade Point Averages (Criterion Variable)**

The criterion variable was academic performance, which was measured by college grade point averages. For the purpose of this study, grade point averages is defined as an indicator of student achievement and student success (Latvala et al., 2019). Grade point averages was collected from archival data for the cumulative 2019-2020 academic year, fall 2019 semester, and spring 2020 semester. Grade point averages included averages from a wide range of undergraduate and graduate degrees offered by the institution and included averages from participants that were classified as full-time students (12-18 credit hours per semester). After permission was given by the Athletic Director to pursue club sports data, an email to the Director of Academic Advancement for club sports was sent requesting grade point averages for each participant from the respective teams. The researcher coded and scanned for any incomplete information or outliers. The researcher saved and protected the excel file for confidentiality purposes and to ensure only clean data remained.

### **Data Analysis**

For this study, data was collected, entered and analyzed using the Statistical Package for Social Sciences (SPSS) 27 software. The researcher used a series of Pearson Product Moment Correlation Coefficient analyses to study and examine the strength of the linear relationship between two quantitative variables: predictor variable (Just Jump System® scores) and the criterion variable (Grade Point Averages) in college club sports students. The Pearson Product Moment Correlation was conducted at the 95% confidence level.

The researcher began data screening by reviewing the results captured in the Excel documents containing both the predictor variable (Just Jump System® scores) and the criterion variable (Grade Point Averages) in club sports students, and then repeated the screening process after entering the participant data into SPSS. The researcher sorted through the data and scanned for inconsistencies on each variable. A scatter plot was used to detect bivariate outliers between the predictor variable and criterion variable. No bivariate outliers were identified.

The assumption of bivariate- normal distribution was tested by creating a visual representation of the data in a scatterplot comparing the predictor variable (Just Jump System® scores) to the criterion variable (Grade Point Averages). The researcher ensured that the assumption of bivariate normal distribution was met based on a visual inspection of the scatterplot.

The assumption of linearity was tested by the researcher by using a scatter plot comparing the predictor variable (Just Jump System® scores) to the criterion variable (Grade Point Averages). The researcher ensured that the assumption of linearity was met.

## CHAPTER FOUR: FINDINGS

### Overview

The purpose for this study was to see if there was a relationship between the predictor variable (physical fitness) and the criterion variable (academic performance) in college club sports students. A Pearson Product Moment Correlation Coefficient was used to test the hypotheses. The Findings section includes the research questions, null hypotheses, data screening, descriptive statistics, assumption testing, and results.

### Research Questions

The research questions for this study include:

**RQ1:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the 2019-2020 academic year?

**RQ2:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the fall 2019 semester?

**RQ3:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the spring 2020 semester?

### Hypotheses

The null hypotheses for this study include:

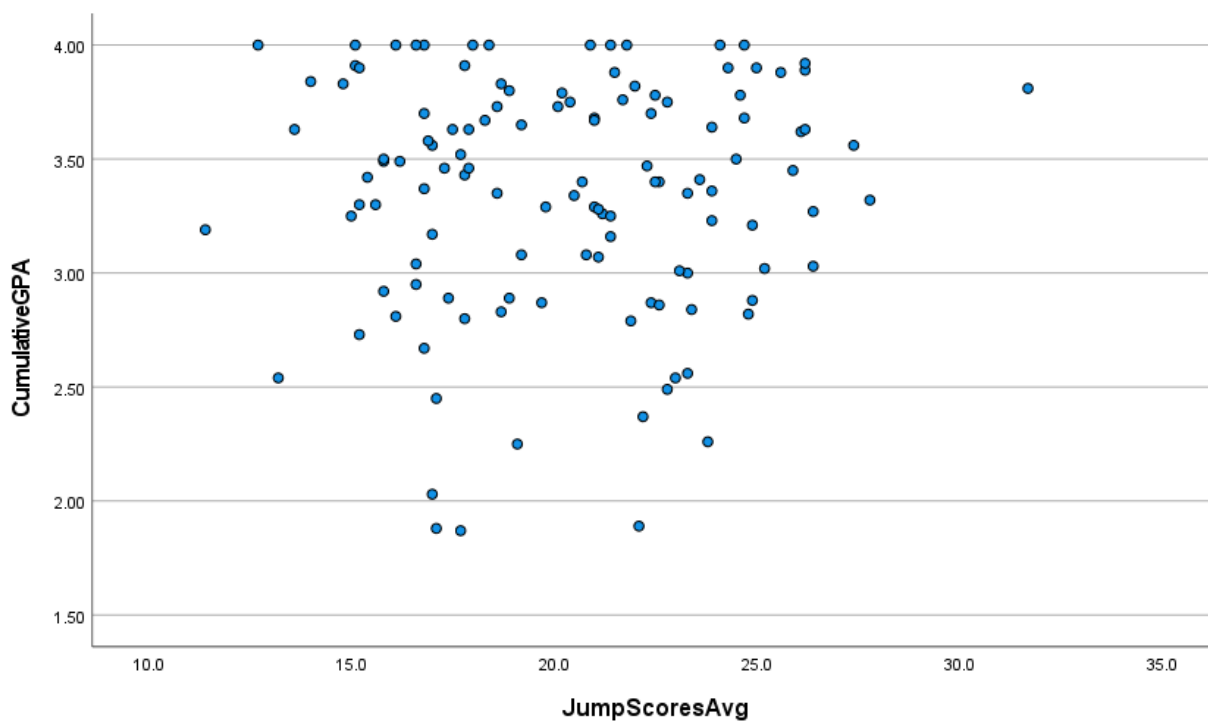
**H<sub>01</sub>:** There is no relationship between Just Jump System® scores and Grade Point Averages for the cumulative 2019-2020 academic year in college club sports students.

**H<sub>0</sub>2:** There is no relationship between Just Jump System® scores and Grade Point Averages for the fall 2019 semester in college club sports students.

**H<sub>0</sub>3:** There is no relationship between Just Jump System® scores and Grade Point Averages for the spring 2020 semester in college club sports students.

### Data Screening

The researcher sorted the data and scanned for inconsistencies on each variable. No data errors or inconsistencies were identified. A scatterplot was used to detect bivariate outliers between the predictor variable and criterion variable. No bivariate outliers were identified. See Figures 1-3 for scatterplots.



*Figure 1.* Scatterplot for Jump Scores and GPA for Cumulative 2019-2020 Year.

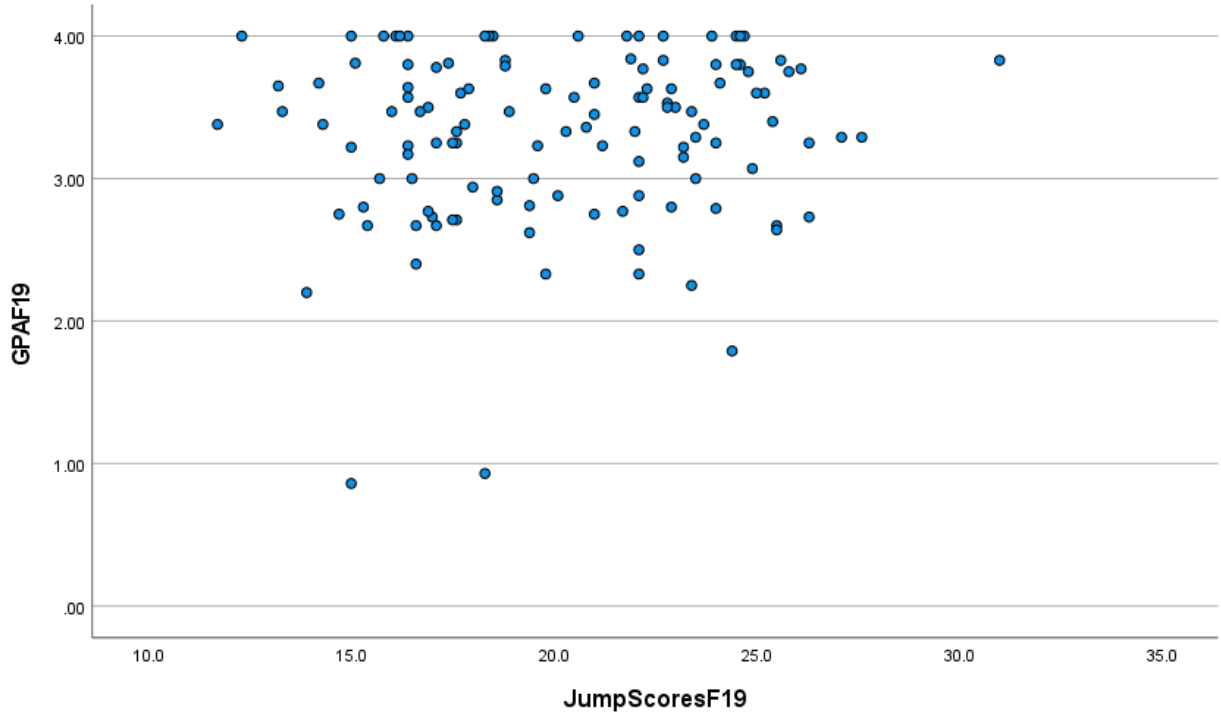


Figure 2. Scatterplot for Jump Scores and GPA for Fall 2019.

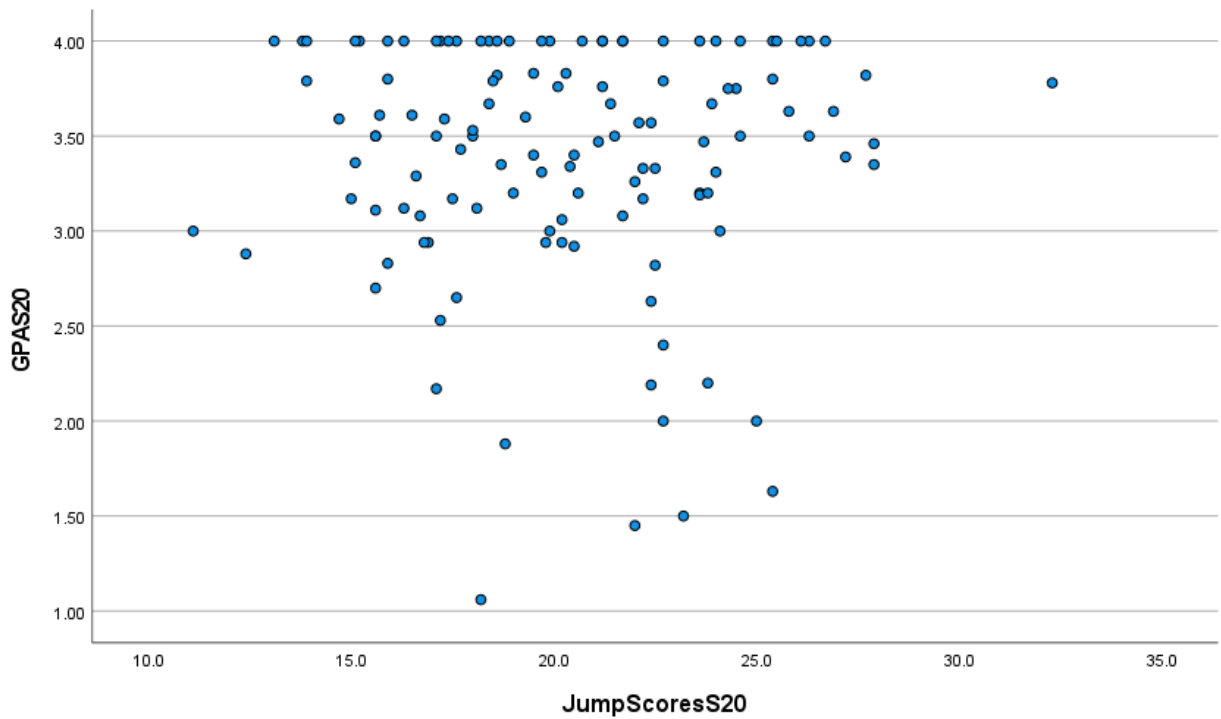


Figure 3. Scatterplot for Jump Scores and GPA for Spring 2020.

### Descriptive Statistics

Descriptive statistics were obtained on each of the variables. The sample consisted of 122 participants. An excellent jump score for males are >28 inches and >24 inches for females, whereas a poor jump score for males are 8-12 inches and 4-8 inches for females. Average jump scores on the Just Jump® System for the cumulative 2019-2020 year ranged from 11.4 inches to 31.7 inches ( $M = 20.28$ ,  $SD = 3.84$ ). Jump scores for the fall 2019 semester ranged from 11.7 inches to 31.0 inches ( $M = 20.19$ ,  $SD = 3.88$ ). Jump scores for the spring 2020 semester ranged from 11.1 inches to 32.3 inches ( $M = 20.32$ ,  $SD = 3.92$ ).

Academic performance was measured using college Grade Point Averages. The grading system that was used was based on a 4.0 quality-point scale. The highest Grade Point Average that a student could achieve is an A or 4.0 and the lowest is an F or 0.0. Cumulative Grade Point Averages for the 2019-2020 year ranged from 1.87 to 4.00 ( $M = 3.35$ ,  $SD = 0.52$ ). Grade Point Averages for the fall 2019 semester ranged from 0.86 to 4.00 ( $M = 3.31$ ,  $SD = 0.59$ ). Grade Point Averages for the spring 2020 semester ranged from 1.06 to 4.00 ( $M = 3.39$ ,  $SD = 0.63$ ).

Descriptive statistics can be found in Tables 1-3.

Table 1

*Descriptive Statistics for Jump Scores and GPA Cumulative 2019-2020 Year*

	N	Minimum	Maximum	Mean	Std. Deviation
JumpScoresAvg	122	11.4	31.7	20.276	3.8410
CumulativeGPA	122	1.87	4.00	3.3487	.51657
Valid N (listwise)	122				

Table 2

*Descriptive Statistics for Jump Scores and GPA for Fall 2019*

	N	Minimum	Maximum	Mean	Std. Deviation
JumpScoresF19	122	11.7	31.0	20.186	3.8842
GPAF19	122	.86	4.00	3.3070	.58536



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Valid N (listwise) 122

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Table 3

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*Descriptive Statistics for Jump Scores and GPA for Spring 2020*


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	N	Minimum	Maximum	Mean	Std. Deviation
JumpScoresS20	122	11.1	32.3	20.316	3.9231
GPAS20	122	1.06	4.00	3.3855	.62666
Valid N (listwise)	122				

---

### **Assumption Testing**

#### **Assumption of Linearity**

The Pearson Product Moment Correlation requires that the assumption of linearity be met. Linearity was examined using a scatter plot. The assumption of linearity was met for all school year terms included in the study. See Figures 1-3 for scatter plot.

#### **Assumption of Bivariate Normal Distribution**

The Pearson Product Moment Correlation requires that the assumption of bivariate normal distribution be met. The assumption of bivariate normal distribution was examined using a scatter plot. The assumption of bivariate normal distribution was met for all school year terms in the study. See Figures 1-3 for scatter plot.

### **Results**

A Pearson Product Moment Correlation was conducted to see if there was a relationship between physical fitness levels and academic performance in college club sports students. The predictor variable was Just Jump System® scores and the criterion variable was Grade Point Averages.

For the Just Jump System® scores and Grade Point Averages for the cumulative 2019-2020 academic year, the researcher failed to reject the null hypothesis at the 95% confidence level where  $r(120) = .04$ ,  $p = .66$ . The effect size was small and the relationship was positive.

For the Just Jump System® scores and Grade Point Averages for the fall 2019 semester, the researcher failed to reject the null hypothesis at the 95% confidence level where  $r(120) = .10$ ,  $p = .27$ . The effect size was small and the relationship was positive.

Lastly, for the Just Jump System® scores and Grade Point Averages for the spring 2020 semester, the researcher failed to reject the null hypothesis at the 95% confidence level where  $r(120) = -.01$ ,  $p = .88$ . The effect size was small and the relationship was negative.

There was no statistical relationship between the predictor variable (Just Jump System® scores) and the criterion variable (Grade Point Averages). See Tables 4-6 for Pearson Product Moment Correlation test results.

Table 4

*Pearson Product Moment Correlation Test*

*Correlations Cumulative Scores and GPA 2019-2020*

		JumpScoresAvg	CumulativeGPA
JumpScoresAvg	Pearson Correlation	1	.040
	Sig. (2-tailed)		.661
	N	122	122
CumulativeGPA	Pearson Correlation	.040	1
	Sig. (2-tailed)	.661	
	N	122	122

Table 5

*Pearson Product Moment Correlation Test*

*Correlations Jump Scores and GPA Fall 2019*

		JumpScoresF19	GPAF19
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JumpScoresF19	Pearson Correlation	1	.101
	Sig. (2-tailed)		.269
	N	122	122
GPAF19	Pearson Correlation	.101	1
	Sig. (2-tailed)	.269	
	N	122	122

Table 6

*Pearson Product Moment Correlation Test*

*Correlations Jump Scores and GPA Spring 2020*

		JumpScoresS20	GPAS20
JumpScoresS20	Pearson Correlation	1	-.014
	Sig. (2-tailed)		.880
	N	122	122
GPAS20	Pearson Correlation	-.014	1
	Sig. (2-tailed)	.880	
	N	122	122

## **CHAPTER FIVE: CONCLUSIONS**

### **Overview**

Chapter five will discuss the outcomes of the Pearson Product Moment Correlation and further highlight the results that surround the research questions and null hypotheses. This chapter will include implications of the study that will add to the existing body of knowledge concerning physical fitness and academic performance in college club sports students. The limitations of the study and recommendations for future research will also be addressed.

### **Discussion**

The purpose of this quantitative study was to determine if there was a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by cumulative and semester-by-semester Grade Point Averages of college club sports students. The significance of the study was to not only investigate whether relationships existed between overall fitness and academic performance among college club sports students, but also to help provide insight on the future development of campus-based health initiatives to have a shared focus of academic outcomes and physical fitness.

The study used a correlational design in order to reveal the direction and magnitude of the relationship between the predictor and criterion variables (Gall et al., 2007). The predictor variable was physical fitness and the criterion variable was academic performance of college club sports students. For the purpose of this study, physical fitness was assessed through vertical jump score averages from the cumulative 2019-2020 academic year, the fall 2019, and spring 2020 semesters via the Just Jump System®. Academic performance was measured by Grade Point Averages from the cumulative 2019-2020 academic year, the fall 2019, and spring 2020 semesters. Archival data that consisted of jump scores and Grade Point Averages of 122 college

club sports students of varying majors and classifications from the 2019-2020 academic year were provided by the university's club sports department to the researcher in the form of a Microsoft Excel spreadsheet. The researcher screened the data for errors and inconsistencies and then proceeded to analyze the archival data using the IBM's SPSS 27 software. A Pearson Product Moment Correlation Coefficient analyses was used. The Pearson Product Moment Correlation was an appropriate approach as the researcher aimed to discover if a relationship existed between two naturally occurring variables in a non-experimental study (Warner, 2013).

In order to seek whether a relationship existed between physical fitness and academic performance of college club sports students, the researcher based this study around three research questions:

**RQ1:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the 2019-2020 academic year?

**RQ2:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the fall 2019 semester?

**RQ3:** Is there a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages for college club sports students during the spring 2020 semester?

For research question one, the null hypothesis stated that there is no relationship between Just Jump System® scores and Grade Point Averages for the cumulative 2019-2020 academic year in college club sports students. Upon conducting a Pearson Product Moment Correlation to test the hypothesis, data revealed that there was no significant relationship between the two

variables. The results showed  $r(120) = .04, p = .66$ , indicating a small effect size and a positive relationship. Therefore, the null hypothesis failed to be rejected at the 95% confidence interval. Though the results of the cumulative 2019-2020 scores and grades were not statistically significant, however, descriptive statistics showed that club sports students averaged above average (20-24 inches for males) and very good (20-24 inches for females) jump scores ( $M = 20.28, SD = 3.84$ ) and a B letter equivalent grade point average ( $M = 3.35, SD = 0.52$ ). The descriptive statistics support research as studies have shown the close associations between greater physical fitness levels and cognitive ability, self-control, executive function, and memory of which, are all critical components influencing academic performance (Hou, Mei, Liu, & Xu, 2020; Lipošek, Planinšec, Leskošek, & Pajtler, 2018). However, because the results were not significant, these descriptive statistics should be interpreted with caution.

In research question two, the null hypothesis stated that there is no relationship between Just Jump System® scores and Grade Point Averages for the fall 2019 semester in college club sports students. Upon conducting a Pearson Product Moment Correlation to test the hypothesis, data revealed that there was no significant relationship between the two variables. The results showed  $r(120) = .10, p = .27$ , indicating a small effect size and a positive relationship. Therefore, the null hypothesis failed to be rejected at the 95% confidence interval. Similarly, to the cumulative 2019-2020 data results, the data for the fall 2019 semester were not statistically significant, however, the descriptive statistics showed that club sports students averaged above average (20-24 inches for males) and very good (20-24 inches for females) jump scores ( $M = 20.19, SD = 3.88$ ) and a B letter equivalent grade point average ( $M = 3.31, SD = 0.59$ ). The fall 2019 semester data also supported literature on the general concept that high levels of physical fitness may result in high academic performance grades as club sports students on average were

seen to both perform above average or higher in physical fitness scores with an average of a B letter grade point average. Though data in for the fall 2019 semester represented high fitness scores and high-grade point averages, the fall semester or the first semester jump scores and grade point averages, resulted in slightly lower scores and grades versus the spring or second semester. Studies have shown to support this outcome as many students entering a new academic year may lack early engagement and feel overwhelmed leading to poor academic performance (Van der Meer, Scott, & Pratt, 2018; Gershenfeld, Hood, Zhan, 2016). However, because the results were not significant, these descriptive statistics should be interpreted with caution.

For the third research question, the null hypothesis stated that there is no relationship between Just Jump System® scores and Grade Point Averages for the spring 2020 semester in college club sports students. Upon conducting a Pearson Product Moment Correlation to test the hypothesis, data revealed that there was no significant relationship between the two variables. The results showed  $r(120) = -.01, p = .88$ , indicating a small effect size and a negative relationship. Therefore, the null hypothesis failed to be rejected at the 95% confidence interval. The data for the spring 2020 semester were not statistically significant, however, the descriptive statistics showed that club sports students remained to average above average (20-24 inches for males) and very good (20-24 inches for females) jump scores ( $M = 20.32, SD = 3.92$ ) and a B letter equivalent grade point average ( $M = 3.39, SD = 0.63$ ). The spring 2020 descriptive statistics also supported literature on the general concept that high physical fitness scores may influence high academic performance grades as club sports students on average were seen to both perform above average or higher in physical fitness scores, with an average of a B letter grade point average. However, because the results were not significant, these descriptive statistics should be interpreted with caution.

Despite the findings of this study, previous literature has indicated that overall fitness, whether it be absolute strength-based, relative strength-based, aerobic-based or an overall combination of general physical fitness, may be associated with improved academic performance (Hou et al., 2020; Peña, Yanez, Gomez, Martin, Castillo, Granados, & Riveros, 2019; Lipošek et al., 2018; Scott et al., 2017). One study in Columbia that focused on single repetition maximum-based exercises that measured muscular strength and fitness, revealed a significant positive relationship ( $r = .64, p < .05$ ) between maximum strength and academic performance in 135 fifth semester university students (Peña et al., 2019). In another study conducted in China amongst 212 medical and 104 dental students, physical fitness scores determined by a battery of fitness tests and academic performance measured by grade point averages over the first three years, revealed that high fitness performance was associated with higher subsequent academic achievement (medical:  $r = .34, p < .001$ ; dental:  $r = .47, p < .001$ ) (Hou et al., 2020). Comparably, a third study that emphasized aerobic fitness and peak oxygen uptake in female university students determined that low aerobic fitness levels or low peak oxygen uptake hindered students from achieving full academic potential, thus suggested the importance of participating in regular aerobic fitness (Scott et al., 2017).

Overall, the results in this study seem to indicate that although the Just Jump System® scores and Grade Point Averages did not appear to be statistically related in college club sports students during the 2019-2020 year, the general premise that is shown throughout literature regarding the positive relationship between physical fitness and academic performance should continue to be investigated. With limited available studies specifically at the college club sports level, the benefits that regular physical fitness may provide and how they can be implemented throughout campus' nationwide will not only influence academic performance but more



importantly, improve the overall health and quality over a lifetime (Calestine et al., 2017; Esslinger, Grimes, & Pyle, 2016).

### **Implications**

The study conducted on Just Jump System® scores and Grade Point Averages of college club sports students to seek whether a relationship existed between physical fitness and academic performance holds several key implications within the realm of higher education. With academic performance and outcomes of students being a priority for many institutions, it is imperative to understand important factors such as physical fitness and the role that it plays in student success (Han, Farruggia, & Solomon, 2018). Though the results of this study displayed no significant relationships and may not support existing literature, the data presented from this study is important for researchers, academic entities, and campus-based fitness initiatives to further explore as the average fitness scores and grade point averages for the cumulative 2019-2020 year, fall 2019, and spring 2020 semesters were all relatively high (above average and higher jump scores and a 3.0 or B letter grade point average). These results aligned with several studies which indicated that partaking in regular physical fitness provided multiple benefits such as enhanced concentration, decreased stress, and improved social relatedness, which all influence academic performance (San Román-Mata, Puertas-Molero, Ubago-Jiménez, & González-Valero, 2020; Meyer & Larson, 2018).

### **Limitations**

This study presented several limitations. The first limitation included the population of the participants. Although club sports students selected for this study came from an institution that provided many amenities, larger institutions with larger budgets may differ in overall fitness and academic outcomes depending upon the additional resources and time the institution has to

offer and allocate towards their students. Classification levels in addition to the program of study for the selected population could also differ from other institutions and other sample populations as the level of demand or ability to obtain a high-grade point average per program can vary in difficulty, which may result in a broader range of academic performance outcomes (Scott et al., 2017).

A second limitation that was presented in the study was the differing pre-test protocols before each jump test session. Prior to each jump mat assessment, each strength coach offered different preparatory protocols mainly due to time and scheduling of the fitness facilities for each team. Research indicated that stretching and warming up prior to engaging in any form of exercise is considered a key element pertaining to joint flexibility due to its ability to enhance biomechanical precision to every movement while allowing the athlete to perform maximum force throughout the range of motion (Alipasali, Papadopoulou, Gissis, Komsis, Komsis, Kyranoudis, Knechtle, & Nikolaidis, 2019). As each team had varying pre-jump protocols, other settings that may require the same preparatory warm-up and stretches may alter the overall results.

Along with the inconsistent pre-test protocols across all teams that participated in the Just Jump System® assessments, a third limitation was when the tests were conducted for each team. The time of day and week may have influenced jump scores as some teams would perform the jump prior to team practice, others would perform jumps after a team practice, some would perform jumps the day before competition, and others would perform jumps with injuries of which, are all important factors when measuring the accuracy of jump scores. Alternative days for jump mat testing was not an option for the participants, which may vary for other institutions and programs depending on the access to equipment, facilities, and coaches.

The fourth limitation that was presented in the study was based around the ceiling effect. The ceiling effect occurs when results are predominately grouped in the highest category of the scale or is often used to describe when participants obtain scores that are at or near the possible upper maximum limit and range (Vita, Coplin, Feiereisel, Garten, Mechaber, & Estrada, 2013; Everitt, 2002). Club Sports students in this study were already considered high achievers as the results showed an average of a 3.3 grade point average for each school term.

The final limitation that was presented and may also be found in other related research was the total duration of the study. This study focused on archival physical fitness scores and academic performance grades over the course of one year rather than a longitudinal study that may have offered a more accurate depiction of whether a relationship existed over the entirety of a college club sports or general college students' program of study. The 2019-2020 academic year was selected as this was the first year that the head strength coach for the club sports department consistently collected Just Jump System® scores for multiple teams.

### **Recommendations for Future Research**

After examining the results, the implications, and the limitations of this study, recommendations for further research are recommended in order to contribute to the already existing body of knowledge surrounding the relationship between physical fitness determined by Just Jump System® scores and academic performance measured by Grade Point Averages in college club sports students.

1. Future expansion and development of research should include widening the population of the nine club sports teams to all club sports teams, NCAA athletes, the general population, or a mixture of all students in order to account for generalization (San Román-Mata et al., 2020). Joubert et al. (2017) suggested that having a larger group of

participants in a study minimizes the chances of obtaining biased or inaccurate outcomes as a greater population highlights a greater range of fitness levels and a greater group of students that span across more academic disciplines.

2. Examining the associations between physical fitness and academic performance by isolating male and female students or sports may be recommended for future research as studies based on gender are limited particularly in the the college-aged population (Alghadir, Gabr, & Iqbal, 2020).
3. Fitness related results may be more precise if further research offered all participants the same protocols not only for the intended assessment but also any procedures prior to testing that may be advantageous such as stretching and warm-ups. Research on warm-up and stretching protocols indicated that stretching is an important factor that is widely used for improved flexibility, increased range of motion, and injury prevention (Azuma & Someya, 2020; Opplert & Babault, 2019).
4. Due to the limited availability (one academic year) of archival data on Just Jump System® scores from the selected institution, the duration of study or a longitudinal design that monitors both the entire length of a college degree program and yearly fitness levels would be recommended for further research. Overall results may depict a more accurate representation of comprehensive physical fitness levels as well as comprehensive academic performance outcomes over the course of an entire higher education degree (Lima, Larsen, Bugge, & Andersen, 2018).
5. This study used the Just Jump System® due to portability, time, and costs in order to determine fitness levels however, expanding the fitness test to a battery of fitness tests such as the FitnessGram that covers more areas of physical fitness over several tests

(aerobic capacity, body composition, flexibility, muscular strength, and muscular endurance) is recommended for further research (Lipošek et al., 2018).

6. In addition to physical fitness assessments, other variables that may also impact total health such as sleep and nutrition is recommended for further research. The amount of sleep and sleep quality as well as diet and food consumption are two factors that can also play a major role in overall health and academic performance as both sleep and nutrition is shown to impact mental, emotional, and physical acuity (Hershner, 2020; Anderson & Good, 2017).
7. There are numerous studies that seek a relationship between physical fitness and academic performance amongst children (Huang, Zeng, & Ye, 2019; Santana, Azevedo, Cattuzzo, Hill, Andrade, & Prado, 2017; Lorenz, Stylianou, Moore, & Kulinna, 2017), however, there are limited studies based around college-aged club sports students, college-aged athletics students, college-aged general students, and college-aged students within North America (Zhai, Ye, Gu, Huang, Wang, Chen, & Fan, 2020; Hou et al., 2020; El Ansari, Suominen, & Draper, 2017). Further research seeking whether a relationship exists between physical fitness and academic performance within the college-aged population would be recommended in order for campus-based health initiatives, to create innovative best practices to implement physical fitness programs nationwide.

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## APPENDICES

### Appendix A

#### Institutional Review Board Approval Letter



October 29, 2020

Jonathan Chung  
Michael Shenkle

Re: IRB Exemption - IRB-FY20-21-157 The Relationship Between Physical Fitness and Academic Performance in College Club Sports Students

Dear Jonathan Chung, Michael Shenkle:

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46: 101(b):

Category 4. Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met:

- (i) The identifiable private information or identifiable biospecimens are publicly available;
- (ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects;
- (iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of "health care operations" or "research" as those terms are defined at 45 CFR 164.501 or for "public health activities and purposes" as described under 45 CFR 164.512(b); or
- (iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.

Your stamped consent form can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. This form should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document should be made available without alteration.

Please note that this exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at [irb@liberty.edu](mailto:irb@liberty.edu).

Sincerely,  
**G. Michele Baker, MA, CIP**  
*Administrative Chair of Institutional Research*  
**Research Ethics Office**

## Appendix B

### Consent Form to Use Club Sports Data (Athletic Director)

#### Consent Form to Use Club Sports Data

##### I. Research Background:

The Liberty University Club Sports department is being asked to take part in a research study (using archival data) seeking if there is a relationship between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages in college Club Sports students. Please read this form carefully and ask any questions you may have before agreeing to take part in the study.

**Title of the Study:** The Relationship Between Physical Fitness and Academic Performance in College Club Sports Students

**Name of Researcher:** Jonathan Chung

**Organization:** Liberty University

**Street address:** 1971 University Blvd.    **City:** Lynchburg    **State:** VA    **Zip:** 24515

**E-mail:**

**Phone:**

##### II. Description of Research Proposal

The purpose of this study is to examine whether a relationship exists between physical fitness as determined by Just Jump System® scores and academic performance measured by Grade Point Averages in college Club Sports students. Participants will include Liberty University Club Sports students from Beach Volleyball, Crew, Figure Skating, Men's DI Hockey, Men's DIII Hockey, Men's Swimming, Men's Volleyball, Synchronized Skating, and Women's DI Hockey teams. The study will not be conducted during the season but archival data will be requested for jump mat scores as well as Grade Point Averages from the 2019-2020 academic year. There will be no financial compensation for participating in the study. All participants and student information will be anonymous and will be securely monitored and safely stored. Study will only officially begin with all consent forms signed and returned and IRB approval is obtained.

##### III. Agreement (to be completed by Athletic Director)

I, \_\_\_\_\_ Athletic Director of \_\_\_\_\_ school,  
understand

- the study and what it requires of the staff and students in my department,
- that the privacy and confidentiality of any staff or student will be protected,
- that I have the right to allow or reject this research study to take place in my department,
- that I have the right to terminate the research study at any time,



- that I have the right to review all consent forms and research documents at any time during the study and up to three years after the completion of the study.
- I grant permission to the researcher to conduct the above named research in my school as described in the proposal.
- I DO NOT grant permission to the researcher to conduct the above named research in my school as described in the proposal.
- I understand that data should be released only by the departments that maintain them. My staff and I will not release data to the researcher without prior approval from the Research Review Board.

Signature of Athletic Director

Date (YYYY-MM-DD)

## Appendix C

### Vertical Jump Test Ranking Scale

Rating	Males (inches)	Males (cm)	Females (inches)	Females (cm)
Excellent	> 28	> 70	> 24	> 60
Very good	24 - 28	61-70	20 - 24	51-60
Above average	20 - 24	51-60	16 - 20	41-50
Below average	16 - 20	41-50	12 - 16	31-40
Poor	12 - 16	31-40	8 - 12	21-30
Very poor	8 - 12	21-30	4 - 8	11-20
	< 8	< 21	< 4	< 11