Fall 12-18-2015

Are Physically Active College Students More Successful Academically Than Their Inactive Peers?

Jared T. Meacham
University of New Orleans, jtmeacha@uno.edu

Are Physically Active College Students More Successful Academically Than Their Inactive Peers?

A Dissertation

Submitted to the Graduate Faculty of the
University of New Orleans
in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy
in
Curriculum and Instruction

by

Jared Meacham

B.S. Virginia Tech, 2001
MS.Ed. Virginia Tech, 2003

December, 2015

Acknowledgements

I wish to acknowledge the University of New Orleans and the College of Education and Human Development for permitting me to engage in such a rewarding and thorough graduate education experience. Having been displaced by the reduction of program offerings following Hurricane Katrina, the graduate faculty of the College of Education and Human Development accepted me into the Curriculum and Instruction program and worked with me to develop the necessary knowledge I would need to be successful in this doctoral program.

My association with Dr. Marc Bonis has been greatly beneficial to me as a new researcher. Dr. Richard Speaker challenged me to strive for a higher level of research quality than I had previously been able to attain. Dr. Ann O'Hanlon and Dr. Patricia Austin challenged me to improve my study and aim for a higher level of insight and for this I am a better researcher. I also wish to express my sincere and never-ending gratitude to Dr. Cornelius E. Gorman who has mentored and guided me through my entire doctoral journey. A special and sincere thank you to Dr. Amanda Rosenzweig for her years of friendship and guidance that have continuously helped me throughout the dissertation process.

I wish to express unending appreciation to my parents, James and Rebecca Meacham, for their lifelong support of my educational pursuits. Mom and Dad, you instilled an intense desire for understanding in me from an early age and for this I am grateful to you. I will never take for granted the sacrifices you have made to provide me with a quality education. You have always encouraged me to pursue my dreams and this document embodies the achievement of a monumental dream in my life. I dedicate this work and my educational journey to you.

TABLE OF CONTENTS

List of Tables

List of Figures

Abstract

Academic achievement and physical activity are some of the most controversial and relevant topics of discussion in the United States today. Collectively, they represent a growing body of research questioning whether these two variables may possibility be related. This research project intended to explore the possible relationship between physical activity and academic achievement in college students. College students represent an adult population that can make their own choices regarding healthful lifestyle practices and can choose their preferred educational field of study. Today's actively enrolled college students reflect the adult cohort that will make up much of the nation's citizenry, making this group an important one to understand. The collegiate student population is severely underrepresented in research regarding questions of potential relationships between academic achievement and physical activity. This shortcoming in the current relevant research was the purpose for which this study was designed.

Using an anonymous online survey instrument, data was collected over a time period of two semesters. Ten thousand currently-enrolled college students eighteen years of age and older from all states and recognized territories of the United States were surveyed. The survey gathered data concerning a student's age, gender, race, body weight, height, geographic region of college attendance, cumulative GPA, and level of physical activity. The FIT Index of Kasari was used to classify each student's physical activity level.

A quintile split by FIT score and descriptive analysis were conducted to determine if physically active students were more successful academically than their inactive peers. Univariate analysis of variance (ANOVA), independent sample t-Test, and descriptive analysis were conducted on data pertaining to secondary research questions regarding FIT scores of students in

each geographical region of college attendance, gender and race. The research found that no statistically significant correlation existed between academic achievement and physical activity in college students. It was determined that academic achievement did improve with physical activity up to a point, but that students with very low and very high physical activity levels had lower academic achievement scores than students with moderate physical activity habits. Therefore, the null hypothesis could not be rejected. The research did find significant differences in the FIT scores of students in the northwest, but not among students in the southwest, northeast, or southeast. Significant differences in FIT scores were also found to exist between males and females and between white and non-white college students. The research found a number of significant differences between groups within the quintile split of FIT score data regarding the primary research question. When the sample was segmented by FIT score categories, differences began to appear. More research should be conducted using these variables in order to better understand the possible relationship that physical activity may have with academic achievement in a college population.

Keywords: academic achievement, college students, exercise, GPA, physical activity

Chapter 1:

Introduction

Students in the United States are more sedentary than ever before and are struggling to keep pace academically with students from other industrialized nations (CDC, 2011). Now, more than ever, school systems within the United States are scrambling to create solutions that will optimize academic performance and create well-educated, healthy, productive citizens. While possible solutions at first may seem simple, they have proven to be anything but clear-cut. Seemingly every intervention has seen some success but ends up revealing just as many shortcomings. Some school systems have decreased time spent on physical education in favor of increased class time to focus on mathematics, reading and the sciences. Others are now working to increase time spent in physical education in order to address the need for focused, healthy students. Nelson and Gordon-Larsen (2006) have found positive academic outcomes in school systems that have embraced the initiative to increase time in physical education class, but the results, while promising, are inconclusive; Trudeau and Shephard (2008) have determined that increased physical activity may not correlate to higher academic achievement in students. While every method has supporting and detracting research, the reality is that the question seems to be more far-reaching, varied, and complex than initially assumed. New questions must be asked in order to better grasp the scope of action that is needed to produce academically competitive students.

Thesis Statement

This dissertation sought to determine if there was a relationship between physical activity level and academic achievement scores in college students. Fox, et. al. (2010) determined that there is a great body of research pertaining to these variables in student populations in grade

school, middle school and high school. However, one area that seemed to be almost entirely overlooked by the research was the academic achievement levels of college students—more specifically, the academic achievement levels of physically active college students as compared to their inactive peers. For various reasons, researchers believe that there may be a link between physical activity and academic achievement (Raspberry, 2011), but no conclusive research has been conducted in the college population. Concrete findings only began to appear when studies examined secondary variables and gathered data associated with them. One challenge in synthesizing the relevant research was that very few studies focused on a variety of factors associated with human subjects and tended to focus only on one or two. Eventually, there must be more college student-centric research that addresses the person as a whole, examining not only their levels of physical activity and their academic standing, but also the many variables that make up who they are.

Purpose

The purpose of this dissertation was to attempt to determine if physically active college students are more successful academically than their inactive peers. By focusing solely on active college students and gathering data regarding their levels of physical activity and academic achievement, this study used synergistic data regarding their gender, age, race, and geographic location in order to develop more well-rounded and conclusive findings that offered new information regarding the factors contributing to academic achievement as it relates to the physical activity levels of students in the college setting.

Theoretical Framework

The theoretical framework governing this study was derived from the Self-Determination Theory (SDT) developed by Deci and Ryan (1994). SDT represents a wide and comprehensive framework for research regarding human personality and motivation. Deci and Ryan explained that SDT formally defines intrinsic and various extrinsic forms of motivation and describes the specific roles that both intrinsic and extrinsic motivation play in human cognition, social development, and individual differences. Moreover, Deci and Ryan determined that SDT provides focus on social and cultural factors and how they facilitate or disrupt the human sense of initiative and volition as well as their sense of well-being and personal performance quality. Given this, the specific conditions that support a human's individual relationship with competence, autonomy, and relatedness were determined to nurture the highest forms of volition, engagement, and motivation for personalized activities, including performance enhancement, creativity, and persistence.

> The Self-determination theory (Deci & Ryan, 1994, pg. 119) suggests that
>
> (*a*) people are inherently motivated to internalize the regulation of uninteresting though important activities; (*b*) there are two different processes through which such internalization can occur, resulting in qualitatively different styles of self-regulation; and (*c*) the social context influences which internalization process and regulatory style occur. The two types of internalization are introjection, which entails taking in a value or regulatory process but not accepting it as one's own, and integration, through which the regulation is assimilated with one's core sense of self. Introjection results in internally controlling regulation, whereas integration results in self-determination.

The Self-determination theory therefore applied to the idea that any person's physical activity level and academic achievement are linked to their personal level of self-regulation, as concerns the performance of activities concerning these variables and their unique levels of introjection and integration, which made it an ideal theoretical framework for this study.

The factors of self-regulation, introjection, and integration as they relate to physical activity level and academic achievement scores were present for any college student. Additionally, the variables of academic achievement and physical activity level were largely dependent upon an individual's level of intrinsic and extrinsic motivation, as well as their sense of competence, their autonomy to engage in practices that affect their lives, and their ability to engage in personalized activities that added to or detracted from their level of academic achievement and physical activity. College students must have a great sense of motivation, competence, and autonomy that lead to some level of introjection and integration in order to take control of their academic and physical activity participation outcomes. Therefore, SDT provided a quality framework for the development of this study.

Statement of the Problem

No consensus exists among researchers as to whether or not there is a relationship between physical activity level and academic achievement in a college population. The college population is one that merits study and the findings concerning these variables in younger student populations provides a logical impetus for this type of research to continue into the adult student population. It is problematic that the body of research surrounding the variables of physical activity level and academic achievement among college students indicates such infrequent study.

The shortage of information pertaining to these variables as they relate to one another presented a clear opportunity for new research.

Research Questions and Research Hypothesis

Are physically active college students more successful academically than their inactive peers? The research hypothesis for this question stated that physically active college students are more successful academically than their inactive peers. Three secondary research questions were also asked in this study.

1. Are there differences in FIT (frequency, intensity and time) scores by geographic area?

This question was asked to determine if there may be some differences in physical activity levels among college students in various geographic regions that may be beneficial in leading to additional research. The research hypothesis was that there is a difference in FIT scores by geographic area, indicating that a significant difference would be shown between college students representative of various areas of the country. A review of the literature revealed that no findings had been determined in previous research regarding FIT scores by geographic region. This study intended to fill that gap in the research.

2. Are there differences in FIT scores by gender?

This question was asked to provide insight into the possibility that there may be gender–specific differences or similarities in levels of physical activity that could provide information useful to the development of future research in this area of study. The research hypothesis stated that there was a difference in FIT scores by gender, implying that male and female college students had significantly different physical activity levels.

3. Are there differences in FIT scores by race?

This question was presented to determine what similarities or differences in physical activity level may exist between populations of different races. This could prove useful in the development of research questions for additional research stemming from this study. The research hypothesis of this question indicated that there was a significant difference in FIT scores among college students of various races, demonstrating that students of different races had different levels of physical activity engagement.

Method of Investigation

Investigating these questions required the use of an internet-based survey that was distributed to thousands of currently enrolled college students. This sample size arose from gathering student responses over a two-semester period. As the second semester neared completion, it became clear that I would receive approximately 10,000 responses; this was the determination of the sample size in this study. This survey asked questions pertaining to each of the four research questions. The collected data was organized using Microsoft Excel so that it could then be imported and statistically analyzed using the SPSS program; this provided specific information regarding each research question and determined how the findings related to the research hypothesis for each question.

Reason for the Study

A review of relevant literature presented a noticeable gap that excluded college students from the body of research concerning physical activity and academic achievement in students. While grade school and high school populations were well documented, the population of college students in the United States was virtually untouched by current research. This study was needed

to provide a body of information about a large population of people that were until recently underrepresented in research. Understanding the levels of physical activity and academic achievement in the college population could provide an unknown wealth of information, which could be used to conduct additional research. This study was vital to the process of understanding whether or not physically active college students perform better academically than their inactive peers. This study also asked additional questions that contributed to the knowledge we have concerning physical activity and academic achievement in specific groups of students categorized along gender, racial or geographic lines. The findings of this study could provide important information that contributes to a better understanding of the college going population and will provide insight into the potential relationship between these two variables.

Significance of the Study

Former college students constitute a sizeable portion of the workforce in the United States. One's success in college is largely determined by the academic scores earned during the course of one's college career. Any factor that may be linked to academic success merits study. This research project hypothesized that a higher physical activity level related to a higher level of academic achievement in college students. It is important to explore this topic in order to determine if there is indeed a significant relationship or not. The findings of this study provided a platform for additional research to be conducted in the future.

Definition of Terms

Academic achievement: a grade point average (GPA) that falls between 0.0 and 4.0. The higher a student's GPA score, the higher that student's level of academic achievement.

College student: a student who is currently enrolled and attending class in a college within the United States of America or one of its official territories.

FIT Index of Kasari: A research instrument used to classify and assign a score from 1 to 100 to a person's physical fitness level based on their frequency, intensity, and time engaged in physical fitness activities.

FIT score: A score that can range from 1 to 100. This score is determined by classifying a student's level of physical activity frequency, intensity, and time on the FIT Index of Kasari instrument. Each variable of frequency, intensity, and time has a number of possible levels, each having its own unique score. Once each variable has been scored, the three scores are multiplied together, producing one FIT score. The higher the FIT score, the more physically active the person.

Gender: one's sense of self as male, female, transgender, or otherwise.

Geographic Area: geographic areas are identified as northwest, southwest, northeast, and southeast, originating from the central area of the United States. Recognized territories are assigned to a geographic area based on proximity.

Participants: college students who submitted survey information for this study.

Race: a population of humans categorized by the color of one's skin.

Recognized territory: populated territories whose political process is directly overseen by the United States of America, as of January 2014. These are Puerto Rico, Guam, the Northern Marianas, the U.S. Virgin Islands, and American Samoa.

Self-reporting: participants reporting their own accounts of the information requested. Information provided through self-reporting was not verified by the researcher.

Survey: an online questionnaire designed to gather specific information from participants.

Statistical significance: used to reject or fail to reject a null hypothesis. It is determined using an alpha value of .05.

Limitations

A number of limitations were recognized in this study. These limitations may have contributed to inaccuracy or inconsistency in the data. This study used a self-reported survey to gather relevant data from college students. The use of a survey did not allow the researcher to verify that information provided was factually accurate. This survey allowed for self-reporting which could have allowed inaccurate information to become part of the collected data. Another limitation was unequal representation among the various categories of student respondents. White students completed many more surveys than did students identifying with any other race, and more participants identifying themselves as female submitted surveys than those identifying themselves as male. This uneven distribution of participants created limitations in the ways the data could be classified and analyzed. This study did not account for first-semester freshman students who may claim a 4.0 GPA without truly having the ability to attain this high level of academic achievement. This may have resulted in data that was not truly representative of the participants surveyed.

Summary and Overview of the Study

This study explored the possibility of a significant relationship existing between physical activity and academic achievement in the United States college population. The null hypothesis stated that physically active college students are not more successful academically than their inactive peers. Secondary research questions pertaining to FIT scores associated with gender,

geographic area and race were also analyzed. The primary research instrument used was the FIT Index of Kasari (Kasari, 1976), which classified and scored each participant's level of physical activity. This instrument was used as the study's only dependent variable, against which all others were compared. The data was organized using a quintile split; this allowed clearly defined groups of students to be identified by FIT score and have their GPA assessed using correlation and comparison statistics. This study aimed to satisfy a gap in the research that did not focus on the variables of physical activity level and academic achievement in college students, but rather focused on school-aged students. All data was collected from participants using an internet-based survey instrument consisting of eleven questions. This method of data collection created a number of limitations to this study, which have been identified. 10,000 participants responded to the survey and statistical analysis was conducted on the gathered data. This study hoped to create a platform for future research to be conducted in this area of interest.

Chapter 2:

Literature Review

The purpose of this chapter is to present a review of the literature pertaining to the physical activity levels of college students and their academic achievement. The literature supports the idea that being physically active has numerous advantages for individuals, including the potential to improve their grades. However, the allocation for physical education in American public schools has reportedly been reduced in recent years (Tremarche, Robinson, & Graham, 2007). This study focused on whether physically active college students are more successful academically than their inactive peers are. An investigation of relevant research showed that there have been few studies exploring the possible relationship between the physical activity level of college students and their academic achievement.

A thorough search of applicable journals and databases was conducted in order to streamline the literature review. Furthermore, the sources were scrutinized for evidence that indicated how physical activity level (time, intensity, and frequency) affects academic achievement, with secondary attention being given to other factors surrounding these variables. Research articles from a number of other specific journals were also analyzed for specific insights that could contribute to the review of applicable literature. The insights were significant to the synthesis of this literature review and will be utilized to provide relevant insight regarding the viewpoints of current literature, as well as to recommend future studies.

This chapter provides a thorough literature review exploring the possible relationship between the physical activity level of college students and their academic achievement. The chapter begins with an outline of the literature that focuses on the description of physical activity

level and its effects, as well as emphasizing any possible shortcomings within the current research. Additionally, there is a detailed description of the sedentary lifestyle of students in the modern era. After a brief discussion of the research concerning the various lifestyles students exhibit, a description of physical activity and academic achievement will follow. Specific descriptions about the implications of physical activity on college students' academic achievement is then discussed in detail, followed by a discussion about the possible relationship of the effects that the race and gender of college students might have on their levels academic achievement. This chapter closes with a synthesis of the most notable discoveries, focusing primarily on the gap in research that this study aimed to fill. The main purpose of this literature review is to offer context to the crucial concepts and constructs relevant to understanding the relationship that physical activity level may have with academic achievement in college students.

Resource Search Strategy

A massive assortment of document sources were used in the search for relevant material concerning the nature and extent of physical activity's effects on the academic achievement of students. A comprehensive search of journal databases was conducted in order to synthesize resources for the investigation of related literature. This was done to develop a cohesive body of information detailing what has already been studied in this area, and also to identify what needs the current body of literature did not satisfy concerning this topic. This method of database and journal resource gathering and synthesis is the most reliable method of filtering the information that is vital and specific to this topic while excluding resources that lack relevance. Many results came from the search for peer reviewed journal articles, although some were excluded from this study, due to their findings being similar to other, more recent articles cited in this study. Each

journal article was read and annotated to determine whether it contained significant information about physical activity and academic achievement of students. All articles listed as resources in this chapter have great relevance to the topic, concerning the possible effects that physical activity may have on academic achievement.

With the intention of identifying as much topic-specific information as possible, it was essential to use keywords to make the search for related studies systematic and efficient. The following keywords were used to compile and categorize information for this literature review: *physical activity, physical activity + obesity, sedentary lifestyle + college students, physical activity + benefits, brain+ physical activity, cognitive benefits + physical activity, physical activity + academic achievement, PE classes + academic achievement, physical activity + government policies, aerobic fitness + academic achievement, physical activity + implication on college student academic achievement, race + college students + academic achievement*, *sex + college students + academic achievement*, and *gender + college students + academic achievement*.

The use of these keywords in the search for relevant resources was important to find a suitable body of peer-reviewed articles, reports, and studies about the relationship between physical activity and academic achievement of college students. The following journal databases were used: EBSCOhost database, ERIC database, Project MUSE, ProQuest database, SAGE Journals Online, Taylor & Francis Journals, and Thompson-Gale PowerSearch.

These journal databases supplied a sufficient body of resources. These resources were needed to provide a robust synthesis of literature producing possible answers to the research questions of this study. This chapter consists of information collected not only from peer-

reviewed journal databases, but also from books and relevant websites. The scope of this chapter contains significant and current research concerning physical activity and academic achievement. Finally, all resources were vetted, and only seventy-nine studies were retained as resources, in order to provide the information needed to fully explain and answer questions concerning the topic of this study.

Most of the resources included in this literature review were published between 2009 and 2014. This body of current research is vital to integrity and accuracy of this chapter, as the factors and variables concerning physical activity and its potential effects on academic achievement are a rather recent area of interest for researchers. Articles were chosen based on their findings regarding the sedentary or active lifestyles of college students and the relationship between physical activity and academic achievement of students.

Study Overview

The purpose of this study was to explore the connection between level of physical activity and academic achievement in an adult population, specifically college students. This research problem was selected due to a clear lack of research concerning these variables in college level students, as the current body of published research is almost exclusively focused on elementary and middle school students.

Previous studies (Carlson et. al. 2008; Chomitz et. al. 2009; London and Castrechini 2011; So 2012; Telford et. al. 2012) reveal that there may be a positive relationship between physical activity level and academic achievement. This rationalization stems from an increasing number of studies demonstrating that physical activity involvement may promote a variety of

positive cognitive, social, psychological, and physical aspects, including academic achievement, in students.

The studies by Carlson et. al., Chomitz et. al., London and Castrechini, So, and Telford et. al. focused on physical activity and its relationship to academic achievement. While insightful, they are focused on populations that do not have control over their personal life choices with regard to many of the circumstances concerning these variables. This study was designed to look more closely at a number of the same variables as the studies cited herein, such as academic achievement and GPA, but in a college population, which has more control over its own choices regarding physical activity, diet, academic preference, and many of the known factors that contribute to body composition and academic achievement. College students can typically make their own decisions as to what they eat, whether they engage in physical activity and to what degree, and how they spend their free time.

Background for the Study

Significant reductions in time spent in physical education (PE) have been adopted in a growing proportion of American public schools (Tremarche et al., 2007). In 2004, the Centers for Disease Control and Prevention (CDC) stated that there was a decline in the frequency of PE classes being scheduled within public schools in the United States of America. In 2011, the CDC reported that a mere 28.7% of American students participated in at least 60 minutes of exercise per week. Within this same survey, the CDC also stated that a decrease in participation in physical activity correlated to an increase in American students who were either classified as overweight or as clinically obese. Regular physical activity has been recognized to be important

because it may reduce the chances of being obese as well as being susceptible to chronic illnesses.

Much research (Ho et. al., 2011; Stephens and Schauben, 2002; Wingfield, McNamara, Janicke, and Graziano, 2011) has been conducted studying the potential relationship between body composition and academic achievement. Some researchers, like Raspberry (2011), have asserted that there is a relationship between academic achievement and physical fitness, while other researchers, including Trudeau and Shephard (2008), argue that no relationship exists between these two variables. Several studies, including those by Flöel et al., (2010), CDC (2011), and Topmorowski (2003), recognize positive benefits that may be attained from engaging in regular physical activity exist and highlight things such a reduction in levels of stress and the development of increased self-confidence. Studies by Kim and So (2012), Carlson et. al. (2008), and Telford et. al. (2008) have also determined that when an individual engages in physical activity, it has a positive impact on their academic achievement. For these reasons, many advocates of improved educational standards in the United States assert the need to increase PE programs, so that American students can reap the potential increases in academic achievement that a great deal of the current research seems to identify as a primary outcome. Castelli, Hillman, Buck & Erwin, 2007, studied 259 grade school students and found that students who engage in physical activity showed better exam scores and better overall grades than did those who did not engage in physical activity.

Moreover, as stated previously, the vast majority of the studies, including those by Kim and So (2012), Carlson et. al. (2008), and Telford et. al. (2008), that have been conducted in the areas of physical fitness and academic achievement primarily focus on elementary or high school

students. This population, however, may not be indicative of the United States student population as a whole due to a number of issues. These issues include the level of control that young students may have to make self-improving decisions, and also the level of governmental control over time spent in PE in public schools, which may limit personal choice. Recent trends (Pinar, 2012) find the federal government legislating standardized testing outcomes, which school officials often use as reasoning to reduce out-of-classroom activities such as PE, in order to achieve these mandates. This created a need in the research to discover what relationships may exist between physical activity and academic achievement in a student population that is not subject to such restrictions. Pinar indicates that the difference between adult learners and elementary and middle school learners is simply the responsibility they have for their own education. He asserts that adult learners enter the college classroom with specific goals and outcomes in mind. This is a primary reason that this study researches these variables in the college population exclusively. Only a few key studies have been published that look at the relationship of academic achievement and physical fitness of college students. This study was designed to fill some of this gap by researching the potential relationship between academic achievement and physical activity in a college population. The available literature concerning these variables is plentiful in grade and high school student populations and this study used this research to identify findings in these populations to frame this study with relevant background information.

Physical Activity and Obesity in the United States

A body that is in good physical shape is a body that is active and that consumes quality nutrients by making healthful food choices. These things are essential to the overall well-being of

an individual. A healthy diet accompanied by regular physical activity has been shown to play a major role in decreasing the risk of developing serious health illnesses such as obesity, diabetes, heart diseases, and other chronic diseases, namely various types of cancer. However, according to the CDC (2011), most Americans do not have a consistently healthy diet and are not participating in physical activity that is sufficient to maintain an optimum lifestyle of health and well-being. As a result of both the lack of quality food choices and a lower rate of physical activity, there has been a steady increase in the obesity rates of virtually every population of people within in the United States. According to the CDC, approximately 1 in 3 adults and 1 in 6 adolescents are obese (CDC, 2011). Research has supported the notion that a decrease in physical activity tends to be correlated with an increased chance of becoming obese.

Low levels of physical activity have long been associated with obesity, and it seems that the relationship between these two variables is indirectly proportional. Pietiläinen and Kaprio (2008) examined the situation of decreasing physical activity and the correlated weight gain ranging from the adolescent stage to early adulthood. Pietiläinen and Kaprio (2008) concluded that if an individual has what is classified as a high physical activity level, the risk for obesity is low. Conversely, if an individual demonstrates a low level of physical activity, the individual would have a high risk of developing obesity. Pietiläinen and Kaprio (2008) also found that low levels of physical activity among teenagers strongly and independently correlated to total abdominal obesity in adolescence. Given the findings, these researchers recommend daily bouts of physical activity in young children to prevent obesity as they age and develop (Pietiläinen & Kaprio, 2008).

The CDC's 2011 survey concluded that 28.2% of American students were either overweight or obese, while it found that 32.4% and 31.1%, respectively, watched or engaged in three or more hours of television or computer games each day as part of their sedentary lifestyle. Research regarding childhood obesity as it is associated with sedentary behaviors and poor dietary habits are conclusive. The findings associated with the prevalence of obesity among children and young adults in the United States should serve as a warning call for individuals to assess their current lifestyle. A sedentary lifestyle in the modern era is one of the primary factors contributing to the increase in obesity rates among children and young adults in the United States. Trends (Fountaine et. al. 2011; Fox & Hillsdon, 2007) clearly show that many individuals are more apt to sit and play video games, watch television, or engage in some other sedentary behavior for the majority of their non-working hours, rather than engaging in physical activity.

Sedentary Lifestyle of Students

The lifestyle of students in the modern-day United States is decidedly sedentary. Fox and Hillsdon (2007) suggest that sitting has been more appealing in modern society as individuals acquire more sources of personalized entertainment, such as personal computers, smart phones, satellite radios, laptops, tablets, and gaming devices. Fox and Hillsdon (2007) argue that the evolution of technology is the primary influence on individuals today that leads to a sedentary lifestyle. Abadie and Brown (2010) discussed the advantages and disadvantages of modern technology. It is clear that on one hand, technology allows for a greater degree of independence, because it allows people to communicate and perform necessary tasks through interconnected devices. On the other hand, it has also created a sense of dependence on technological devices among children. Modern culture promotes highly efficient and accessible transportation methods,

as well as readily available processed food products, which result in a sedentary lifestyle and the tendency to overeat, both of which are known to contribute to obesity. Obesity has been shown to play a prominent role in the development of various diseases, such as cancer, a number of cardiovascular diseases, and a slew of metabolic diseases and conditions, such as diabetes. It seems that nearly every aspect of modern culture in the United States promotes or requires a person to lead, at least to some degree, a sedentary lifestyle, and this seems to be even more prevalent among college students.

The college years are a time of great opportunity for students to make personal decisions with a high degree of autonomy. The college setting in the United States tend to provide students with a great deal of independence, which allows students to make decisions that previously had typically been made by their parents or guardians. Perhaps one of the most important decisions a college student must make is whether to incorporate physical activity into their daily life or not, and to what degree. It is typical that college students will spend the majority of their day listening to lectures, attending classes, engaging in school-related events, and working on papers and projects. At this stage in the life of college students, they may not be getting enough daily exercise to positively affect their health. Most research shows that for the duration of college years, students tend to become more sedentary, because their physical activity levels are greatly reduced, while their body weight and Body Mass Index increase. The ability to escape a sedentary lifestyle while attending college is something that requires personal determination and is not an easy task for many students. This provides even more reason to continue to research, educate, and empower college students to prioritize physical activity as part of their educational

experience. However, despite this understanding, the majority of college students still tend to lead a lifestyle that is sedentary (Johnston, 2010).

Fountaine, Liguor, Mozumdar, & Schuna (2011) found that college students allot themselves 3.67 hours of leisure time per day. When leisure activities were categorized, most of college students spend nearly two hours watching television, which culminates in over half of their leisure time being spent sitting down. Obviously, when students sit down to watch television, they are engaged in a sedentary activity. If college students are spending the majority of their time sitting in classrooms and working on projects, then using their leisure time to continue this trend of sedentary behavior, it is no wonder that so much attention is being focused on the many aspects of physical activity and the growing rate of obesity among students in the United States. Clearly, when sedentary behavior increases, physical activity must decrease. This is why Fox & Hillsdon, (2007) as well as Fountaine et al., (2011) hypothesized that an increase in hours spent watching television is one of the reasons why college students experience a decrease in physical activity.

Generally, sedentary lifestyle adoption has increased in recent years due to increased screen time of college students using computers, televisions, watching movies, and playing video games. This is the growing trend, as is an increasing rate of documented addiction of college students engaged with social networking sites such as Facebook, Twitter, Instagram, YouTube, and Vine. Fountaine et al. (2011) discovered that college students spend 2.8 hours to 11.6 hours per week engaging with social media sites. Fountaine et al. used the displacement hypothesis to determine how increases in screen time exposure has negatively influenced the physical activity of college students. The displacement hypothesis asserts that there is a symmetrical, zero-sum

relationship: if an individual designated much of their time as screen time, the individual would have to devote less time to physical activity (Fountaine et al., 2011). Yet another assertion of the displacement hypothesis pertains to the natural evolution of behavior, where newly adopted activities and actions of an individual will inevitably phase out old activities and actions (Fountaine et al., 2011). Fountaine et al. (2011) also concluded that if college students' screen time exposure is affecting their usual activities and actions devoted to physical activity, there is proportionate increase in sedentary behaviors and a corresponding decrease in physical activities.

Establishing a healthy lifestyle is very important for individuals of all ages. However, it may prove more challenging for college students than it does for others. This is true due to the huge influx of new experiences college students undertake relatively rapidly, involving transitional situations like leaving high school (where students live with their families and know all of their classmates) to enter college life (which often mandates that students live away from their families), being thrust into an environment where they are making new relationships, and (likely) studying very hard to do well academically. It is not a stretch of the imagination to suppose that student health may not be the priority of most college students. High school students do not have to deal with all of the additional stressors that come with the freedom of being a college student. And, since many college activities are completely foreign to a new student, acclimation is sometimes challenging, and habits that were once healthful may quickly be replaced by sedentary situations (Fountaine et al., 2011; Johnston, 2010) that could perpetuate into more inactive tendencies over time.

A study by Johnston (2010) at Indiana University looked at college students and sedentary living. The conclusion was that the vast majority of college students become

considerably more sedentary as they approach their senior year in college. Johnston also noted that students who graduate from college tend to be less active and heavier than students who do not graduate. Johnston and fellow researchers conducted a survey asking about the physical activity habits of college students. One of the most telling and significant findings was that regardless of the college student's year of study, there was always a decrease in moderate physical activity level, which was classified as any activity where the breathing rate and heart rate of an individual goes up noticeably. More specifically, it was found that students also reported walking less with each progressive year in college. As students age, they tend to rely more heavily on cars and buses to get to around their college or university campuses. Johnston discovered that freshmen college students walked an average of 684 minutes each week, while college seniors only walked for an average of 436 minutes. Johnston's research revealed that the overarching reason for the increasingly sedentary lifestyle of college students was that this period of life constituted a transition period for students, which made a sedentary lifestyle simpler and more easily adopted than a physically active one.

Fountaine et al., (2011) has shown that a sedentary lifestyle not only affects the overall health of students, but also has an effect on the academic achievement students attain in the classroom. Taras (2005) stated that physically active students exhibit greater focus and attention for the period of a class than do sedentary students. Similarly, Basch (2012) concluded that physical inactivity is excessively prevalent among urban minority teenagers and has a noticeably adverse influence on their academic achievement scores.

Benefits of Physical Activity

Regular engagement in physical activity has numerous benefits. CDC (2011) research supports the idea that regular physical activity may relieve anxiety, anger, and even depression. After engaging in physical activity, individuals may experience a sense of well-being and most individuals experience an improvement in their overall well-being during times when physical activity is a regular part of their life (CDC, 2011). Physical activity has also been shown to boost mental health because it leads to the increased flow of oxygen in the blood, with a direct impact on the brain. Physical activity is thought to possibly develop and improve the mental acuity and memory of an individual. The CDC states that regular physical activity can help in the following areas:

1. Control overall body weight
2. Reduce risk of cardiovascular disease
3. Reduce risk for type 2 diabetes and metabolic syndrome
4. Reduce risk of some cancers
5. Reduce risk for high blood pressure
6. Strengthen bones and muscles
7. Improve mental health and mood
8. Reduce the risk of depression and anxiety
9. Improve ability to do daily activities and prevent falls
10. Increase chances of living longer (CDC, 2011).

Consistent physical activity may improve the health of many bodily systems, including the cardiovascular, muscular and skeletal systems, while physical inactivity and the adoption

of a sedentary way of life tend to lead to increased weight and decreased health and function of bodily systems. As such, increasing physical activity is important to prevent adult diseases.

Brain and physical activity. Flöel et al., (2010) have found that there is a relationship between the quality of human brain function and the physical activity level of an individual. Individuals who regularly engage in physical activity tend to have improved cognitive and memory functions (Flöel et al., 2010). Physical activity has been found to improve brain function in the following ways:

1. Physical activity increases oxygen saturation (Kleim et al., 2002)
2. Physical activity increases activity of brain neurotransmitters, such as serotonin and neorepinephrine, that facilitate information processing (Kubesch et al., 2003)
3. Physical activity upregulates neurotrophins, such as brain-derived neurotrophic factor, insulin-like growth factor-I, and basic fibroblast growth factor. (Schinder and Poo, 2000)

Flöel et al. (2010) also stated that physical activity improves students' grades. In fact, the authors went as far as to state that, "drop-out rates were lower for youth who consistently participated in interscholastic sport" (Flöel et al., 2010, p. 2757). Because physical activity has many benefits to brain function, increasing physical activity may increase academic achievement of students (Ruscheweyh et al., 2011).

Cognitive benefits of physical activity. A 2003 study at the University of Georgia found that engaging in physical exercise for as little as 20 minutes would improve information processing and memory functions of the brain (Tomporowski, 2003). Engaging in exercise, specifically aerobic exercise, was shown to have a positive and significant correlation to the improvement of

overall brain function (Chapman et. al., 2013). This was found to take place from the molecular level to the behavioral level of the brain. Physical activity acts on the brain to stimulate its plasticity through the stimulation of the cells making up the hippocampus, which plays a key role in the ability to be spatially aware, as well as both short- and long-term memory (Voss, Nagamatsu, Liu-Ambrose, and Kramer (2011). Physical activity and exercise tend to increase the brain's growth factors and help facilitate new neuronal connections within the human brain. Moreover, there has been found to be an antidepressant effect associated with distance running that can be linked to more cellular growth in the hippocampus, which is where learning and memory take place (Bjørnebekk, Mathé, & Brené, 2005). Voss, Nagamatsu, Liu-Ambrose, and Kramer (2011) also conducted a study on the relationship between physical activity and improved cognitive function of the human brain, specifically in the hippocampus. These researchers found that as people get older, it is a natural occurrence that some parts of the brain will inevitably begin to atrophy. A number of studies, including one conducted by Voss et al., (2011) show that the average brain's hippocampus shrinks up to two percent yearly. Voss et al. (2011) organized a group of healthy but sedentary adults for the purposes of conducting a study. The researchers employed the use of magnetic resonance imaging (MRI) to measure the size of each participant's hippocampus. The researchers found an increase in the average hippocampus size of nearly 2% among participating adults who completed an assigned physical activity program. Moreover, it was found that the memory capability of these individuals had also improved (Voss et al., 2011).

A recent study conducted by Chapman et. al (2013) studied 37 cognitively healthy but sedentary adults. These researchers discovered that engaging in regular exercise aids adults in

increasing both their memory functions and their overall brain health. This research also revealed the benefits that aerobic exercise has on an individual's memory. These researchers found that aerobic exercise caused a significant reduction in the cognitive effects of aging. This study's volunteer participants were sedentary adults who were randomly assigned to participate in a physical training program or assigned to a waiting list control group. Participants assigned to the physical training group participated in aerobic exercise on either a treadmill or stationary exercise bike for one hour, three times a week, for twelve weeks. The cognition and cardiovascular fitness of the exercise program participants was assessed before the program began. The same assessment was conducted halfway through the program, and then again at the end of the program. Researchers measured brain flow using arterial spin labeling (ASL) MRI. The final results revealed that there was a substantial increase of blood flow to the brain in the anterior cingulate, which indicates that there is a higher level of neuronal activity. Furthermore, quality blood flow levels to the anterior cingulate are closely associated to superior cognition in the latter years of a person's life. Chapman et al. (2013) pointed out that physical activity may be one of the most advantageous and cost-effective therapies available associated with improved memory performance. Research has shown that improved overall memory performance could lead to an improved level of academic achievement among students.

Davis et al. (2007) conducted a study to examine the potential effect physical activity may have on cognitive function when delivered in the form of moderate aerobic exercise. Davis et al. (2007) randomly assigned 171 sedentary, overweight or obese 7 to 11 year olds (there were 56% female participants and 61% were African American) to either a low dose of aerobic exercise (20 minutes per day), a high dose of aerobic exercise (40 minutes per day), or a control

group that was offered no exercise program. Some of the exercises included in the program involved running games, modified basketball games, soccer games, and jumping rope. The primary focus of the exercise program was for the students to engage in games they would enjoy, rather than engaging in activities that they may find to be designed for skills enhancement or competition. Cognitive function of the study's participants was assessed using the Cognitive Assessment System, which is a standardized psychological assessment that is used to measure four interrelated cognitive processes concerning planning, attention, simultaneous processing, and successive processing. Brain activity of the child participants was measured using a functional MRI. Neuroimaging data revealed that participants who were assigned to either the low or high dose exercise program had noticeable improvements in prefrontal cortex circuitry. These findings suggest that a reasonable level of regular physical activity may be a simple but effective technique to augment a child's mental functioning, as it is vital to cognitive development.

Davis et al.'s (2007) study is unique, distinctive, and relevant for a number of reasons. The Cognitive Assessment System is more appropriate when applied to a school setting rather than attempting to measure cognition in a laboratory. The large number of participants helped to reduce researcher bias and gave validity and reliability to the study. Davis et al. (2007) also included a significant number of African American boys and girls in this study, which provided broader racial understanding in this population. The study also complied with the Consolidated Standards of Reporting Trials (CONSORT) criteria during the process of the randomized clinical trials, which provided a credible basis for the study.

Chaddock (2012) explored the effect that physical activity may have on the brain and cognition during childhood. The topic of research was inspired by previously conducted studies using rodents, as well as older adults, which repeatedly showed that positive relationships exist between aerobic exercise and cognitive function of the human brain. Research by Kim and So, (2012) and Rasberry et al., (2011) suggests that physical activity and higher levels of aerobic fitness in children may have a positive impact upon not only the individual's brain function, but also their academic performance in school.

Chaddock (2012) mentioned that the participants in the study who were already physically fit had significantly larger brain volumes in the hippocampus and the basal ganglia than did the child participants who were not physically fit. Furthermore, it was determined that children who are physically fit demonstrated superior brain functioning, which was linked to better academic achievement scores than those attained by children who were not physically fit. Brain function of the participants was assessed using functional magnetic resonance imaging (fMRI), while the child participants performed tasks that required their attention, necessitated they overcome a number of different interferences, and exercised their ability to exhibit inhibitory control.

Participants in the Chaddock (2012) study showed that one hour of moderate physical activity can demonstrate an increase in brain volume in both the basal ganglia and the hippocampus. Children who were physically active on a regular basis also exhibited increased fractional anisotropy, which implies an increase in neural fiber density, axonal diameter, and myelination within white matter, which are all viewed as positive outcomes. Active children also exhibited a decreased radial diffusivity in the brain, which researchers interpret as a circumstance

contributing to increased information processing ability. Additionally, physically active children demonstrated an improvement in their ability to maintain attentional control during a task. The researchers concluded that physical activity may be a contributing factor that improves the cognitive and brain health of eight- to nine-year-old children.

However, a number of studies found that there is no relationship between the cognitive function of the brain and a person's level of physical activity. Keeley and Fox (2009), after analyzing the findings of eighteen studies, found weak positive associations among the variables of physical activity and fitness, academic achievement, and cognitive function. Huang et al. (2013) suggested an inverse relationship between habitual physical activity or cardiorespiratory fitness and peripheral brain-derived neurotrophic factor (BDNF) in healthy humans.

Physical Activity and Academic Achievement

This section will discuss the trend of reductions in PE time in American schools and how that may coincide with reduced standardized test scores. This section will also discuss instances regarding behavioral issues that may stem from hyperactivity due to a sedentary lifestyle and how this may play into the overall learning environment of a student. This will tie into a discussion of the relevant research concerning governmental efforts to improve academic achievement at the expense of physical activity programs traditionally found in schools in the United States. Lastly, there will be a discussion of the impact that a student's home life plays on academic achievement. Specifically, the discussion will center on the many varied situations associated with latchkey kids, single-parent kids, and the amount of time students spend in front of screens (screen time), as this may relate to the academic achievement of students in modern day America.

PE classes and adolescent students. Schools in the United States continually strive to improve the academic performance of their students. However, in an effort to improve academic outcomes, many schools have resorted to lessening the allotted time for physical education and recess in order to allow for more time for in the classroom. A growing body of researchers and educators have argued that this might not be the ideal approach to improving academic outcomes and see this step as shortsighted. Studies by Tomporowski (2003) and Fountaine et al., (2011) have found that physical activity improves the cognitive capabilities of children as well as being correlated with improvements in their academic performance. Research conducted by the CDC, Columbia University, the New York City Health Department, the Department of Education, and the Universities of Illinois, West Virginia, and California, to name a few, have all asserted that there is a need for physical education in the educational system.

Students who engage in physical activities tend to present with lower body fat percentages, greater muscular strength, and tend to have better overall mental health (Davis et al., 2007). Even though these studies were conducted to research PE classes and their effect on the academic performance of children, a review of the literature demonstrates that there is a growing body of evidence that suggests children who are more active can focus better, display increased memory function, and are faster to perform tasks (Chapman et al., 2013; Tomporowski, 2003).

Educators know that many factors influence academic performance, including a child's socioeconomic background and the quality of parental involvement in their lives. However, despite these factors, there is a strong suggestion in the research that says active children have better performance, especially in reading and mathematics. Kim and So, (2012) along with

Rasberry et al., (2011) have also suggested that the benefits of physical activity outweigh the benefits from increasing time spent in the classroom. Given the available body of research supporting the idea that physical activity should be a core educational factor and not simply an option, many schools are taking note and making accommodations.

Positive relationship between PE and academic achievement. A 2011 study that reviewed 251 other articles concerning the relationship between physical activity and academic performance found that more than half (50.5%) of all links between the two variables were positive, 48% were not significant, and 1.5% were negative. This suggests that physical activity is either positively linked to academic performance or that at the very least, there is no significant relationship between the two (Rasberry et al., 2011).

Kim and So (2012) examined the connection between academic performance and the number of PE classes attended by students each week. The study concluded that attending three or more PE classes per week was positively associated with improved academic performance. Among the 75,066 Korean students studied, it was also found that students attending less than three PE classes each week demonstrated a negative association with academic performance. Several studies (Carlson et. al. 2008; Mahar et. al. 2006) demonstrate a positive relationship between time spent in PE and academic outcomes in students, specifically demonstrating improvements in classroom focus, mathematics and reading.

Physical activity and improved math performances. A number of studies have concluded that physical education classes help to improve the mathematical capability of students. Carlson et al. (2008) studied the link between the time students spent in physical education classes and their academic achievement in a longitudinal study of students in grades ranging from kindergarten to

the fifth grade. The conclusion was that there is a small but significant relationship between the academic achievement of female students in mathematics and reading. Furthermore, in a two-year longitudinal study, Telford et al. (2012) also concluded that there was improved academic progress among elementary school children receiving PE from specialists rather than from their typical instructors.

Physical activity and improved reading performance. A study researching standardized test scores of students engaged in regular, intensive, school-based PE programs revealed that "students who received more hours of quality PE per year scored higher" on the English and Language Arts (ELA) section of the Massachusetts Comprehensive Assessment System (MCAS), (Tremarch, 2007, p. 58).

Physical activity and improved math and reading performance. As stated by the National Early Childhood Longitudinal Study, female students who participated in PE for more than one hour per week showed significantly improved academic achievement in reading and mathematics when compared to female students who participated in PE with a duration of an hour or less per week. Additionally, it was found that teenagers who reported participating in school-based physical activities, such as PE and team sports or playing sports with their parents, were 20% more likely to receive an "A" in math or English than were their sedentary peers (Nelson & Gordon-Larsen, 2006). Moreover, a 2007 study showed that children who received good scores in aerobic capacity fitness tests also performed well on math and reading exams, in comparison to children who did not earn good grades on the same exams (Castelli, Hillman, Buck, & Erwin, 2007). Trost and van der Mars (2010) further asserted that school-based PE programs cause

students to participate in regular physical activity, which helps those students acquire skills and habits necessary to pursue an active lifestyle.

Negative relationship between PE and academic achievement. Some studies have discovered that there in fact may be no significant relationship between PE and academic achievement among students. Coe, Pivarnik, Womack, Reeves, and Malina (2006) found that the grades were similar irrespective of whether students were enrolled in PE during the first or second semesters of the school year. These same researchers failed to detect any significant improvement in the standardized test scores of students following vigorous physical activity during their sixth-grade year. Similarly, Trudeau and Shephard (2008) found that an extra hour per day of time allotted specifically to physical activity programming did not significantly influence the academic performance of primary school students in the study.

The Sports, Play, and Active Recreation for Kids project demonstrated that despite spending twice as many minutes per week in PE programs, children included in this program performed equally in academic measures with children who were not included in the active group. However, this study demonstrates a number of flaws, particularly in the high dropout rate of participants and the method of subject selection.

Keeley and Fox (2009) asserted that there is a lack of evidence to conclude that additional PE time would significantly increase academic achievement. However, there was also no evidence found that led the researchers to conclude that any additional time spent in PE would be detrimental. Hammond (2013), agreement with Keeley and Fox, also concluded that there is no relationship between the amount of time students spend in PE and their academic achievement, as measured by the fourth grade MAP test.

Aerobic Fitness and Academic Achievement

This section will discuss a number of studies about the research variables of aerobic fitness and academic achievement. It is divided into two sections, based on whether studies found a positive relationship between aerobic fitness and academic achievement or no relationship or a weak relationship between aerobic fitness and academic achievement. Cardiovascular endurance, or aerobic fitness, is one of the primary components of physical fitness, and it is one of the most basic, inexpensive, and fundamental formats of exercise available to students. Given this, and for a better understanding of how physical fitness variables may relate to educational outcomes, it is important to establish whether or not a relationship exists between aerobic fitness and academic achievement.

Positive relationship between aerobic fitness and academic achievement. The vast majority of the studies mentioned previously stated the benefits that aerobic fitness has on the brain. Many researchers have also examined whether or not aerobic fitness has a substantial impact on academic achievement in various populations.

A study of third and fifth grade students from four schools in one school district found that fitness measures, namely aerobic fitness, and standardized academic test scores had a positive correlation (Castelli, Hillman, Buck, & Erwin, 2007). It has also been determined that a student's aerobic capacity may be linked to higher levels of academic achievement as "achievement level" is defined by standardized test scores. Moreover, this correlation appears to have longevity and seems to be sustainable over time (Wittberg et al., 2012).

Santiago et al. (2013) studied the relationship of aerobic capacity and academic achievements in a sample population of Hispanic elementary school girls. Santiago et al.'s

(2013) study also resulted in the conclusion that aerobic capacity may indeed have a positive relationship with a student's performance in mathematics. Therefore, one may suggest that working to improve the aerobic fitness of a child may improve not only their academic achievement scores, but may also reduce their risk of developing childhood obesity (Wittberg et. al, 2012).

Negative relationship between aerobic fitness and academic achievement. A single research article was found that reported no relationship between the two variables of aerobic fitness and academic achievement. Trudeau and Shephard (2008) concluded that although physical activity does seem to improve concentration and behavior in the classroom as well as memory, there is no significant relationship between academic performance and physical fitness in primary school students. Even so, the researchers also concluded that allotting more time to physical activity would not negatively impact grades.

The Impact of Physical Activity upon Academic Achievement

This section will focus on the significance of physical activity as regards academic achievement. Most research on the topic agrees that physically active students perform better academically. An examination of fitness testing results of roughly 890,000 students in California showed a substantial positive correlation between physical fitness achievement and performance in both reading and mathematics on state achievement tests (Grissom, 2005). Agreeing with Grissom, other researchers have also found that physical movement and physical fitness are associated with the likely outcome of grade improvement (Wittberg et al., 2012).

Some research shows that improving the physical fitness of children may improve their academic achievement and potentially reduce their risk of developing childhood obesity

(Wittberg et al., 2012; Welk et al., 2010; Hillman, Pontifex, & Raine, 2009). It is noted that the increase of just one hour per day of time typically spent in the classroom being allotted instead to physical activity programs may have no positive or negative impact on grades, but the potential impact on a student's physical fitness may be substantially improved (Trudeau & Shephard, 2008). Fox, Barr, Anderson, Neumark-Sztainer, and Wall (2009) conducted a study using a sample population of 4,746 middle and high school students who each self-reported the amount of time they participated in a physical activity in a given week. The researchers looked specifically at whether they participated in sports teams or whether they were simply physically active. Both of these variables were used to determine if a relationship existed between these and the student's academic achievement. The findings of this study indicated a positive correlation between physical activity involvement and academic achievement. However, the findings among the various ages and genders were not conclusive as to whether academic success was related to physical activity only, to sports participation only, or to both.

Coe et al. (2006) found that students who performed vigorous physical activity regularly received higher grades when compared to students who did not perform regular vigorous activity over the time of an entire school year. Howie and Pate (2012) conducted a comprehensive review of the historical scientific record surrounding physical activity and academic achievement. The research team reviewed 125 articles published over the past five decades, fifty-three of which were published after 2006. The researchers found that the majority of the conclusions supported a decidedly positive association between physical activity and academic achievement, although some questions emerge as the research is analyzed. Faucette et. al. (1995) discovered that there are recognizable differences in physical activity levels of fourth grade students, depending on the

type of activity they engaged in. These researchers studied twenty reported types of physical activities among 669 boys and 595 girls. They noted that there was no significant difference between boys and girls in the intensity level of the top three activities chosen for each group. However, the researchers did find that overall, boys self-selected activities related closely to team sports, like football and baseball, while girls self-selected activities such as jumping rope, dancing, and gymnastics. These findings lends support to the notion that there may be variations of engagement in physical activity based on criteria such as whether it is self-selected or mandated, or whether it is organized or recreational.

Physically active students perform better on tests. This section will analyze studies that examine whether being physically active has an impact on student test scores. Chomitz et al. (2009) showed that passing both the MCAS Mathematics test and the MCAS English test significantly improved as the number of physical fitness tests passed improved. While some researchers have found that there is a significant connection between physical fitness and academic achievement, it is important to note that they also tend to caution against overstating the findings, as causation has not been substantiated.

Researchers are also beginning to ask questions about how much physical activity is optimal, how much is not enough, and how much is too much. Some findings have shed light on this question. So (2012), in a study of 75,066 Korean students, found that strengthening exercises, when performed two, three, four or five days per week, was associated with positive academic outcomes in students, as compared to the academic outcomes of their inactive classmates. However, when students performed these same strengthening routines more than five times per week, both boys and girls demonstrated negative links with academic performance

when compared to their inactive peers. The reason for this is unknown, but it is important to mention this emerging research focus as it relates to physical fitness and academic achievement in students.

Implications of physical activity on college student academic achievement. There are many studies that report a positive relationship between physical activity and grade point average (GPA) in students, and there are also plenty of studies that yield a negative relationship between these variables in similar populations. However, as noted previously, very few studies concerning these variables have been conducted on college students, as most of these studies use sample populations of children as participants. Very few studies concerning physical activity and academic achievement in college student populations exist, but this section will discuss the research that is available in this area of study. Al-Isa et al. (2011) examined a sample of 787 Kuwaiti college students. The Body Mass Index (BMI) of these students was measured. To compare the data, the researchers worked to determine the motivation students had to be physically active. Several key factors were found to be related to the motivation these college students had to participate in physical activity. These factors included student gender, marital status, BMI category (obese or not obese), the outcome of their last health examination, their desire to complete a higher college degree, and identification of the countries they found to be ideal for visiting. Two subsections in this section need to be addressed: (a) the positive relationship between BMI and academic achievement in students and (b) the negative relationship between BMI and academic achievement in students.

Positive relationship between BMI and academic achievement. BMI is a standard, although not highly accurate, measure of the body composition of an individual. Most studies have

concluded that having a favorable BMI could mean that a student may also perform well academically. Stephens and Schauben (2002) investigated the nature of this relationship and determined that the more a student's interscholastic sports participation increased, the more their GPA improved.

Moreover, Keating, Castelli, and Ayers (2013) examined the possible connection between weekly strengthening exercise frequency and GPA of 1,125 college students at a sizeable state university located in the southern region of the United States. The findings demonstrated that college students who participated more regularly in strength exercise training had considerably higher GPAs than college students who did no strength training (Keating et al., 2013). From this, we know that regular strength training exercises not only has health benefits for participants, but also seems to be closely related to positive academic achievement among student populations in a collegiate setting. However, this study did identify the need for further research to be conducted, and because of its single-university participant population, its findings cannot be generalized across the United States college population as a whole.

In 2011 a study that looked at various aspects of aging on the brains of 226 subjects was published. This study determined that a favorable BMI was closely associated with not only a person's educational level, but also their level of physical activity (Ho et al., 2011). It further suggested that brain mass was significantly greater in people of higher educational levels and those who were physically active, as compared to those of lower educational levels and those who were inactive. The researchers concluded that regular physical activity may have a positive effect on overall brain structure and function. Looking at variables more closely related to physical fitness and academic outcomes in children, Wingfield, McNamara, Janicke, and

Graziano (2011) found that there is a positive correlation between all factors of body composition, physical fitness, and academic performance for 5th grade females. These findings collectively support the notion that regular physical activity may have far reaching positive associations with many known and unknown factors that contribute to academic achievement in students.

Negative relationship between BMI and academic achievement. Some studies have found that a negative relationship may exist between BMI and academic achievement in student populations. Castelli, Hillman, Buck, and Erwin (2007) found a negative correlation between BMI and academic performance across grade levels in both male and female students. Offering support to this position, Kaestner and Grossman (2008) found that overweight children demonstrated no significant differences in academic achievement test scores from their peers who displayed healthy body weights. Agarwal, Bhalla, Kaur, and Babbar (2013) conducted a study on the effects BMI may have on cognition of first-year medical students in a medical college located in northern India. These researchers found that there were no significant correlation between BMI and cognition among these medical students. They also found that there was no correlation between a student's physical level of self-concept and academic performance. Being obese had little negative effect on the self-perception of the Indian medical students who participated in this study. The assumed reasoning for this outcome is that obesity in many Indian cultures does not seem to have a negative stigma. Despite being obese or overweight, students still had a positive perception of themselves and were able to perform as well in their academics as did their favorable weight peers. These findings do not correspond with those of Keating, Castelli, and Ayers (2013) and Ho et al., (2011) indicating that there may be a cultural aspect at

play here that is not represented in the research design of these studies. Regarding BMI and academic achievement, it is evident that future research should study these variables to construct a research design that allows for the discovery of potential cultural implications.

Continuing with this line of research findings, Kaestner, Grossman, and Yarnoff (2011) stated that there is little indication to believe that weight status has any influence on educational success, either poorly or positively. Body weight status, according to these researchers, also had no substantial influence on grade improvement or on the decision of teenagers to drop out of school. All in all, these studies draw interesting conclusions that clearly call for more research to be done, not just in the area of physical activity as it relates to academic achievement, but also into the many variables surrounding each, as they seem to have some impact on these outcomes in an academic setting.

Physical Activity and Government Policies

This section will look at research in order to discuss the role of government policies in increasing or decreasing the physical activity participation of students in the United States. Most of the studies found here demonstrate a negative correlation between time spent in physical activity programs and government policies designed to improve the academic achievement of students.

According to a 2011 study, numerous positive physical activity and fitness methods were linked with higher MAP scores, which supported the curriculum and policy program of the school district, which was designed to apply more focus to the development of healthier lifestyles in students (Edwards, Mauch, & Winkelman, 2011). Trudeau and Shephard (2008) also concluded that,

> Physical activity can be added to the school curriculum by taking time from other subjects without risk of hindering student academic achievement. On the other hand, adding time to academic or curricular subjects by taking time from physical education programs does not enhance grades in these subjects and may be detrimental to health (p. 10).

The Physical Activity Across the Curriculum (PAAC) methodology has been found to possibly encourage daily physical activity in elementary school children and may also improve the academic achievement standing of students (Donnelly et al., 2009). Additionally, Donnelly et al. (2009) suggested that in order to optimize academic outcomes, physical activity should be included in the curriculum of any school, as it has been shown to help improve the academic achievement of students, when managed by trained physical activity educators.

Robertson-Wilson, Dargavel, Bryden, and Giles-Corti (2012) reviewed thirteen different articles which examined school-based physical activity guidelines that have been implemented for students over the past decade. This unique investigation "examined or was related to physical activity behavior; applied to a youth population in a school setting; highlighted a law, bill, or policy reflective of physical activity based on government initiatives; and involved an evaluation." (Robertson-Wilson et al., 2012, p. 644). These researchers found seven studies that highlighted the Child Nutrition and Women, Infants, and Children Reauthorization Act of 2004, while the six remaining studies emphasized state-level policies as they relate to physical activity-only initiatives. Only eight articles assessed governmental policy implementation, and three studies assessed the quality of policy execution. Additionally, only two of the articles that were analyzed evaluated the overall influence of the policies. The conclusion of the authors stated that

policies in fact do affect health outcomes and therefore should be purposefully developed and implemented (Robertson-Wilson et al., 2012). The findings of this study are significant because they emphasize the call for policy development and implementation, as well as the need for great attention to be displayed by the many independent bodies designated to govern those policies. These findings also call for governmental bodies to closely and carefully evaluate physical activity policies in schools, as they have been shown to affect health outcomes of students.

Significant Racial Difference

Keating et al. (2013) found that Caucasian and Latino college students tend to engage in more weekly physical activity than their Asian peers do. The researchers mention that it is possible that Asian parents do not place similar value on their children's athletic and physical engagement. This is especially true in the case of Asian females. Additionally, Asian women do not generally prefer to exercise using strength exercises (Hanson, 2005). College students in a recent study were found to exercise approximately 3.5 days per week. The researchers found out that black females tend to be the least active group out of all college students studied (McArthur & Raedeke, 2009). And in conclusion, according to Strayhorn (2010), academic "achievement prior to college matters most for Latino males, while African American males reap significant benefits from their socioeconomic standing and involvement during college" (p. 332). More research should be done in this area to identify more substantial racial factors that may exist, as they are associated with academic achievement and physical activity in college populations.

Gender of College Students and Academic Achievement

It is important to include gender as a factor that could potentially influence the academic achievement of college students. Obese females have been found to demonstrate higher academic performance than do obese males, according to Agarwal et al., (2013). However, this study does not take into account the participant's physical activity level, only their status as obese, which allows for some criticism to be applied to the study, in that physical activity has been shown to produce positive effects on a student's cognition (Hillman et. al. (2008). Carlson et al. (2008) concluded that females with higher numbers of physical education classes have a positive correlation to academic achievement as compared to males. Male college students exceeded females when it comes to the levels of engagement concerning physical activity (Al-isa et al., 2011). So (2012) stated that dynamic bouts of physical activity were positively linked to academic performance outcomes in a male population.

In contradiction of these findings, Keating et al. (2013) found that there is no substantial difference in the engagement of weekly strength exercise sessions between female and male college students. This would support the notion that both female and male college students are involved in a similar number of strength exercise sessions per week. Earlier studies have suggested that differences should be easily identified between the two genders, as they tend to have different body image ideologies. However, to highlight what may in fact be the most important outcome to focus on, So (2012) found that physical activity was positively associated with academic performance in both male and female students. Even so, it is important to note that each study carries its own limitations that beg for more research to be conducted. While So conducted a robust study including 75,066 Korean students, limitations in the research design

must be noted. This study used information gathered in the 5th Korea Youth Risk Behavior Web-based Survey (KYRBWS-V) project, conducted in 2009, and there was no effort made to identify a cause-and-effect relationship between the variables of physical activity and academic performance. While there is a great focus on research being conducted in this area, this body of research seems to be primarily demonstrating that positive associations between physical activity and academic achievement do exist in both male and female populations.

Summary and Conclusion

This review of relevant literature associated with the many factors surrounding physical activity and academic achievement revealed that there are still a great many aspects of both physical activity and academic achievement that have not been conclusively examined in the literature. The literature did seem to have substantial support for the notion that there tends to be a positive relationship between regular engagement in physical activity and positive academic outcomes. Most of the studies mentioned here used a correlational design and demonstrated a positive relationship between physical fitness and academic achievement.

What is clear both in the research and within the policies put forth by governmental bodies is that there is emphasis on preparing children to take and successfully pass standardized tests. As such, school administrators are beginning to incorporate effective evaluation strategies to assess the quality of these programs, so that the students can be given an advantage as schools work to improve standardized test scores. Some school districts in the United States have reduced their students' time spent in physical education and have focused instead on increases in classroom instruction time as a means of improving test scores. Other school districts have

prioritized time allotted to physical education and physical activity programs and have maintained or slightly reduced classroom instruction time.

The review of literature provides plenty of studies that both support and refute the notion that there is a positive relationship between physical fitness and academic achievement among students in all educational levels. However, a majority of studies have been found to support the hypothesis that there is a positive and significant relationship that exists between factors concerning physical fitness and academic achievement. Research concludes that regular physical activity improves brain functioning, particularly in the area of cognition and memory, but also improves the ability of students to focus for longer durations than their inactive peers. The literature also demonstrates that engaging in regular aerobic fitness activities provides a positive and significant relationship with academic achievement in students. However, most research falls short of further explaining the relationship between these variables. More research should be conducted that looks not only at the questions surrounding physical activity and academic achievement, but also the many variables associated with these factors, as the research shows that any possible relationship may be affected by other variables, such as, but not limited to, age, gender, race, and even geographic location.

Chapter 3:

Methodology

The purpose of this study was to determine whether or not physically active college students are more successful academically their inactive peers. The variables of physical activity level and academic achievement (GPA) were gathered to satisfy the data needed to address the primary research question. Secondary research questions were asked in order to determine if the secondary variables of age, gender, race or geographic location had any bearing on whether or not physically active college students are more successful academically than their inactive peers. These secondary questions were:

- Are there differences in FIT scores by geographic area?
- Are there differences in FIT scores by gender?
- Are there differences in FIT scores by race?

A survey was issued to 10,000 active college students eighteen years of age or older. The survey was issued by classroom instructors to students attending college in all states and recognized territories of the United States of America. Data collection spanned a two semester (fall and spring) period of time, and all data received was suitable for the purposes of this study, with no data from the submitted surveys being excluded. Statistical analysis was conducted on the two primary variables of physical activity level and academic achievement scores (GPA). This data was organized by conducting a quintile split, where groups of an equal number of participants were categorized by FIT scores and then compared with one another based on GPA. Additionally, statistical analysis was conducted using the secondary variables of age, gender,

race, and geographic location, to determine if there were any discrepancies between or among these groups that was not identified in the analysis of the two primary variables.

Appropriateness of the Research Design

This research project was of correlational and quantitative design. This was the ideal methodology to use for the research question of this dissertation, because it allowed the researcher to accurately analyze the data to find correlational instances that could be quantified using statistical analysis, with high levels of accuracy and no possibility of researcher bias tainting the findings of the data. The correlational research design was appropriate for this project, as the research question sought to discover if a relationship existed between different variables. The quantitate research design was appropriate because the research project's method of survey data collection lent itself to being analyzed completely and without exception through the use of descriptive statistical analysis.

Research Design

The online survey was designed around the information needed to satisfy the data collection requirements for the four research questions of this study. The eleven question survey consisted of the following questions:

1. Do you consent to participate in this survey?

This question followed an informed consent message notifying each student of the purpose of this study, what their voluntary role would be, and of any potential risks of participation. If the participant answered "no," the survey automatically ended with a message thanking them for their participation and allowing for no further data collection. If the participant answered "yes," they were allowed to continue on to the next question.

2. In what state do you currently attend college?

This demographic information was important to address the secondary research questions concerning FIT scores attained by students in one of four geographic areas.

3. What is your cumulative grade point average (GPA)?

This question was designed to collect data that would be needed to address the need to know each participant's academic achievement level, which was defined as grade-point average.

4. What is your age?

This survey required students to be eighteen years of age at minimum. Therefore, anyone younger than eighteen years of age did not have an age option to choose and could not complete the survey.

5. Are you male or female?

This question was included to allow for data collection regarding FIT scores by gender. There was a write-in area that allowed participants to define how they identified themselves should they not identify as male or female.

6. What is your race?

This question allowed for data collection to address the secondary research questions concerning FIT scores by race. Seven common racial classifications were provided, with an "other" section to write-in a race that may not be listed. Participants were notified that they were free to choose more than one of the racial options provided, should they identify with more than one.

7. How much do you weigh?

This question was designed to collect data that may be used as part of follow-up questions. This information could prove useful for future research being conducted using this same data set.

8. What is your height in feet and inches?

This question was included to collect data that could prove useful in the development of secondary research questions. It was not used to address the research questions of this study. However, this information could be useful for future research using this set of data.

9. How often do you exercise?

This question was necessary to satisfy the exercise frequency variable required by the FIT Index of Kasari. The answer options ranged from six or more times per week to less than one time per month.

10. With what intensity do you usually exercise?

This question was also necessary to include in order to provide information needed by the FIT Index of Kasari. Possible answers ranged from light movement such as walking or bowling to high intensity activities such as heavy weight lifting, boxing and sprinting.

11. How long do you usually work out?

This question was needed to satisfy the needed variable of time for the FIT Index of Kasari (Kasari, 1976). Possible answers ranged from less than ten minutes per workout to more than thirty minutes per workout.

Once submitted, the survey concluded with a message thanking the students for their participation. Cookies embedded in the survey prohibited any computer from submitting more

than one completed survey. This step was taken to limit the possibility of one student submitting multiple surveys.

This project contained one dependent variable across all statistical analysis and data sets. The dependent variable was FIT score. Cronbach's alpha test of reliability was conducted on FIT scores. The reliability coefficient for FIT scores was $\alpha = .74$, indicating acceptable reliability. Validity measures for FIT scores were supported by use of the FIT Index of Kasari in a number of research studies conducted since it was developed by Kasari (1976); it is used in studies by Strydom et. al. (1991), Van der Merwe (1995), Heyward and Stolarczyk (1996), Van der Westhuizen (1997), Boshoff (1998), Fourie (1999), Rabie (1999), Wilders and Strydom (2003), Sponchiado (2007), McKune et. al. (2009), as well as Wentzel and McKune (2013).

The FIT score is a standardized table that categorizes a person's physical activity level as a score ranging from 1 to 100. Independent variables, each statistically analyzed with the FIT score, were academic achievement (GPA), gender, race, age, and geographic location of college attendance. Statistical significance, used to reject or fail to reject a null hypothesis, was determined using an alpha value of .05.

Setting and Participants

This research project was conducted using an online survey that was distributed via email to 7,180 college professors in all states and recognized territories of the United States of America to voluntarily distribute to their students. Participants were required to be currently enrolled college students who are at least eighteen years of age. The sample of participants in this study was 10,000 currently enrolled college students. Colleges were selected due to the convenience in accessing email lists of their faculty and department heads. Most institutions accepted the

Institutional Review Board approval provided by the University of New Orleans allowing this project to be conducted using human subjects. However, a number of universities did require submission of a request for research to their Institutional Review Board for approval. All requests for research using students at a given institution were granted. When possible, a diligent attempt was made to request participation from professors of rural colleges and universities and then from those of urban colleges and universities within a given state or territory in order to attain a balance between urban and rural student participants. This was done to attempt to provide opportunities for participation to a wide and diverse group of students representing as many areas of each state or territory as possible. Due to the anonymous nature of the survey, it is not possible to determine the college or university from which the various survey participants came.

Instrumentation

The primary instrument used to classify participant FIT scores was the FIT Index of Kasari (Kasari, 1976). Cronbach's alpha test of reliability was conducted on FIT scores. The reliability coefficient for FIT scores was $\alpha = .74$, indicating acceptable reliability. FIT scores were composed by taking the product of the following three Likert-scaled survey questions: frequency (*how often do you exercise*), intensity (*with what intensity do you usually exercise*), and time (*how long do you usually work out*). FIT scores can range from 1 to 100, where higher scores indicate a more physically active person; it was then treated as a continuous variable.

Table 3.1. *The FIT Index of Kasari*

Parameters: ***(1) frequency of exercise, (2) intensity of exercise, (3) time spent on workout***

Parameter	Finding	Points
Frequency	>/= 6 times per week	5
	3 - 5 times per week	4
	1 - 2 times per week	3
	a few times per month	2
	less than one time per month	1
Intensity	High intensity activities that cause sustained heavy breathing and perspiration (high impact aerobics, running, speed swimming)	5
	Moderately high aerobic activities, intermittent sports activities that result in sustained heavy breathing and perspiration (step aerobics, speed walking, tennis, racquetball, squash)	4
	Moderate aerobic activities (normal bike riding, jogging)	3
	Low to moderate aerobic and sports activities (recreational volleyball)	2
	Light aerobic exercise (normal walking, golfing)	1
Time	> 30 minutes	4
	20 – 30 minutes	3
	10 – 20 minutes	2
	< 10 minutes	1

FIT index = (points for frequency) x (points for intensity) x (points for time)

Interpretation:
• minimum score: 1
• maximum score: 100
• The higher the score, the more physically active the person.

Limitations:

• Serious athletes could attain the maximum FIT score.
• Participants who were injured or are unable to exercise through no fault of their own, but who would otherwise exercise regularly, may have displayed a low FIT score.

Procedure

Professors and their students were invited to participate in this study through a request letter emailed directly to 7,180 professors. This request letter is illustrated in Appendix A. It is unknown how many professors participated in this study by distributing the survey to their students. Very few completed surveys were submitted in the initial weeks of distribution, despite approximately 100 professors being emailed each day. However, during the third week of survey participation requests, the completed survey frequency increased considerably and continued to snowball throughout the data collection process. Toward the end of the second semester of data collection, it was clear that approximately 10,000 completed surveys would be submitted. This was the reasoning for the size of the sample size of this study, as it was merely a matter of time remaining for data collection and incoming survey completion frequency.

Data was collected using a survey developed on the Survey Monkey web platform, illustrated in Appendix B. The survey settings were designed so that the survey collected only data pertinent to the research project, with no data being collected that could in any way identify the participants. Upon gaining agreement from college professors to share the survey with their students, a specific URL (website link) was sent to the professors who then emailed it, or posted it online, for their students to participate. The survey's introduction page clearly outlined that participation was voluntary and carried no reward, while decisions not to participate carried no penalty. Participating students were required by the survey settings to complete the entire survey, or the survey could not be submitted. Upon submission of the survey, the data was collected by the Survey Monkey platform and was then exported into a Microsoft Excel file so that statistical analysis of the data could be conducted.

The Institutional Review Board (IRB) found this research design to be of minimal risk to participants and that any magnitude or probability of discomfort or personal harm that may be anticipated during participation in the research project was not any greater than they would have in any ordinary, daily life situation. The IRB found the study to be compliant with regulations for conducting research using human participants.

Analysis and Data Processing

The survey data was entered into SPSS v.21.0 for Windows. Descriptive statistics were then conducted to describe the characteristics of the data sample. Percentages and frequencies were displayed and presented for categorical data, which included college state, gender, race, frequency, intensity, and time. Means and standard deviations were calculated for all continuous variables, which included GPA scores, age, weight (in pounds), height (in feet), and FIT scores.

Data was screened for inclusion criteria and univariate outliers. The following inclusion criteria were met for all participants in the study: must be 18 years of age or older and currently attending college. The responses from the participants who did not meet the inclusion criteria were then removed from the study. Univariate outliers were assessed on the continuous variable of interest: FIT scores. Outliers were examined by standardizing the scores and checking for values (or *z* scores) above 3.29 or below -3.29 (Tabachnick & Fidell, 2012). Any and all outliers that were found were then removed from the data set.

Internal consistency analysis was then conducted in order to establish values of reliability on FIT scores. The reliability measure determined that the scores computed by the online survey instrument used in the study was meaningful, useful, and had a purpose. This confirmed that the survey instrument was reliable. The Cronbach's alpha test of reliability gave values for the mean

correlation (displayed as an alpha coefficient) between all item pairs and the exact number of items found in a scale (Brace, Kemp & Snelgar, 2006). The reliability analysis for the FIT Index of Kasari (Kasari, 1976) was conducted on FIT scores. This instrument's reliability was determined following the guidelines laid forth by George and Mallery (2010): alpha coefficients may fall within a range from unacceptable to excellent where > .9 is excellent, > .8 is good, > .7 is acceptable, > .6 is questionable, > .5 is poor, and ≤ .5 is not acceptable.

Ethical Considerations

Participant identities remained anonymous, ensuring they could not be individually identified by any of the data collected for this research project. The IRB deemed this research design to be of minimal risk to volunteer participants. All participants completed the survey with the knowledge that participation was voluntary and offered no reward or penalty for participation or non-participation. Data collected through the survey was secured in an online password-protected account.

Validity

A number of studies have used The FIT Index of Kasari as a research instrument providing evidence of external validity. This is assumed, in that these researchers have found the data from the Index of Kasari to be generalizable across populations of people. In all instances, these studies have found the Index of Kasari to produce an analysis that may be generalized. In particular, the FIT Index of Kasari has appeared in a number of research studies conducted since its development by Kasari (1976). It is often referenced as the physical activity index of Sharkey (1984) and is used in studies by Strydom et. al. (1991), Van der Merwe (1995), Heyward and Stolarczyk (1996), Van der Westhuizen (1997), Boshoff (1998), Fourie (1999), Rabie (1999),

Wilders and Strydom (2003), Sponchiado (2007), McKune et. al. (2009), as well as Wentzel and McKune (2013).

Summary

This correlational, quantitative research design used an online self-reported survey to gather data from 10,000 currently enrolled college students aged eighteen years and older. Self-reported variables did raise some concerns about the truthfulness of the data collected, as each anonymously submitted response could not be verified for accuracy. The self-reporting nature of this survey casts some doubt on the accuracy of the data, as participating students could have been dishonest, whether knowingly or unknowingly, with the answers they provided. Various statistical analysis methods were used on this data set, concerning a number of variables, including FIT score, academic achievement (GPA), age, gender, race, and geographic location of college attendance. The data was organized using a quintile split, with 2,000 participants listed by FIT score in each of five categories. This allowed for the GPA of each group to be closely studied and then compared against one another. The primary and secondary research questions were answered by either rejecting or failing to reject the null hypothesis in the next section.

Chapter 4:

Results

Data Screening

Data were collected from 10,000 voluntary participants and screened for inclusion criteria and univariate outliers. Data were assessed to ensure the following inclusion criteria were met: participants must be 18 years of age or older and currently attending college at that the time data were collected. All 10,000 participants met the inclusion criteria. Univariate outliers were assessed on the continuous variable of interest: FIT scores. Outliers were examined by standardizing the scores and checking for values (or *z* scores) greater than 3.29 and less than -3.29 (Tabachnick & Fidell, 2012); no outliers were found in the data set. The responses submitted by all 10,000 students were then examined in the study.

Descriptive Statistics

The majority of students were female (6,859, 69%) and White (7,886, 79%). Many students attended college in the NE region (3,639, 36%) of the United States. When asked how often they exercised, 3,740 (37%) students indicated 3-5 times per week. When asked with what intensity they usually exercise, 3,289 (33%) students indicated moderately high. The majority of students worked out more than 30 minutes per workout (6,505, 65%). Frequencies and percentages for students' demographics are presented in Table 4.1; frequencies are presented visually in Figures 4.1 – 4.6.

Table 4.1. *Frequencies and Percentages of Students' Demographics*

Demographic	*n*	%
College state region		
NE	3,639	36
NW	1,616	16
SE	2,471	25
SW	2,274	23
Gender		
Male	3,141	31
Female	6,859	69
Race		
American Indian or Alaska Native	307	3
Arabic or Middle Eastern	159	2
Asian	733	7
Black or African American	704	7
Hispanic or Latino	766	8
Native Hawaiian or other Pacific Islander	121	1
White	7,886	79
Other	78	<1
Missing	2	<1
How often do you exercise		
Less than one time per month	768	8
A few times per month	1,893	19
1 – 2 times per week	2,511	25
3 – 5 times per week	3,740	37
6 or more times per week	1,088	11
With what intensity do you usually exercise		
Light aerobic exercise	1,172	12
Low to moderate aerobic and sports activities	1,040	10
Moderate aerobic activities	2,821	28
Moderately high aerobic and sport activities	3,289	33
High intensity activities	1,678	17
How long do you usually work out		
Less than 10 minutes per workout	389	4
10 – 20 minutes per workout	710	7
20 – 30 minutes per workout	2,396	24
More than 30 minutes per workout	6,505	65

Note. Percentages might fail to total 100 due to various reasons, such as rounding errors or the fact that participants were allowed to select multiple responses.

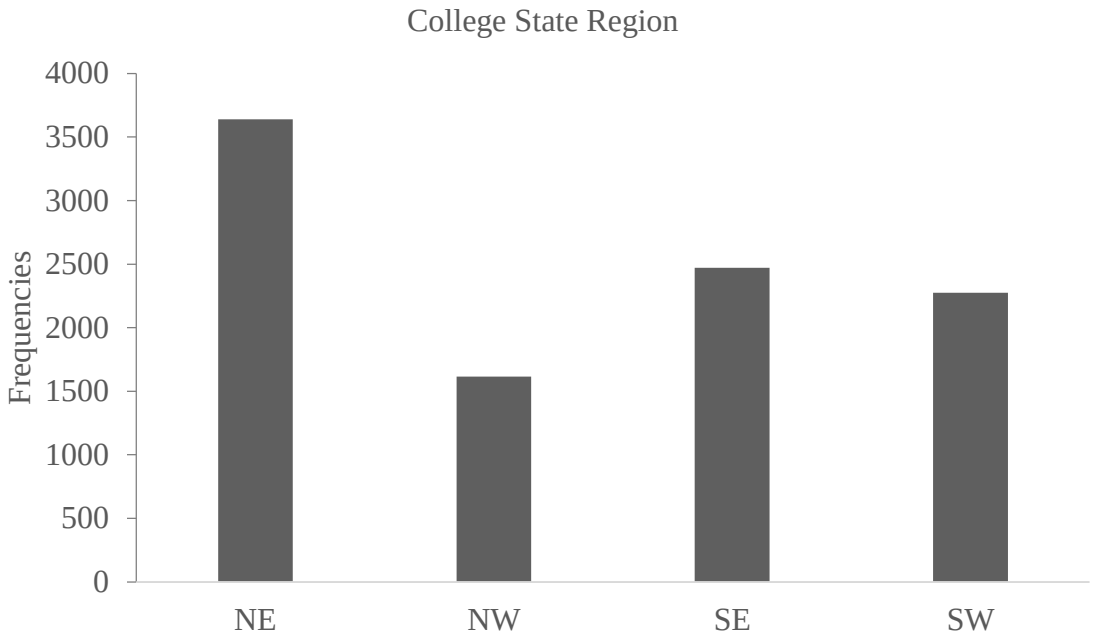


Figure 4.1. Frequencies on college state region.

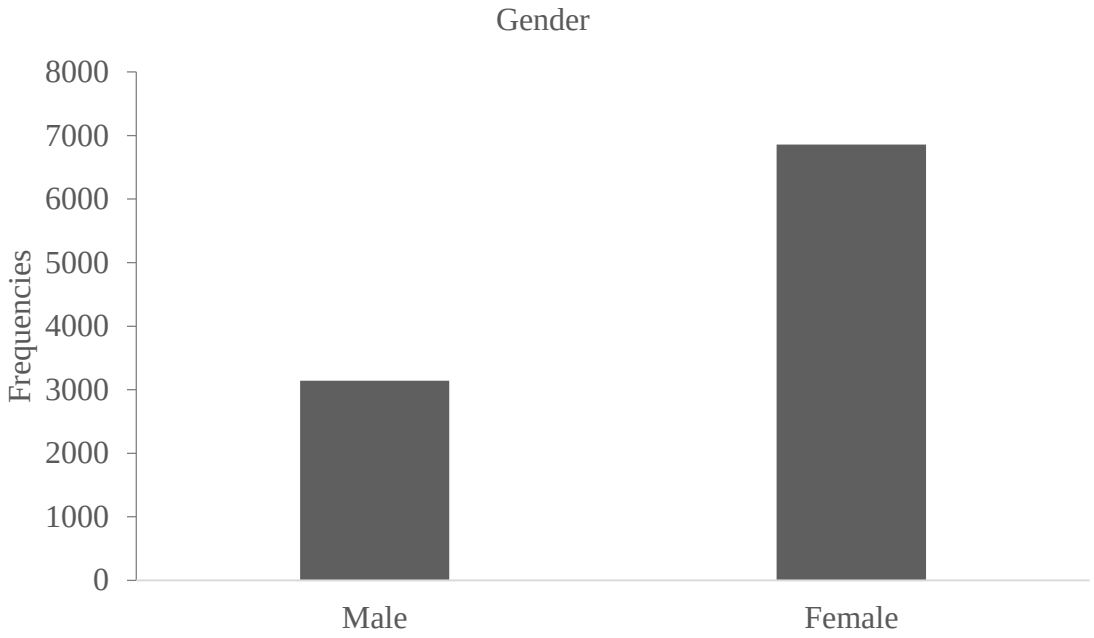


Figure 4.2. Frequencies on gender.

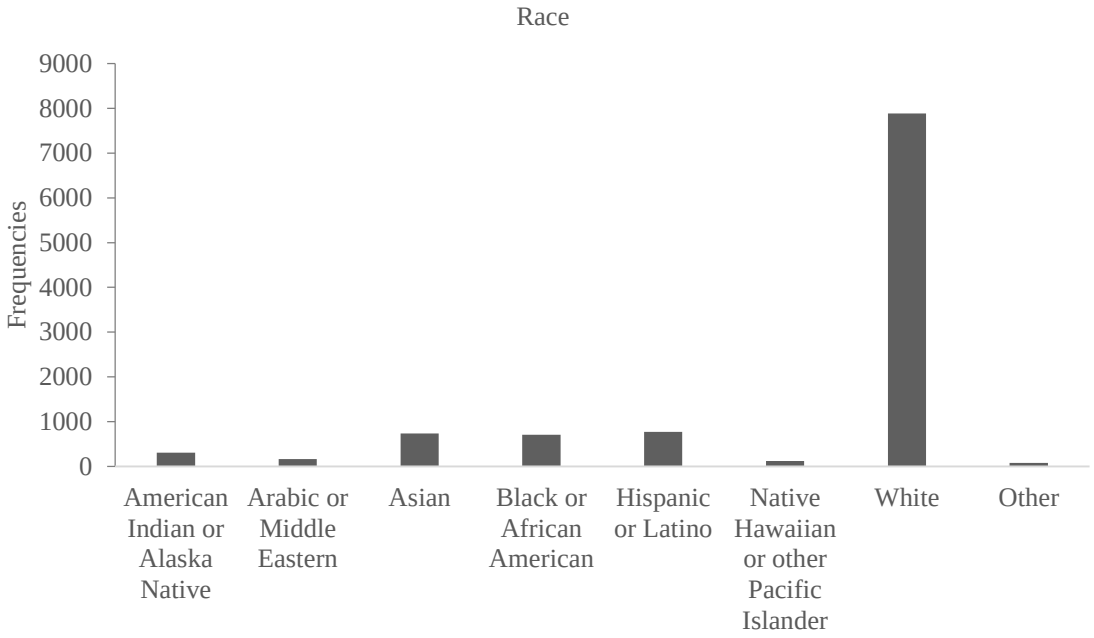


Figure 4.3. Frequencies on race.

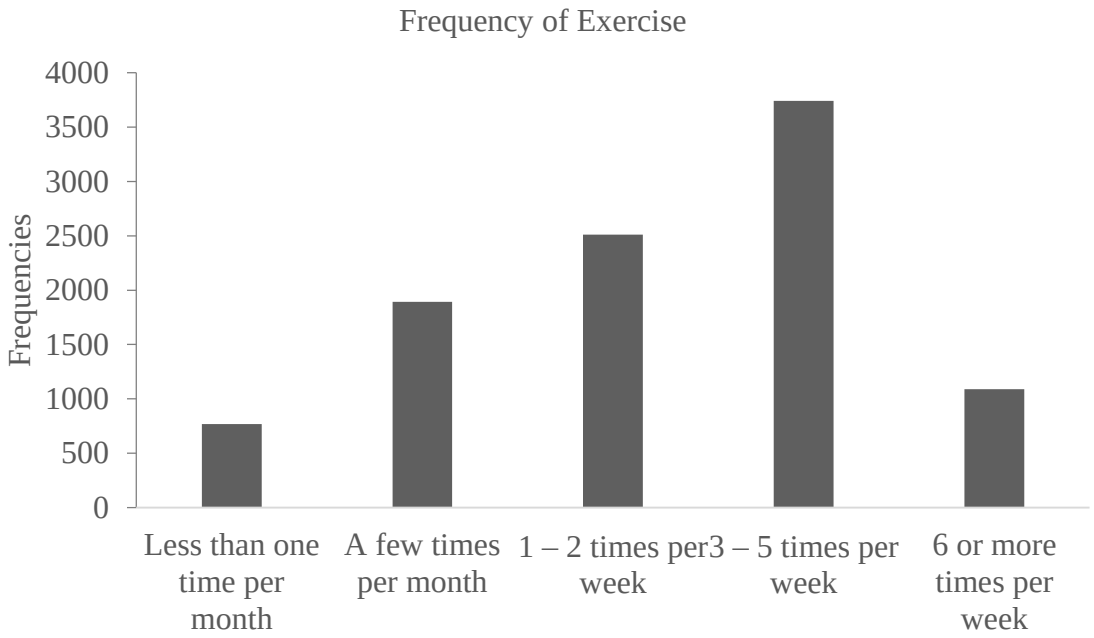


Figure 4.4. Frequencies on frequency of exercise.

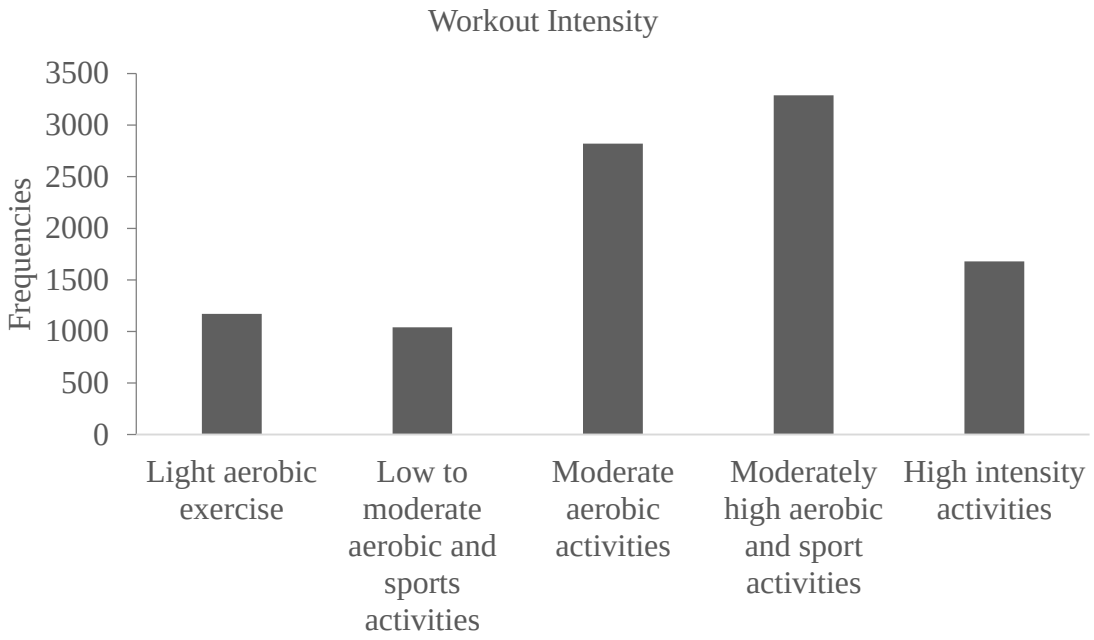


Figure 4.5. Frequencies on workout intensity.

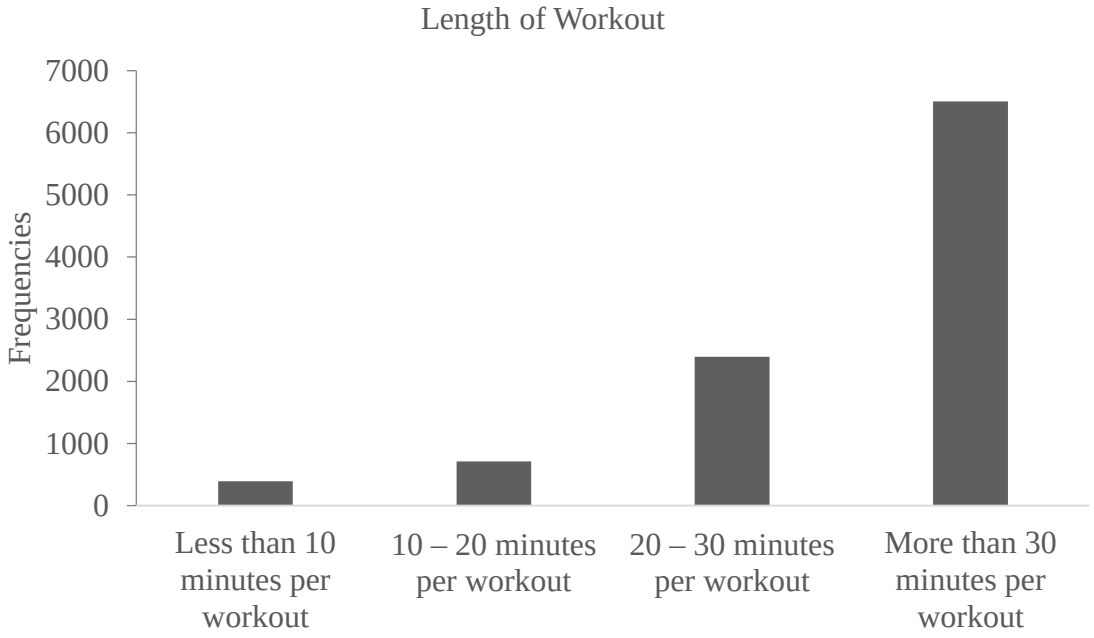


Figure 4.6. Frequencies on length of workout.

GPA scores ranged from 0 to 4, with mean (*M*) = 3.40 and standard deviation (*SD*) = 0.47. Weights (in pounds) ranged from 80 to 485, with *M* =158.29 and *SD* = 39.63. Total height (in inches) ranged from 50 to 83, with *M* = 66.90 and *SD* = 3.94. Means and standard deviations on students' demographic variables are displayed in Table 4.2.

Table 4.2. *Ranges, Means and Standard Deviations on Students' Demographics*

Variable	*Min.*	*Max.*	*M*	*SD*
GPA	0	4	3.40	0.47
Weight (in pounds)	80	485	158.29	39.63
Total height (in inches)	50	83	66.90	3.94

The approximate distribution of GPA scores displayed a moderately left skew, as the longer tail at the left side shows in Appendix D. This indicated that a GPA of 1.0 or less is rare and that the majority of students have a GPA at or above 3.0. The reason for this skewed GPA data was unclear. It could be that students using the self-reporting survey were dishonest and did not truthfully list their GPA as very low, or perhaps grade inflation within institutions indicate grades to be higher than they really should be. Lastly, this skew in GPA may be attributed to low academic performers dropping out or being suspended from school or possibly abstaining from participation in this self-reporting survey altogether.

FIT scores (Kasari, 1976) were created by using the product of frequency of exercise, workout intensity, and length of workout. FIT scores ranged from 1 to 100, with *M* = 42.98 and *SD* = 27.28. Cronbach's alpha test of reliability was conducted on FIT scores. The reliability coefficient for FIT scores was $\alpha = .74$, indicating acceptable reliability (George & Mallery, 2010). Descriptive statistics on FIT scores, along with Cronbach's alpha test of reliability coefficient, are presented in Table 4.3.

Table 4.3. *Range, Mean, Standard Deviation and Reliability Coefficient on FIT Scores*

Variable	*Min.*	*Max.*	*M*	*SD*	Cronbach's α	No. of items
Fit scores	1	100	42.98	27.28	.74	3

Research Question One

Are physically active college students more successful academically than their inactive peers?

$H_0$1: There is no significant correlation between GPA scores and FIT scores.

H_a1: There is a significant correlation between GPA scores and FIT scores.

Research question one was addressed using a Pearson product-moment correlation analysis to discover if a statistically significant relationship exists between GPA scores and FIT scores. Statistical significance using an alpha value of .05 was determined. Prior to conducting any analysis, the assumptions of the Pearson correlation concerning linearity and homoscedasticity were displayed via scatterplots (Stevens, 2009). Deviations from linearity were noted in the scatterplot between GPA and FIT scores, thus violating the assumption. The residuals scatterplot was not roughly rectangular shaped and a non-random pattern was depicted, thus violating the assumption. Because the assumptions were not met, the non-parametric alternative to the Pearson correlation was conducted: Spearman rho correlation. Spearman rho correlation results indicated no association between GPA and FIT scores, r,(10000) = .004, p = >0.05. This indicated that there is not a significant relationship between GPA and FIT scores in this college population. The result of the Spearman correlation is presented in Table 4.4. The correlation findings of the Spearman correlation do reveal a lack of correlation between physical activity and GPA among college students, but does not sufficiently answer the primary research question. The lack of correlation between the two primary variables does not necessarily mean

that there are no relationships to be found between specific groups of students falling into defined categories using these variables. Additional statistics were required to more adequately address the primary research question.

Table 4.4. *Spearman Rho Correlation Between GPA and FIT Scores*

Variable	FIT scores
GPA	.004

Note. * $p < .01$, ** $p < .001$.

To further analyze this question, the data was sorted by FIT scores ranging from the lowest score of 1 to the highest score of 100. The data was then split into five equal categories using a quintile split, with each containing 2,000 participant FIT Scores. Table 4.5 outlines the frequency and percentage of students falling into each of these five unique categories, and both the mean and standard deviation of cumulative GPA of each category.

Table 4.5. *Frequencies and Percentages of FIT Scores and Cumulative GPA*

Physical Activity Category	*n*	*%*	*Mean GPA*	*SD*
Group 1 - Very Low Activity	2000	20	3.37	.51
Group 2 - Low Activity	2000	20	3.39	.47
Group 3 - Active	2000	20	3.41	.47
Group 4 - High Activity	2000	20	3.43	.45
Group 5 - Very High Activity	2000	20	3.38	.46

Note. Percentages may not sum to 1 due to rounding.

The means and standard deviations, as well as the range of values for FIT scores, are outlined in Table 4.6. Since categories of equal size were chosen, some participants fell into different groups while having the same FIT scores. Those participants who had FIT scores found in multiple categories were assigned a category based on the order in which they were listed in the sorted data. The FIT score ranges for the groups were from 1 to 16 for group 1, 16 to 32 for

group 2, 32 to 48 for group 3, 48 to 64 for group 4, and 64 to 100 for group 5. Each of the five groups were associated with a physical activity level. These physical activity level and group number associations are listed in Table 4.5 and Table 4.6. The largest FIT score range of group five versus the smaller FIT score ranges in the first four groups demonstrated that the majority of the observations had FIT scores falling below 64. Appendix D depicts a histogram of FIT Scores.

Table 4.6. *Means, Standard Deviations, and Ranges of FIT Scores by Physical Activity Category*

Physical Activity Category	*n*	*M*	*SD*	*min*	*max*
Group 1 - Very Low Activity	2000	7.69	4.64	1	16
Group 2 - Low Activity	2000	24.32	4.89	16	32
Group 3 - Active	2000	41.20	5.90	32	48
Group 4 - High Activity	2000	58.74	7.06	48	64
Group 5 - Very High Activity	2000	82.92	12.21	64	100

Note. Percentages may not sum to 1 due to rounding.

In analyzing the data to determine whether significant differences existed in the GPA scores between the five physical activity categories in the quintile split, a one-way ANOVA was conducted; however, the assumption of normality was violated for GPA, the dependent variable. This is illustrated by the strong deviations of the sample quantiles for GPA from the theoretical quantiles characteristic of a normal distribution, as shown in Appendix E. The histogram in Appendix F illustrates a strong skew to the left in the GPA distribution.

Since the assumption of normality was violated for GPA, a Kruskal-Wallis one-way analysis of variance was performed. The Kruskal-Wallis analysis is the non-parametric equivalent to the one-way ANOVA. The Kruskal-Wallis test makes no assumptions regarding distribution of the data, and it does not assume that there is a linear relationship. The Kruskal-Wallis test uses

only the ranks of the research data to compare differences in the median averages of the groups. Therefore, the null hypothesis is that the distributions are equal for all groups.

The results of the Kruskal-Wallis test showed statistical significance, $\chi^2(4) = 14.426$, $p = .006$. The analysis indicated that there were statistically significant differences between the distributions of GPA for the physical activity groups. Significant differences being found, several Wilcoxon rank-sum tests were performed to determine which of the quintile split groups were significantly different. The results showed significance for three comparisons. The distribution of GPA scores found in group 1 were significantly different from the distribution of GPA scores in group 4 ($W = 1908800$, $p = .012$). The distribution of GPA scores in group 1 were not significantly different from the distribution of GPA scores in group 2 ($W = 1973100$, $p = .459$), group 3 ($W = 1933300$, $p = .066$), or group 5 ($W = 2023800$, $p = .513$). The distribution of GPA scores in group 2 was not significantly different from the distribution of GPA in group 3 ($W = 1959800$, $p = .269$), group 4 ($W = 1935500$, $p = .076$), or group 5 ($W = 2053700$, $p = .140$). The distribution of GPA scores in group 3 was determined to not be significantly different from group 4 ($W = 1977000$, $p = .527$). The distribution of GPA scores in group 3 was significantly different from group 5 ($W = 2097100$, $p = .007$). The distribution of GPA scores in group 4 was significantly different from group 5 ($W = 2120600$, $p = .001$). Table 4.7 provides a summary of the results of the Wilcoxon rank-sum tests.

Table 4.7. *Wilcoxon Rank-Sum Tests for the Differences in GPA by Physical Activity Category*

Group Comparisons	*W*	*p*
1 vs 2	1973100	.459
1 vs 3	1933300	.066
1 vs 4	1908800	.012*
1 vs 5	2023800	.513
2 vs 3	1959800	.269
2 vs 4	1935500	.076
2 vs 5	2053700	.140
3 vs 4	1977000	.527
3 vs 5	2097100	.007*
4 vs 5	2120600	.001*

Note. * = $p < .05$.

Additional investigation of the various group means showed that the mean GPA for group 1 was lower than the mean GPA found in groups 2, 3, and 4. However, the mean GPA in group 5 was found to be less than groups 2, 3, and 4. The statistically significant results of the Wilcoxon rank-sum tests, as well as the analysis of the group mean averages, suggested that college students in physical activity categories, 2, 3, and 4, had better academic achievement scores than did students in categories 1 and 5.

Research Question Two

Are there differences in FIT scores by geographic area?

$H_0$2: There are no significant differences in FIT scores by geographic area.

H_a2: There are significant differences in FIT scores by geographic area.

To directly address research question two, a univariate analysis of variance (ANOVA) was then conducted to discover if any statistically significant differences exist in FIT scores by geographic area. Statistical significance using an alpha value of .05 was then determined. The dependent variable in this analysis was FIT scores and the independent grouping variable in this

analysis was geographic area (NE, NW, SE, and SW). Prior to conducting analysis, the assumptions of normality and homogeneity of variance were analyzed. Normality on FIT scores was then assessed using a Kolmogorov-Smirnov (KS) test and the result was significant, $p < .001$, thus violating the assumption. However, Pallant (2010) suggests that the analysis is robust against the assumption if there are at least 30 subjects for the analysis. The assumption of homogeneity of variance was then assessed by incorporating Levene's test, and the final result was not significant, $p = .126$; the assumption was met.

The ANOVA model resulted in findings that were found to be statistically significant, $F(3, 9996) = 11.40$, $p < .001$, partial $\eta^2 < .00$, indicating that differences exist on FIT scores by geographic area. The ANOVA model's effect size (partial η^2) of less than .00 indicated that very small statistical differences existed in FIT scores among the geographic areas (NE vs. NW vs. SE vs. SW). Post-hoc analyses were then conducted to discover where the statistical differences exist. Students in NW ($M = 46.24$) had statistically higher FIT scores than students in NE ($M = 43.15$), SE ($M = 41.38$), and SW ($M = 42.12$). No other statistical differences were discovered among the geographic areas. The null hypothesis—there are no significant differences in FIT scores by geographic area—was rejected. Geographic areas are defined in Table 4.8. The results of the ANOVA are presented in Table 4.9. Means and standard deviations in FIT scores by geographic area are displayed in Table 4.10. The means are also visually presented in Figure 4.7.

Table 4.8. *States and Recognized Territories by Geographic Area*

NE	NW	SE	SW
Connecticut	Alaska	Alabama	American Samoa
Delaware	Colorado	Arkansas	Arizona
District of Columbia	Idaho	Florida	California
Illinois	Kansas	Georgia	Guam
Indiana	Montana	Louisiana	Hawaii
Iowa	Nebraska	Mississippi	New Mexico
Kentucky	North Dakota	North Carolina	Nevada
Maine	Oregon	Puerto Rico	North Mariana Islands
Maryland	South Dakota	South Carolina	Oklahoma
Massachusetts	Washington	Tennessee	Texas
Michigan	Wyoming	Virginia	Utah
Minnesota		Virgin Islands	
Missouri			
New Hampshire			
New Jersey			
New York			
Ohio			
Pennsylvania			
Rhode Island			
Vermont			
West Virginia			
Wisconsin			

Table 4.9. *ANOVA on FIT Scores by Geographic Area (NE vs. NW vs. SE vs. SW)*

Source	*SS*	*df*	*MS*	*F*	*p*	partial η^2
Region	25368.75	3	8456.25	11.40	.000	.00
Error	7413785.10	9996	741.68	—	—	—
Total	25907832.00	10000	—	—	—	—

Table 4.10. *Means and Standard Deviations on FIT Scores by Geographic Area (NW vs. NW vs. SE vs. SW)*

	NE (N = 3639)		NW (N = 1616)		SE (N = 2471)		SW (N = 2274)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
FIT scores	43.15	27.59	46.24	27.43	41.38	26.68	42.12	27.12

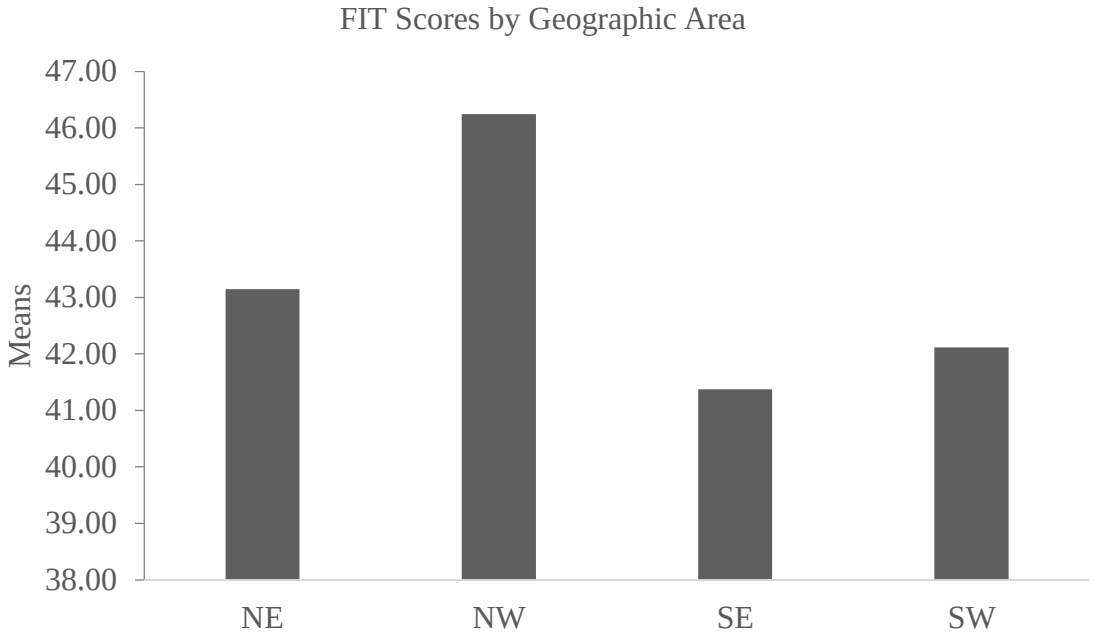


Figure 4.7. Means on FIT scores by geographic area

Research Question Three

Are there differences in FIT scores by gender?

$H_0$3: There is no significant difference in FIT scores by gender.

H_a3: There is a significant difference in FIT scores by gender.

To determine the answer to research question three, an independent sample *t*-Test was proposed to find if a statistically significant difference existed in FIT scores by gender. Statistical significance was then determined using a .05 alpha value. The dependent variable in this analysis was FIT scores. The dichotomous independent variable in this analysis was gender (male vs. female). The assumptions pertaining to normality and homogeneity of variance were assessed prior to analysis. The assumption of normality on FIT scores was assessed in research question two. The assumption of equality of variance was then assessed using a Levene's test and the final

results were found to be significant, $p < .001$, thus violating the assumption; equality of variance was not assumed for analysis.

The results of the independent sample *t*-Test were statistically significant, $t(5487.61) = 19.93$, $p < .001$, *Mean Difference* = 11.99, Cohen's $d = .44$, indicating that differences exist in FIT scores between males and females. The independent sample *t*-Test's effect size (Cohen's *d*) of .44 indicated that a small statistical difference existed in FIT scores between males and females (Morgan, Leech, Gloekner & Barrett, 2007). Males ($M = 51.20$) had statistically higher FIT scores than females ($M = 39.21$). The null hypothesis, stating that there is no significant difference in FIT scores by gender, was rejected. The results of the *t*-Test are presented in Table 4.11. Means are visually presented in Figure 4.8.

Table 4.11. *Independent Sample t-Test on FIT Scores by Gender (Males vs. Females)*

	Males (N = 3141)		Females (N = 6859)					
Source	*M*	*SD*	*M*	*SD*	*MD*	*t*(5487.61)	*p*	Cohen's *d*
FIT scores	51.20	28.89	39.21	25.64	11.99	19.93	.001	.44

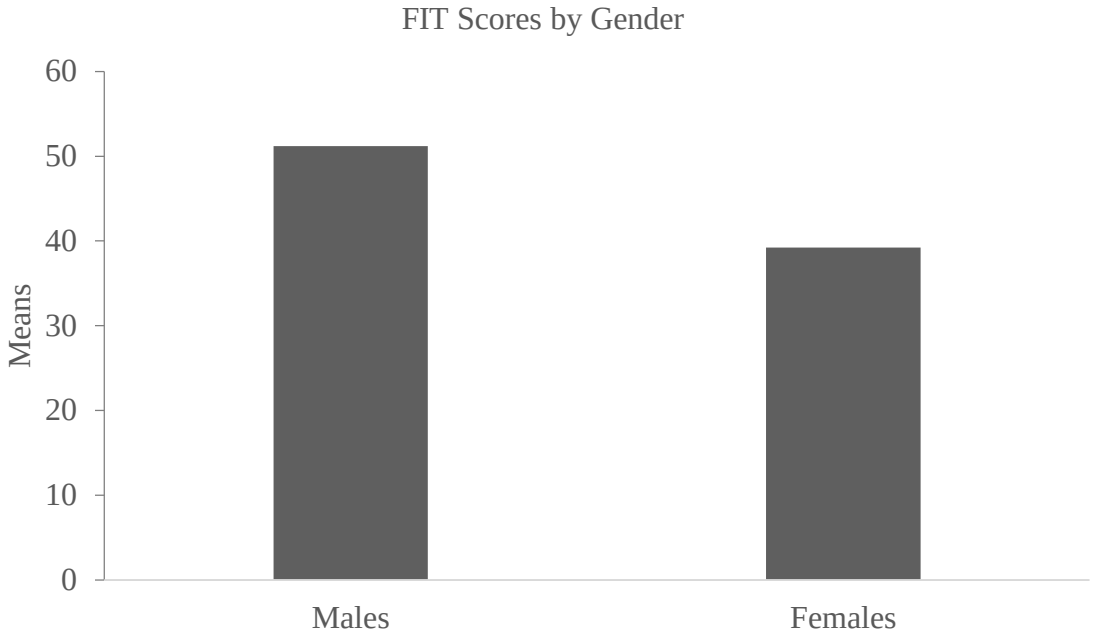


Figure 4.8. Means on FIT scores by gender.

Research Question Four

Are there differences in FIT scores by race?

$H_0$4: There are no significant differences in FIT scores by race.

H_a4: There are significant differences in FIT scores by race.

To adequately address the fourth research question, a univariate analysis of variance (ANOVA) was proposed to determine if any statistically significant differences existed in FIT scores by race. Statistical significance was determined using an alpha value of .05. The dependent variable in this analysis was FIT scores and the independent grouping variable in this analysis was race. Because of the unequal sample sizes of the various racial groups, race was split into the following categories: White vs. other. Because the number of groups for race was reduced to two groups, an independent sample *t*-Test was conducted. Before conducting any analysis, the assumptions of normality and equality of variance were assessed. Normality on FIT

scores was confirmed in research question two. The assumption of equality of variance was assessed by incorporating a Levene's test and the final results were found to be not significant, $p = .475$, thus meeting the assumption.

The results of the *t*-Test were statistically significant, $t(9996) = 5.61$, $p < .001$, *Mean Difference* = 3.45, Cohen's $d = .12$, indicating that differences existed in FIT scores by race (White vs. other). The independent sample *t*-test's effect size (Cohen's *d*) of .12 indicated that a small statistical difference existed on FIT scores between White students and students of other races (Morgan, Leech, Gloekner & Barrett, 2007). White students ($M = 43.89$) had significantly higher FIT scores than students of other races ($M = 40.45$). The null hypothesis—there are no significant differences in FIT scores by race—was rejected. The final results of the *t*-test are presented in Table 4.12. The means are visually presented in Figure 4.9.

Table 4.12. *Independent Sample t-Test on FIT Score by Race (White vs. Other)*

	White (N = 7311)		Other (N = 2687)					
Source	*M*	*SD*	*M*	*SD*	*MD*	*t*(9996)	*p*	Cohen's *d*
FIT scores	43.89	27.12	40.45	27.55	3.45	5.61	.001	.12

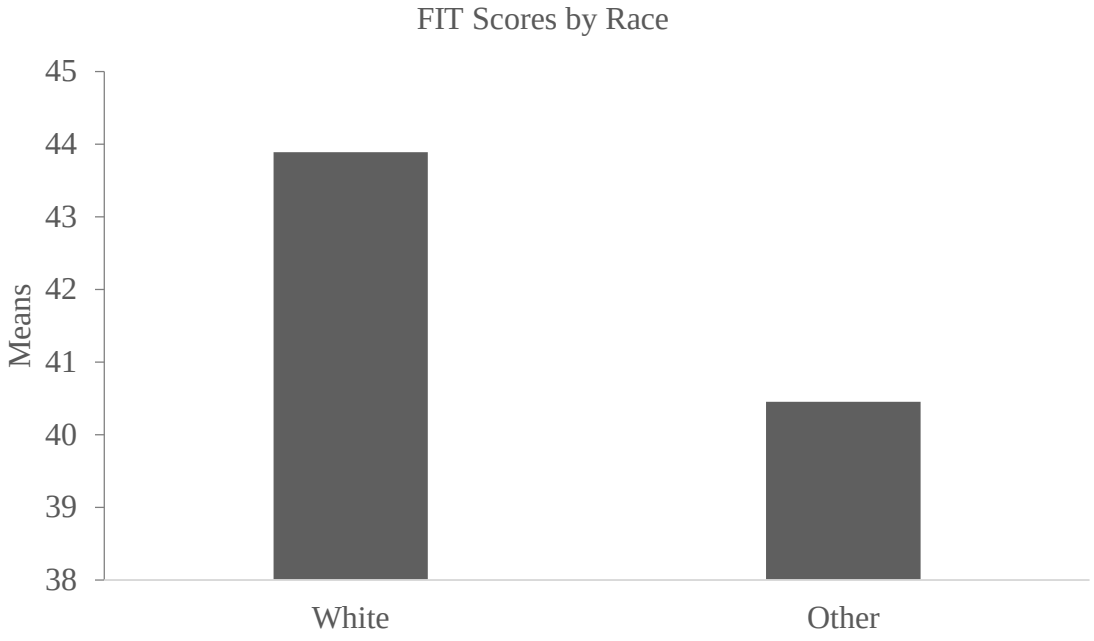


Figure 4.9. Means on FIT scores by race.

Summary

Research question one was assessed with a Spearman rho correlation between GPA and FIT scores. The result of the correlation analysis was not statistically significant, indicating that GPA and FIT scores did not have a statistically significant relationship. Additional statistical analysis was done using a quintile split, which was used to categorize the participants by FIT scores, where each of the five equal categories held exactly 2,000 participants. Wilcoxon rank-sum tests were conducted and yielded statistically significant findings. These findings suggested that college students in physical activity categories 2, 3 and 4, had better academic achievement scores than did students in categories 1 and 5. Interpreting the exact reasons for these statistical findings is a challenge but are important to highlight. The possibility exists that various institutions inflate grades while others ensure more accuracy. Another possibility is that some students' self-reported data that was not true, while others submitted truthful data. There is really

no way to know for certain why the quintile split group data displays in the manner it does. Summarizing the findings, it was determined that students with greater physical activity levels perform better academically, up to a point, before GPA scores fall once again. Students with very low and very high physical activity levels have lower academic achievement than do students who have low physical activity to high physical activity levels. These findings determined that students with physical activity levels in the middle range of FIT scores, specifically FIT scores of 16 to 64, performed better academically than did students of very low physical activity levels, indicated by FIT scores of 16 or less, and very high physical activity levels, indicated by FIT scores of 64 and above. Therefore, the null hypothesis failed to be rejected.

Research question two was assessed with an ANOVA on FIT scores by geographic area (NW vs. NE vs. SE vs. SW). The result of the ANOVA was statistically significant and the null hypothesis was rejected.

Research question three was assessed with an independent sample *t*-test on FIT scores by gender (male vs. female). The result of the *t*-Test was statistically significant and the null hypothesis was rejected.

Research question four was assessed with an independent sample *t*-Test on FIT scores by race (White vs. other). The result of the *t*-Test was statistically significant and the null hypothesis was rejected.

Chapter 5:

Discussion, Recommendations and Conclusions

Are physically active college students more successful academically than their inactive peers? This was the primary research question this study addressed. Secondarily, this study delved further into this question regarding sub-groups of the participants surveyed. This study investigated this question with regard to age, gender, race, and geographic location, to try to determine if there were discrepancies among any of these groups that may not have been evident in the findings of the primary research question.

Methods and Procedures

This study was designed as a quantitative, correlational study. Using an online survey, data was collected from 10,000 voluntary currently-enrolled college students from all states and recognized territories of the United States. The survey asked students to list specific information about themselves, ranging from age, gender, race, height, and weight, to state of college attendance, and frequency, intensity, and duration of physical activity they performed. Upon gathering all the data, descriptive statistics were incorporated to extrapolate specific information regarding these variables as they applied to the research questions.

Major Findings

Research question one was assessed using a quintile split, which categorized the participants by FIT scores. Wilcoxon rank-sum tests were conducted and determined statistically significant findings. According to this analysis, which used a quintile split of the data to categorize participants by FIT score in five equal categories each containing 2,000 students, college students in physical activity categories 2, 3, and 4, had better academic achievement scores than did students in categories 1 and 5. These findings show that students with physical

activity levels falling into the middle range physical activity level, with FIT scores of 16 to 64, have higher academic achievement than students with very low physical activity levels, with FIT scores below 16, and very high physical activity levels, with FIT scores above 64. The null hypothesis failed to be rejected for the primary research question.

Research question two was assessed with an ANOVA on FIT scores by geographic area (NW vs. NE vs. SE vs. SW). The result of the ANOVA was statistically significant and the null hypothesis was rejected.

Research question three was assessed with an independent sample *t*-test on FIT scores by gender (male vs. female). The result of the *t*-test was statistically significant and the null hypothesis was rejected.

Research question four was assessed with an independent sample *t*-test on FIT scores by race (White vs. other). The result of the *t*-test was statistically significant and the null hypothesis was rejected.

Discussion

The null hypothesis of the primary research question, asking if active college students are more successful academically than their inactive peers, could not be rejected. The study indicated that there were a number of statistically significant differences between college students with various physical activity levels, but that those students at the top and bottom of the FIT score ranges had lower academic achievement than did students with FIT scores in the middle ranges. Although the larger body of research on topics surrounding this area of study tend to demonstrate at least some relationship between physical activity and academic achievement, this study produced a virtually nonexistent correlation between these variables. Despite the research

(Chapman et al., 2013; Tomporowski, 2003) concluding that physically active children have a better ability to focus and perform on standardized tests, this phenomena does not seem to transfer to the college population in all cases. Whether this may be attributed to the unique educational stage that these study researched is unknown. College students may have different associations between physical activity and academic achievement than do students in elementary, middle and high school, and perhaps this is a study that can be conducted in the future. This may be illustrated best when contrasting the findings of this study with that of Kim and So (2012), where it was found that children who exercise three or more times each week did significantly better academically than those who did not exercise. Given the findings of this study, other findings, such as those by Kim and So, are simply not seen when studying students in the college population. Perhaps this can be attributed to limitations that may be found in this study or the study design itself. One possible limitation in this study is that this was a survey-format study that relied on self-reporting for data collection. This could pose challenges to accuracy of the data, as people often misreport information. A second limitation noted in this study is that of first-semester college freshmen reporting a 4.0 GPA. Perhaps this situation flawed the findings of this study and should be considered when designing future research in the college population.

Given the divergent research findings identified in the literature review, the possibility that no relationship may be found to exist between physical activity and academic achievement was foreseen and accounted for by the development of a quintile split methodology, which allowed a more specific examination of the characteristics of physical activity level and academic achievement among college students categorized into five equal groups. This was further enhanced by the development of secondary research questions that investigated the

specific characteristics associated with the student participants. The result of the current study's primary research question was supported by the findings of Raspberry et. al., who found that physical activity is either positively linked to academic performance or, at very least, there is no significant relationship between the two (Raspberry et. al., 2011). Although most research did indicate a relationship, this range of possibilities continually showed itself throughout the review of literature and left more questions than answers, which was the ultimate factor in the decision to formulate secondary research questions. The current findings regarding the first research question clearly showed that no significant difference could be shown to exist regarding academic achievement between active and inactive college students, which validated the need for a categorized physical activity scale to analyze GPA scores in these different categories, as well as researching the three secondary questions. An unforeseen conclusion produced an uncommon correlation of .004 ($p>0.05$), which concluded that there is virtually no relationship between the variables of physical activity and academic achievement among college students. Given the large and growing body of research finding significant relationships to exist between these two variables in various groups of people, the findings of this study are particularly interesting, in that of the 10,000 participating college students, no relationship between their levels of physical activity and their levels academic achievement could be observed when viewing this group of students as a whole. However, significant findings did appear once the data was split into five equal groups arranged by FIT scores in order from least to greatest. This method of analysis did produce significant differences between the groups, and it was determined that college students with the lowest and highest physical activity levels have lower academic achievement scores

than do students with more moderate physical activity levels. Significant relationships were also found among each of the secondary research questions.

The second research question pertained to the potential differences in FIT scores among college students who attended college in various geographical locations of the country, namely the NE, NW, SE, and SW. The findings of the statistical analysis allowed the null hypothesis to be rejected and it was discovered that college students in the NW showed a significantly higher FIT score that did college students found in the other geographical areas. Formulation of this question stemmed primarily from the study featured in the literature review of this study, in which first-year medical students in India were studied to determine if BMI had a bearing on academic achievement. The finding that it did not have a significant influence on grades was the main reason for the development of a secondary research question using geography as a variable, albeit in the United States. This proved useful, as the data did show that a geographical difference existed. This finding suggested that these secondary research questions might shed more light onto this topic of research as each was analyzed.

The third research question asked if there were significant differences in FIT scores between genders (male and female). As was the case with geographic area of college attendance, the statistical findings regarding gender differences allowed for the null hypothesis to be rejected, definitively demonstrating that, in this population sample, there was in fact a significant difference in FIT scores between males and females. This research question was developed organically during the development of the other secondary research questions. Given the nature of this study, it was rather logical to assume that there could possibly be a difference between the genders, and therefore, it was important to include this question in the research. Additionally, the

research of Castelli, Hillman, Buck, and Erwin (2007) found a negative correlation between BMI and academic performance across grade levels in both male and female students, which presented the need for this study to test this in a college population, to further understand this relationship. Ultimately, the finding determining that there is a significant difference between the genders further supported the notion that secondary research questions were important to the overall inquiry of this study, as they provided valuable information that may be used for future research in this area.

The fourth and final research question asked if there was a significant difference in FIT scores between races. A number of studies provided insight into possible racial differences, but McArthur & Raedeke's (2009) study finding that black females were the least active among all races studied in a college setting provided enough curiosity about the variable of race to determine that it should be included as a variable for research in this study. Because of sample size and the large proportion of white students that voluntarily participated in the study, versus the much smaller percentage of non-white students who participated, race classifications were assigned as "White" and "non-White." As with the other secondary research questions, the statistical analysis confirmed that there was a significant difference in FIT scores between the races represented in this study, and the null hypothesis was rejected.

Future study in this area must be done to gain a better understanding of these variables and how they may or may not be related in various populations of students. Research directed at college students in specific groups is recommended. As this study illustrates, there are differences in FIT scores between specific groups of college students. And, as this study shows, there are significant differences in the relationships between the physical activity levels and

academic achievement scores in specific groups of college students as well. Perhaps these questions issued to college students as a whole do not produce significant relationships, but the statistical significance presents itself within specific groups based on physical activity level, gender, race, and geographic area. Possible studies that explore the relationship between physical activity and academic achievement among males vs. females may produce insightful results. Also, with regard to race, additional research in this area may produce unique findings among college students from different racial groups. Finally, with regard to geographical region, further study in this area should be performed to explore the possibilities that college students in certain geographic areas perform differently academically with relation to their levels of physical activity. In an effort to better understand the aspects of physical activity as it may or may not relate to academic achievement in college students, all of these studies could stem from the research conducted in this study.

Limitations

A number of limitations were known prior to the start of this study and a number of them emerged as the study progressed. Those that were known revolve around the participants themselves. This study used a survey to gather data on college students. One limitation to this was the inability of the researcher to guarantee truthful and accurate data from this self-reporting sample population. Another limitation that was known was the fact that there would not be an equal distribution of participants within the variables being analyzed. As it turned out, White students completed far more surveys than did students of other races, and therefore, this study did not have enough participation from students of other races to adequately compare FIT scores or academic achievement scores between the races. Ultimately the study had to determine the

relationship between “White” students and “other” students. The final limitation that developed as the study progressed was recognition that first-semester freshmen students did not have an academic background of grades to consider and therefore their scores could be uncharacteristically high, often being reported as a 4.0 grade-point average simply because they have not yet received grades from their first semester. Beyond these, the limitations were few, and although the limitations mentioned here are important to note, the overall integrity of the study remained intact.

Conclusions

The conclusions drawn from this study are important because they clearly demonstrate that the variables of physical activity and academic achievement are complex and must be studied using the many possible factors that contribute to each. This study showed that while no significant differences may be noted across the broad spectrum of a complete group of college students, there are often important and noteworthy differences when research looks more specifically at the subjects by categorizing them appropriately. This study may provide a directional focus for future studies to not only look at a singular primary research question, but to break it down into its many components, in order to potentially achieve a much more detailed description of what is occurring.

A second contribution this study made to the body of research was that it produced a quality amount of self-reported statistical information about adults in the college setting. Research regarding physical activity variables as they are associated with academic achievement is greatly lacking and this study provided a resource in that emerging field of study. The

researcher feels that the findings of this study are telling and, given the large sample size, believes these findings can be supported and built upon by future research.

Recommendations

Recommendations for research in the field of study in which this study has been conducted are numerous. First, the researcher recommends a large and significant sample size. It could be that some studies are not able to be considered for inclusion into the body of quality research simply because sample size is too small. When researching college students in the United States, an adequate sample size must be attained in order to provide a quality sample of this tremendously diverse population. When possible, and in order to ensure absolutely accuracy, researchers should attempt to attain factual information regarding variables such as physical activity level and GPA, instead of self-reported data as found in this study.

A second recommendation is to include multiple research questions that clearly delve more deeply into the many aspects of participants' identities. Where participants are from may matter. Their age, their gender, their socioeconomic status, and a slew of other possible variables may be telling to the overall findings of future research, so it is the opinion of this researcher that studies conducted in this field of inquiry, at least for the time being, should have broad-reaching research questions and be able to progressively hone in on the specific populations being studied.

The final recommendation from this researcher is that researchers should enlist the insight of professionals in the field of study who are outside of the academic realm. So many studies have little to no bearing on the education of the general public simply because the variables being studied are not ideal or are not applicable to real-world situations. Professionals working in

industries like the health and fitness fields can help one focus in on what really matters to people, so that research has real-world applications to people across the spectrum.

References

Abadie, B., & Brown, S. (2010). *Physical activity promotes academic achievement and a healthy lifestyle when incorporated into early childhood education*. Retrieved from http://forumonpublicpolicy.com/vol2010no5/archivevol2010no5/abadie.pdf

Agarwal, S., Bhalla, P., Kaur, S., & Babbar, R. (2013). Effect of body mass index on physical self-concept, cognition & academic performance of first year medical students. *The Indian Journal of Medical Research, 138*(4), 515.

Al-Isa, A., Campbell, J., Desapriya, E., & Wijesinghe, N. (2011). Social and health factors associated with physical activity among Kuwaiti college students. *Journal of Obesity, 2011,* 512363. doi: 10.1155/2011/512363.

Basch, C. (2011). Physical activity and the achievement gap among urban minority youth. *Journal of School Health, 81*(10), 626-634.

Bias, K. (2009). *Physical education programs in relation to the national standards*. ProQuest Dissertations & Theses. (UMI 3362653)

Bjørnebekk, A., Mathé, A., & Brené, S. (2005). The antidepressant effect of running is associated with increased hippocampal cell proliferation. *International Journal of Neuropsychopharmacology*, *8*(3), 357-368.

Boshof, H. (1998). The relationship between physical activity and single coronary risk factors in men with a family history of coronary heart disease (translated). Potchefstroomse University for Christian Higher Education. (dissertation).

Brace, N., Kemp, R., & Snelgar, R. (2006). *SPSS for psychologists* (3rd ed.). Mahwah, NJ:

Lawrence Erlbaum Associates, Publisher.

Carlson, S., Fulton, J., Lee, S., Maynard, L., Brown, D., Kohl III, H., & Dietz, W. (2008). Physical education and academic achievement in elementary school: data from the early childhood longitudinal study. *American Journal of Public Health, 98*(4), 721-727.

Castelli, D., Hillman, C., Buck, S., & Erwin, H. (2007). Physical fitness and academic achievement in third-and fifth-grade students. *Journal of Sport and Exercise Psychology, 29*(2), 239.

Chapman, S., Aslan, S., Spence, J., DeFina, L., Keebler, M. & Didehbani, N. (2013). Shorter term aerobic exercise improves brain, cognition, and cardiovascular fitness in aging. *Frontier Aging Neuroscience, 12*(5), 75.

Chomitz, V., Slining, M., McGowan, R., Mitchell, S., Dawson, G., & Hacker, K. (2009). Is there a relationship between physical fitness and academic achievement? Positive results from public school children in the northeastern United States. *Journal of School Health, 79*(1), 30-37.

Coe, D., Pivarnik, J., Womack, C., Reeves, M., & Malina, R. (2006). Effect of physical education and activity levels on academic achievement in children. *Medicine and Science in Sports and Exercise, 38*(8), 1515.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). St. Paul, MN: West Publishing Company.

Cramer, D. (1998). *Fundamental statistics for social research: Step by step calculations and computer techniques using SPSS for Window*. New York, NY: Routledge.

Davis, C., Tomporowski, P., Boyle, C., Waller, J., Miller, P., Naglieri, J., & Gregoski, M. (2007). Effects of aerobic exercise on overweight children's cognitive functioning: a randomized controlled trial. *Research Quarterly for Exercise and Sport, 78*(5), 510-519.

Deci, E., Eghrari H., Patrick B., Leone D. (1994). Facilitating internalization: the self-determination theory perspective. *Journal of Personality, 62*(1), 119-142.

Donnelly, J., Greene, J., Gibson, C., Smith, B., Washburn, R., Sullivan, D. & Williams, S. (2009). Physical Activity Across the Curriculum (PAAC): a randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. *Preventive Medicine*, *49*(4), 336-341.

Edwards, J., Mauch, L., & Winkelman, M. (2011). Relationship of nutrition and physical activity behaviors and fitness measures to academic performance for sixth graders in a Midwest city school district. *Journal of School Health*, *81*(2), 65-73.

Epstein, M. (2011). *Coordinative aerobic exercise does not enhance attention and concentration in college students* (Doctoral dissertation, The University of Montana).

Faucette, N., Sallis, J., McKenzie, T., Alcaraz, J., & Kolody, B. (1995). Comparison of fourth grade students' out-of-school physical activity levels and choices by gender. *Journal of Health Education, 26*(2) Supplement, 82-90.

Flöel, A., Ruscheweyh, R., Krüger, K., Willemer, C., Winter, B., Völker, K., & Knecht, S. (2010). Physical activity and memory functions: Are neurotrophins and cerebral gray matter volume the missing link? *Neuroimage, 49*(3), 2756-2763.

Fourie, W. (1999). Physical activity and some lifestyle aspects as indicators of happiness and

health status of mothers (translated). Potchefstroomse University for Christian Higher Education. (dissertation).

Fox, K., & Hillsdon, M. (2007). Physical activity and obesity. *Obesity Reviews*, *8*(1), 115-121.

Fox, C., Barr-Anderson, D., Neumark-Sztainer, D., & Wall, M. (2010). Physical activity and sports team participation: Associations with academic outcomes in middle school and high school students. *Journal of School Health*, *80*(1), 31-37.

George, D. & Mallery, P. (2010). *SPSS for Windows step by step: a simple guide and reference, 18.0 update* (11th ed.). Boston, MA: Allyn and Bacon.

Grissom, J. (2005). Physical fitness and academic achievement. *Journal of Exercise Physiology Online*, *8*(1), 11-25.

Hammond, B. (2013). *The effect time spent in physical education has on MAP scores* (Doctoral dissertation, Northwest Missouri State University).

Hanson, S. (2005). Hidden dragons: Asian American women and sport. *Journal of Sport & Social Issues*, *29*(3), 279-312.

Heyward V., Stolarczyk L. (1996). Applied body composition assessment. Champaign, IL.: Human Kinetics. NEEDS &

Hillman C., Erickson K., Kramer A. (2008). Be smart, exercise your heart; exercise effects on brain and cognition. *Nature Reviews Neuroscience. 9,* 58–65. NEEDS &

Hillman, C., Pontifex, M., Raine, L., Castelli, D., Hall, E., & Kramer, A. (2009). The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. *Neuroscience*, *159*(3), 1044-1054.

Ho, A., Raji, C., Becker, J., Lopez, O., Kuller, L., Hua, X., & Thompson, P. (2011). The effects of physical activity, education, and body mass index on the aging brain. *Human Brain Mapping, 32*(9), 1371-1382.

Howie, E., & Pate, R. (2012). Physical activity and academic achievement in children: A historical perspective. *Journal of Sport and Health Science, 1*(3), 160-169.

Huang, T., Larsen, K., Ried-Larsen, M., Møller, N., & Andersen, L. (2013). The effects of physical activity and exercise on brain-derived neurotrophic factor in healthy humans: A review. *Scandinavian Journal of Medicine & Science in Sports, 24*(1), 1-10

Johnston, J. (2010). *College days -- more sedentary days*. Retrieved from http://www.eurekalert.org/pub_releases/2010-11/iu-a2c110510.php

Kaestner, R., & Grossman, M. (2008). Effects of weight on children's educational attainment. *NBER Working Paper*, (13764).

Kaestner, R., Grossman, M., & Yarnoff, B. (2011). *Effects of weight on adolescent educational attainment*. Retrieved from http://www.nber.org/papers/w14994.pdf

Kantomaa, M., Stamatakis, E., Kankaanpää, A., Kaakinen, M., Rodriguez, A., Taanila**,** A. & Tammelin, T. (2013). Physical activity and obesity mediate the association between childhood motor function and adolescents' academic achievement. *Proceedings of the National Academy of Sciences*, *110*(5), 1917-1922.

Kasari, D. (1976). The effects of exercise and fitness on serum lipids in college women. University of Montana. (MA thesis). In Sharkey, B.J. 1984 *Physiology of fitness. 2nd ed.* Champaign, IL: Human Kinetics.

Keating, X., Castelli, D., & Ayers, S. (2013). Association of weekly strength exercise frequency

and academic performance among students at a large university in the United States. *The Journal of Strength & Conditioning Research*, *27*(7), 1988-1993.

Keeley, T., & Fox, K. (2009). The impact of physical activity and fitness on academic achievement and cognitive performance in children. *International Review of Sport and Exercise Psychology, 2*(2), 198-214.

Kim, S., & So, W. (2012). The relationship between school performance and the number of physical education classes attended by Korean adolescent students. *Journal of Sports Science and Medicine, 11*(2), 226-230.

Kleim J., Cooper N., Vanden Berg P. (2002). Exercise induces angiogenesis but does not alter movement representations within rat motor cortex. *Brain Research* 934, 1-6.

Kubesch S., Bretschneider V., Freudenman R., Weidenhammer N., Lehmann M., Spitzer M. Gron G. (2003). Aerobic endurance exercise improves executive functions in depressed patients. *Journal of Clinical Psychiatry* 64, 1005-1012.

Chaddock, L. (2012). *The effects of physical activity on the brain and cognition during childhood.* Retrieved from https://www.ideals.illinois.edu/bitstream/handle/2142/42327/Laura_Chaddock.pdf?sequence=1

London, R., & Castrechini, S. (2011). A longitudinal examination of the link between youth physical fitness and academic achievement. *Journal of School Health, 81*(7), 400-408.

Mahar, M, Murphy S., Rowe D., Golden J., Shields A., Raedeke T. (2006). Effects of a classroom-based program on physical activity and on-task behavior. Medicine & Science in Sports & Exercise, *38*(12), 2086-94. NEEDS &

McArthur, L., & Raedeke, T. (2009). Race and sex differences in college student physical activity correlates. *American Journal of Health Behavior*, *33*(1), 80-90.

McKune, A., Semple, S., Smith, L., Wadee, A. (2009). Complement, immunoglobulin and creatine kinase response in black and white males after muscle-damaging exercise. *South African Journal of Sports Medicine, 21*(2): 47-52.

Morgan, G., Leech, N., Gloekner, G. & Barrett, K. (2007). *SPSS for introductory statistics: Use and interpretation* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Nelson, M., & Gordon-Larsen, P. (2006). Physical activity and sedentary behavior patterns are associated with selected adolescent health risk behaviors. *Pediatrics*, *117*(4), 1281-1290.

Pagano, R. (2010). *Understanding statistics in the behavioral sciences* (9th ed.). Belmont CA: Wadsworth Cengage Learning.

Pallant, J. (2010). *SPSS Survival Manual* (4th ed.). New York, New York: McGraw-Hill.

Pietiläinen, K., & Kaprio, J. (2008). Physical inactivity and obesity: A vicious circle. *Obesity (Silver Spring), 16*(2), 409-414.

Pinar, W., (2012). *What is Curriculum Theory?* (2nd ed.). New York, New York: Routledge.

Rabie, P. (1999). The influence of physical activity on the mental wellbeing of women (translated). Potchefstroomse University for Christian Higher Education. (dissertation).

Rasberry, C., Lee, S., Robin, L., Laris, B., Russell, L., Coyle, K., & Nihiser, A. (2011). The association between school-based physical activity, including physical education, and academic performance: A systematic review of the literature. *Preventive Medicine*, *52*, S10-S20.

Robertson-Wilson, J., Dargavel, M., Bryden, P., & Giles-Corti, B. (2012). Physical activity policies and legislation in schools: a systematic review. *American Journal of Preventive Medicine*, *43*(6), 643-649.

Ruscheweyh, R., Willemer, C., Krüger, K., Duning, T., Warnecke, T., Sommer, J. & Flöel, A. (2011). Physical activity and memory functions: an interventional study. *Neurobiology of Aging*, *32*(7), 1304-1319.

Ryan, R., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Santiago, J., Roper, E., Disch, J., & Morales, J. (2013). The relationship among aerobic capacity, body composition, and academic achievement of fourth and fifth grade Hispanic students. *Physical Educator*, *70*(1).

Schinder A., Poo M. (2000) The neurotrophin hypothesis for synaptic plasticity. *Trends in Neuroscience* 23, 639-645.

Sharkey, B. (1984). *Physiology of fitness. 2nd ed.* Champaign, IL: Human Kinetics.

So, W. (2012). Association between physical activity and academic performance in Korean adolescent students. *BMC Public Health*, *12*(1), 258.

Sponchiado, P. (2007). Description of the effects of the protocol "school of modern column" with individuals with chronic low back pain. *Fitness & Performance Journal 6*(5): 283-288.

Stevens, J. (2009). *Applied multivariate statistics for the social sciences* (5th ed.). Mahwah,

Strayhorn, T. (2010). When race and gender collide: social and cultural capital's influence on the academic achievement of African American and Latino males. *The Review of Higher Education*, *33*(3), 307-332.

Strydom, G., Kotze, J., Roux, G., Schoeman, J., Joubert, L. & Van der Merwe, A. (1991). The Physical Activity Profile of South African Whites in Transvaal cities. *South African Journal for Research in Sport, Physical Education and Recreation (translated)*, *14*(2): 65-76.

Tabachnick, B. & Fidell, L. (2012). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Taras, H. (2005). Physical activity and student performance at school. *Journal of School Health, 75*(6), 214-218.

Telford, R., Cunningham, R., Fitzgerald, R., Olive, L., Prosser, L., Jiang, X., & Telford, R. (2012). Physical education, obesity, and academic achievement: A 2-year longitudinal investigation of Australian elementary school children. *Journal Information*, *102*(2), 368-374.

Tomporowski, P. (2003). Effects of acute bouts of exercise on cognition. *Acta Psychologica*, *112*(3), 297-324.

Tremarche, P., Robinson, E., & Graham, L. (2007). Physical education and its effect on elementary testing results. *Physical Educator*, *64*(2), 58-64.

Trost, S. (2008). Physical education, physical activity, and academic performance in youth. *Chronicle of Kinesiology and Physical Education in Higher Education*, *19*(3), 33-40.

Trost, S., & van der Mars, H. (2010). Why we should not cut PE. *Health Learn, 67*(4), 60-65.

Trudeau, F., & Shephard, R. (2008). Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 10.

Van der Merwe, S. (1995). Physical activity and mental welfare of white men in Potchefstroom (translated). Potchefstroomse University for Christian Higher Education. (dissertation).

Van der Westhuizen, D. (1997). The interaction between a physical activity index, a physical work capacity test and lifetime influence on single blood lipids (translated). Potchefstroomse University for Christian Higher Education. (dissertation).

Voss, M., Nagamatsu, L., Liu-Ambrose, T., & Kramer, A. (2011). Exercise, brain, and cognition across the life span. *Journal of Applied Physiology, 111*(5), 1505-1513.

Wentzel, E. & McKune, A. (2013). Effect of a foot pump device on lower leg swelling in physically inactive office workers. *Journal of Ergonomics Society of South Africa, 25*(2): 22-31**.**

Wilders, C. & Strydom, G. (2003). The relation of physical activity with lifestyle and spiritual well-being in South African women. *South African Journal for Research in Sport, Physical Education and Recreation, 25*(2): 105-119.

Appendices

Appendix A

April 15, 2014

Dear Students,

My name is Jared Meacham and I am writing to you about a research project I am completing for my dissertation with the University of New Orleans under committee chair Dr. Marc Bonis. It seeks to discover a relationship between physical activity and academic achievement among college students. My aim is to get responses (they are anonymous) from a diverse group of students in all states and affiliated territories. This is an inquiry to ask that you consider participating in this study.

One goal I have is to give students from all regions of each state representation among the 10,000 students whose data I will collect. For your assurance, my IRB approval letter for exempt research is attached to this email. Using a survey from Survey Monkey, students will complete the survey honestly. The survey takes about two minutes to complete and consists of eleven multiple choice questions. Your participation in this study is voluntary and your decision to not participate carries no penalty of any kind.

Should you have any questions concerning this study, please call me (918) 805-0461 or you may call Dr. Marc Bonis (504) 280-6165 at the University of New Orleans for answers to questions about this research project and your rights as a human subject and any concern you may have.

I thank you for your time and consideration.

Should you be willing to take this survey, this is the link for your review:

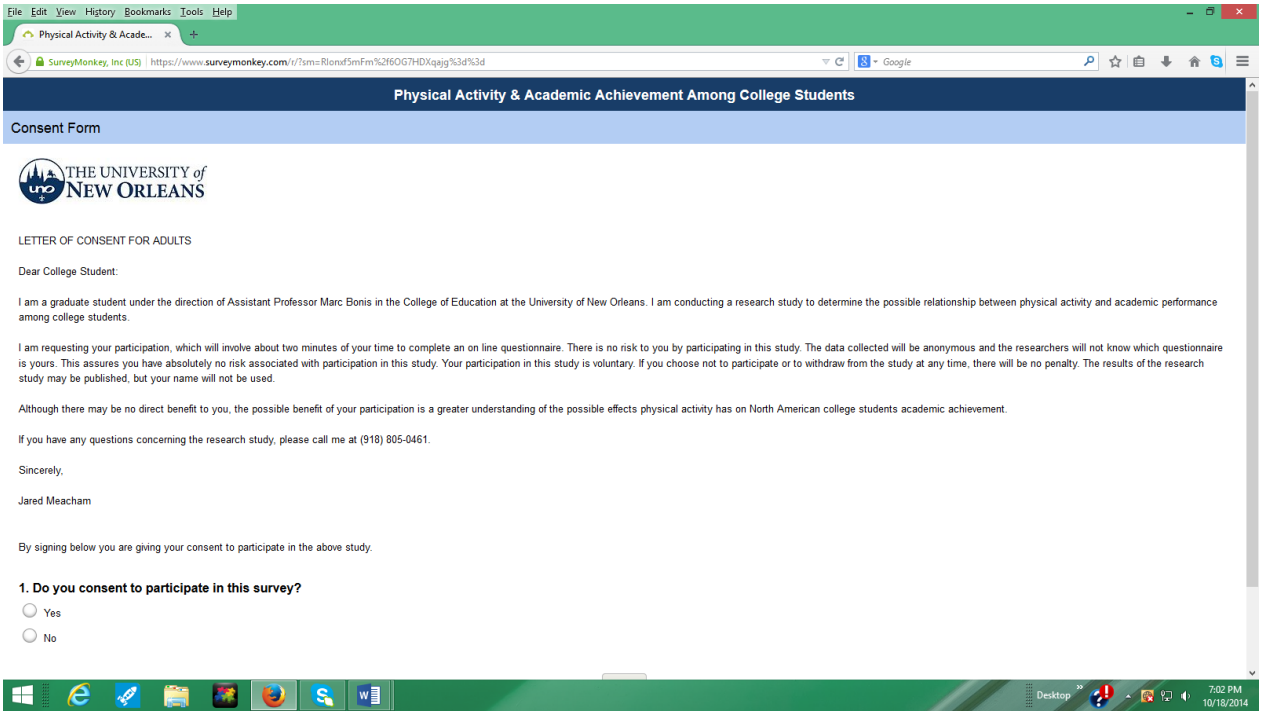
https://www.surveymonkey.com/s/5M2QQLM

This link should open with a simple click of the mouse. However, should this fail, copying and pasting the link directly into a new browser window will work.

Sincerely,

Jared Meacham
6634 S. Utica Pl.
Tulsa, OK 74136
jtmeacha@uno.edu
(918) 805-0461

Appendix B



Physical Activity & Academic Achievement Among College Students

Consent Form

THE UNIVERSITY of NEW ORLEANS

LETTER OF CONSENT FOR ADULTS

Dear College Student:

I am a graduate student under the direction of Assistant Professor Marc Bonis in the College of Education at the University of New Orleans. I am conducting a research study to determine the possible relationship between physical activity and academic performance among college students.

I am requesting your participation, which will involve about two minutes of your time to complete an on line questionnaire. There is no risk to you by participating in this study. The data collected will be anonymous and the researchers will not know which questionnaire is yours. This assures you have absolutely no risk associated with participation in this study. Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. The results of the research study may be published, but your name will not be used.

Although there may be no direct benefit to you, the possible benefit of your participation is a greater understanding of the possible effects physical activity has on North American college students academic achievement.

If you have any questions concerning the research study, please call me at (918) 805-0461.

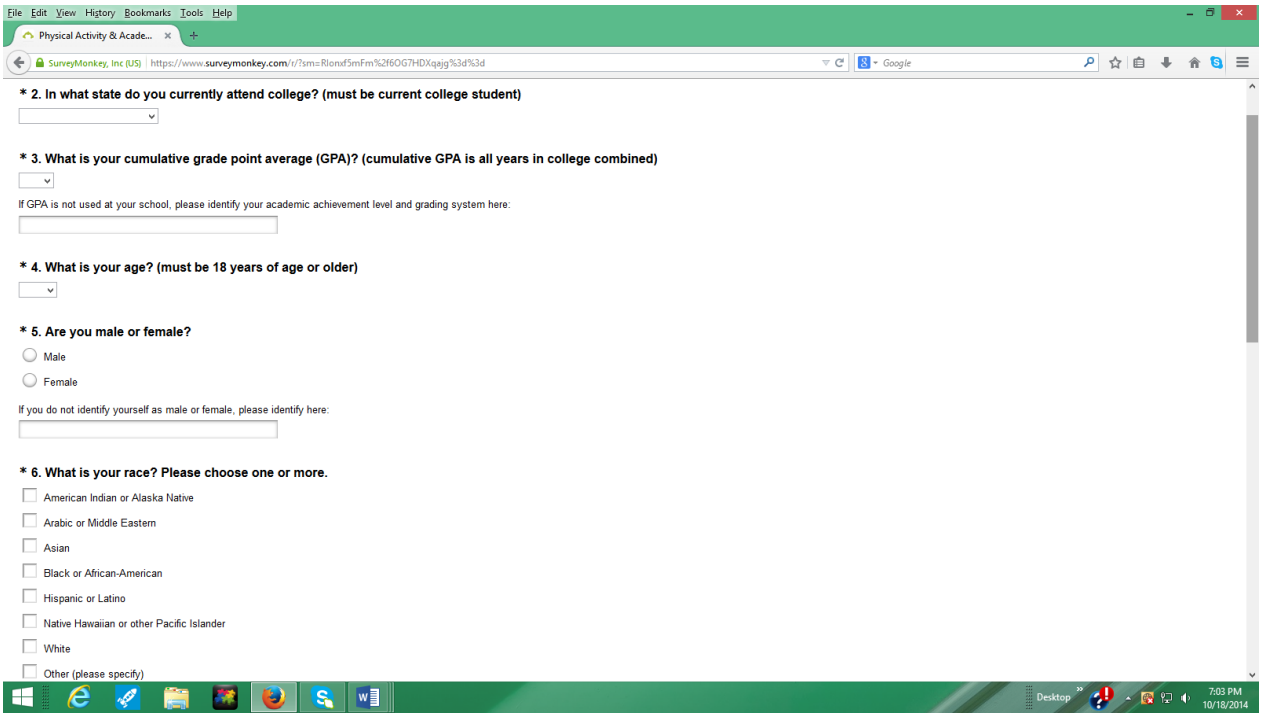
Sincerely,

Jared Meacham

By signing below you are giving your consent to participate in the above study.

1. Do you consent to participate in this survey?

- Yes
- No



*** 2. In what state do you currently attend college? (must be current college student)**

*** 3. What is your cumulative grade point average (GPA)? (cumulative GPA is all years in college combined)**

If GPA is not used at your school, please identify your academic achievement level and grading system here:

*** 4. What is your age? (must be 18 years of age or older)**

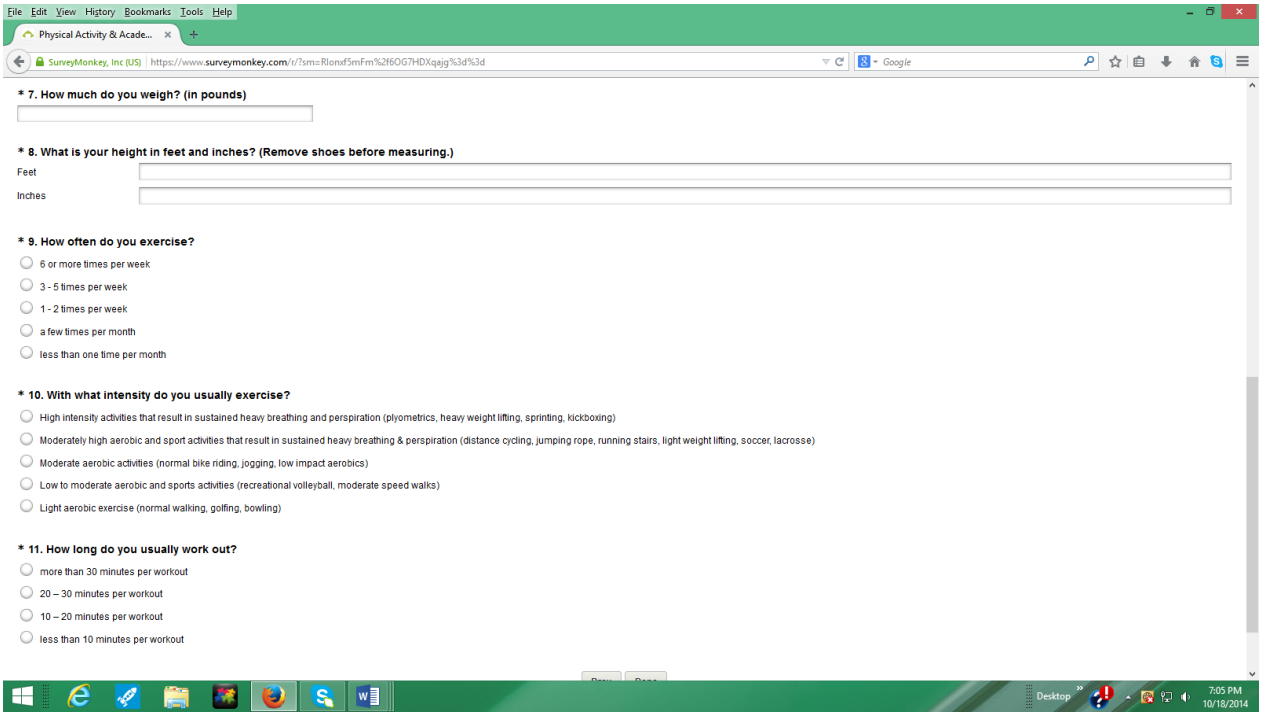
*** 5. Are you male or female?**

- Male
- Female

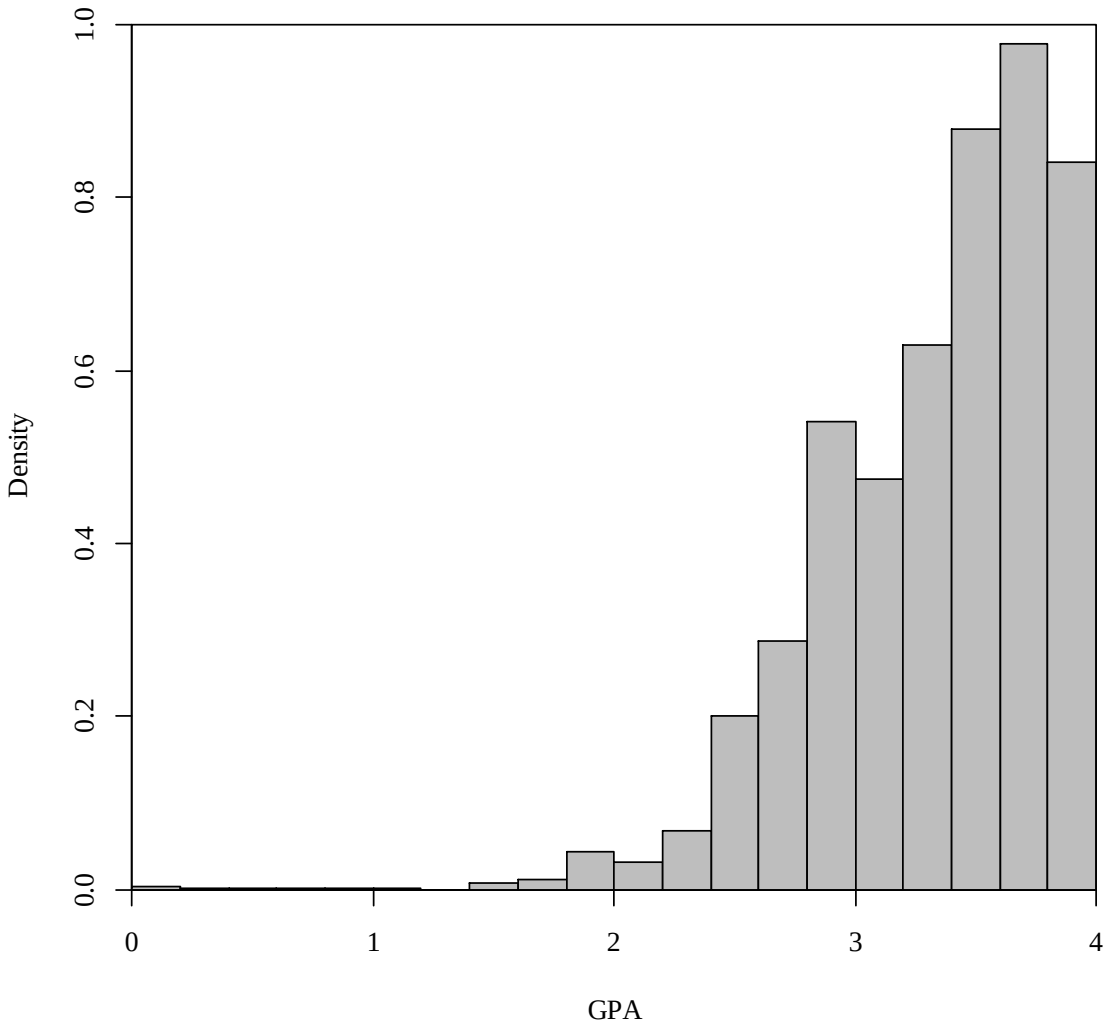
If you do not identify yourself as male or female, please identify here:

*** 6. What is your race? Please choose one or more.**

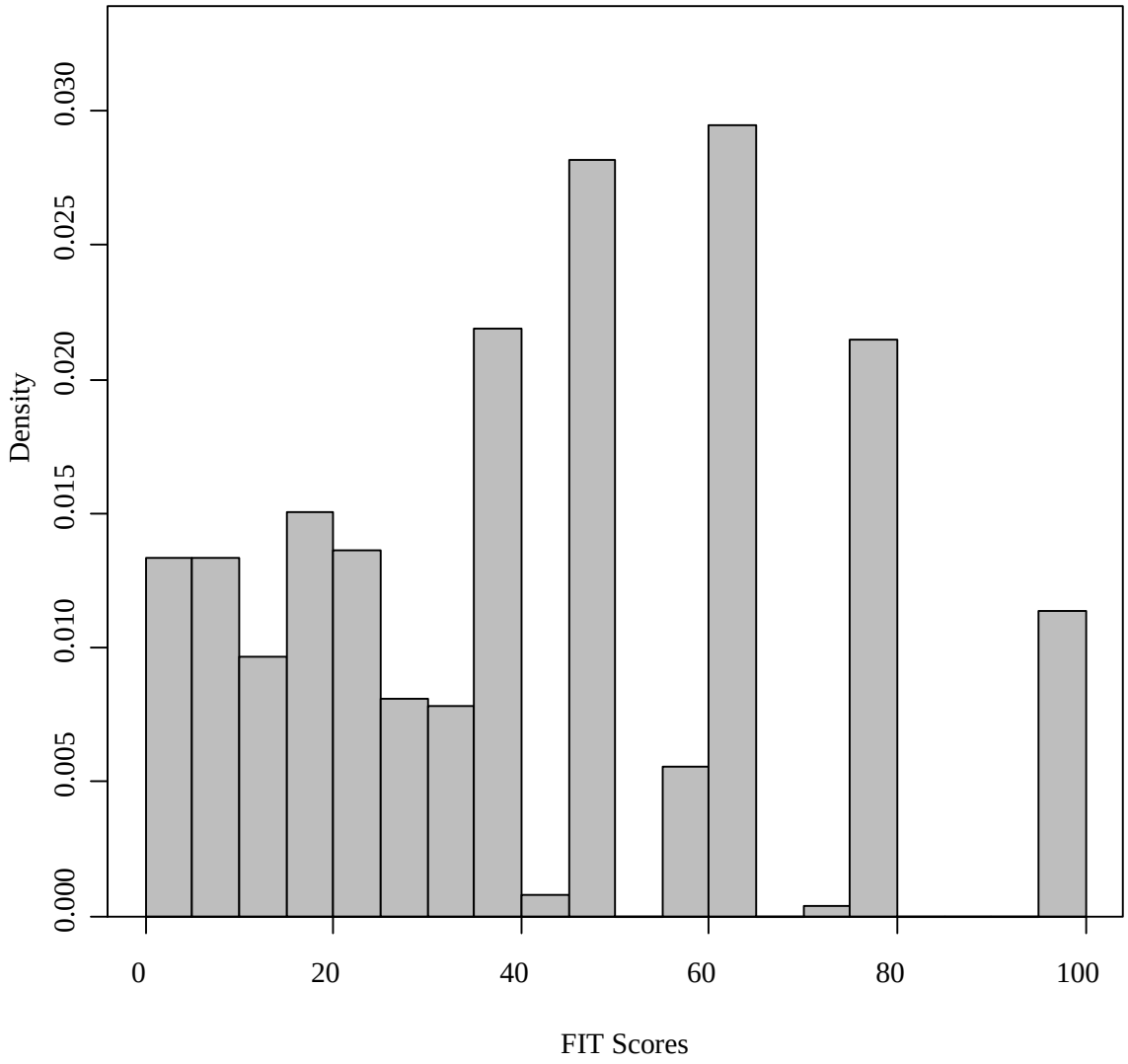
- American Indian or Alaska Native
- Arabic or Middle Eastern
- Asian
- Black or African-American
- Hispanic or Latino
- Native Hawaiian or other Pacific Islander
- White
- Other (please specify)


File Edit View History Bookmarks Tools Help
Physical Activity & Acade...
SurveyMonkey, Inc (US) https://www.surveymonkey.com/r/?sm=RIonxf5mFm%2f6OG7HDXqajg%3d%3d
Google
* 7. How much do you weigh? (in pounds)
* 8. What is your height in feet and inches? (Remove shoes before measuring.)
Feet
Inches
* 9. How often do you exercise?
6 or more times per week
3 - 5 times per week
1 - 2 times per week
a few times per month
less than one time per month
* 10. With what intensity do you usually exercise?
High intensity activities that result in sustained heavy breathing and perspiration (plyometrics, heavy weight lifting, sprinting, kickboxing)
Moderately high aerobic and sport activities that result in sustained heavy breathing & perspiration (distance cycling, jumping rope, running stairs, light weight lifting, soccer, lacrosse)
Moderate aerobic activities (normal bike riding, jogging, low impact aerobics)
Low to moderate aerobic and sports activities (recreational volleyball, moderate speed walks)
Light aerobic exercise (normal walking, golfing, bowling)
* 11. How long do you usually work out?
more than 30 minutes per workout
20 – 30 minutes per workout
10 – 20 minutes per workout
less than 10 minutes per workout
Desktop
7:05 PM
10/18/2014

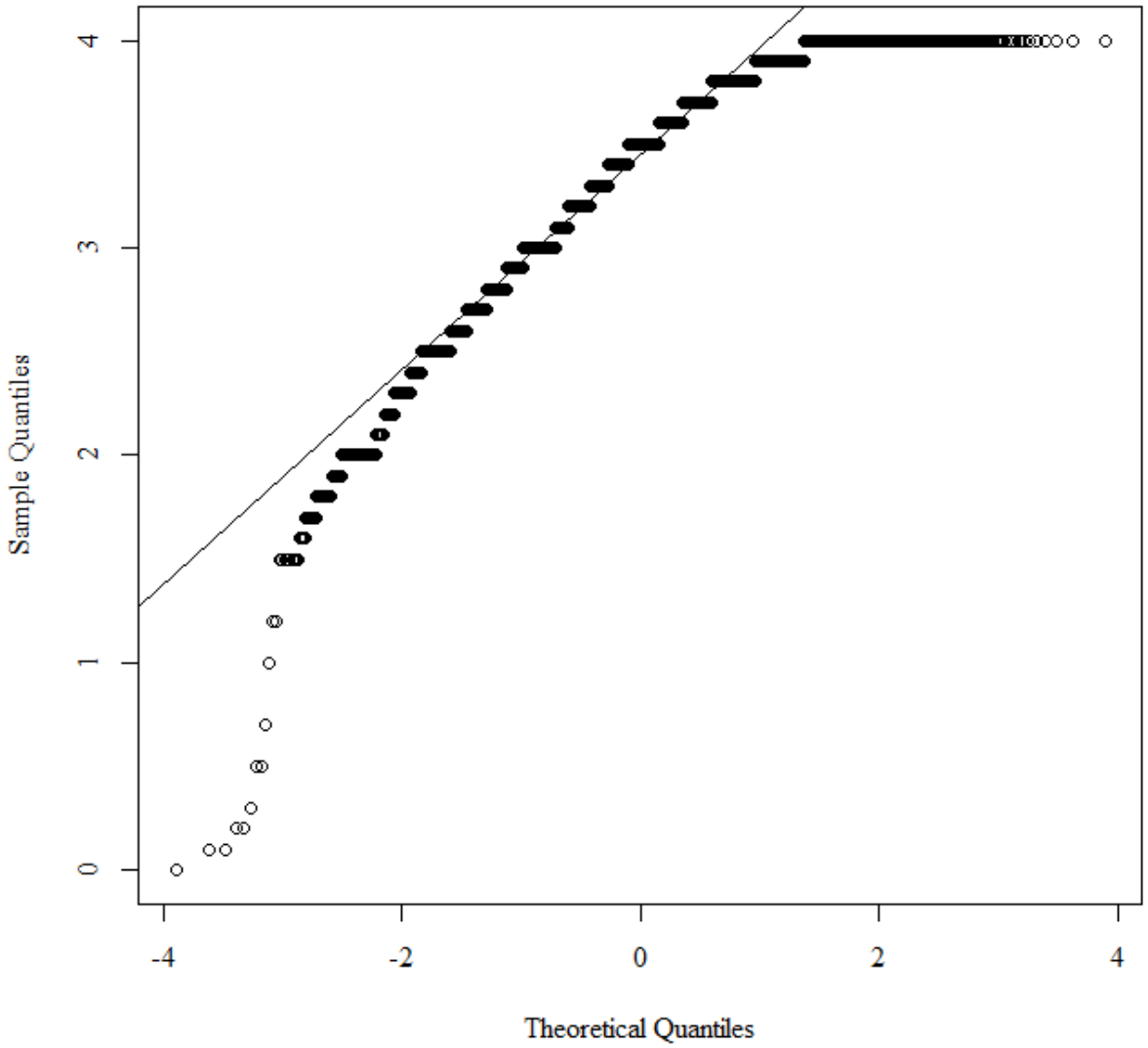
Appendix C



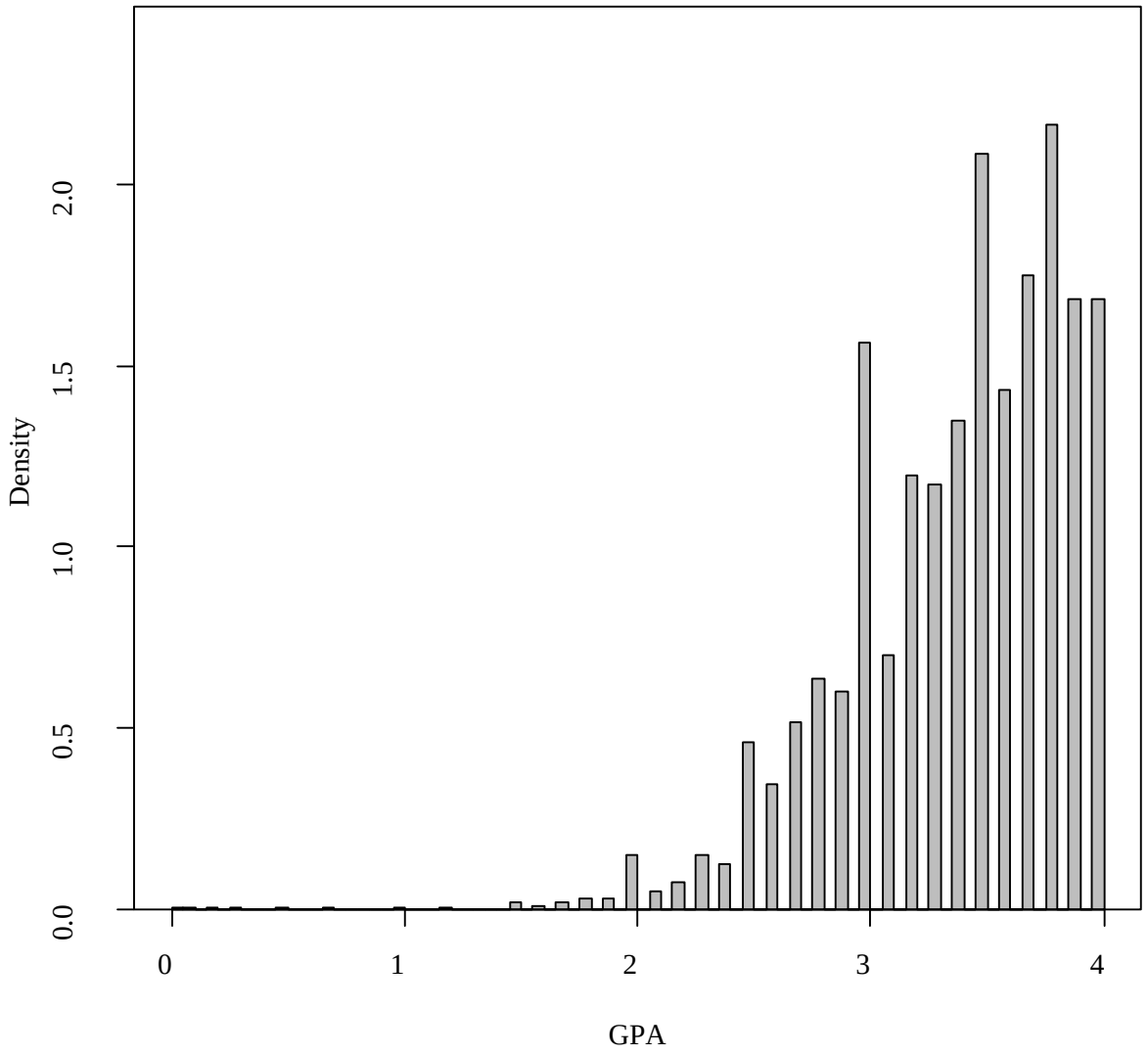
Appendix D


Density
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0
20
40
60
80
100
FIT Scores

Appendix E



Appendix F



Vita

Jared Meacham is an entrepreneur in the health and fitness industry and resides in Tulsa, Oklahoma. Originally from Phoenix, Arizona, Mr. Meacham earned a bachelor's degree in human nutrition, foods, and exercise from Virginia Tech before returning to earn his master's of health promotion, also from Virginia Tech. Mr. Meacham's interests include cognition, learning styles, human development and the relationship the physical body has upon mental processes. Mr. Meacham enjoys spending time with family, his dogs, and engaging in regular travel.