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# Examining the Effects of Caffeine, Sleep and Exercise on the Academic Performance of PA Students

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# EXAMINING THE EFFECTS OF CAFFEINE, SLEEP AND EXERCISE ON THE ACADEMIC PERFORMANCE OF PA STUDENTS

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## ABSTRACT

Caffeine is the most widely consumed stimulant drug in the world and is consumed by nearly ninety percent of North Americans (Mednick, Cai, Kanady, & Drummond, 2008). Since caffeine is a highly consumed drug amongst a wide variety of demographics, it is important to consider the ramifications of caffeine on a person's general well-being. In recent years, there has also been an increasing correlation between the number of individuals consuming caffeine and the rise of insufficient sleep (Mednick et al., 2008). Due to the high demands and stresses of college and graduate school, it is not surprising that many students sacrifice sleep and substitute with caffeine for the sake of their academic performance. Most students are unaware of the potential repercussions of these behaviors. Associated with these habits of excess caffeine consumption and sleep deficiency, students are not meeting weekly exercise recommendations. Due to busy schedules, nearly 40-50% of college students are deemed physically inactive (Deliens, Deforche, De Bourdeauhuij, & Clarys, 2015). Since these habits are all common in the student population, the purpose of this study was to identify whether there is a relationship between caffeine, sleep and exercise and the academic performance of Physician Assistant students. Three PA schools in the Twin Cities of Minnesota were surveyed and were asked about their caffeine, sleep and exercise habits. By comparing the GPAs of students who met the recommendations of caffeine, sleep and exercise to students who did not meet the recommendations, this study determined if there was a link between these variables and academic performance. Quantitative data about PA students' caffeine, sleep, and exercise behaviors was collected through a Qualtrics survey. The data obtained from the surveys was analyzed using unpaired, two-sample T-Tests. The results

indicated that there is not a statistically significant relationship between caffeine, sleep or exercise and the surveyed students' GPA. Due to the small sample size and narrow distribution of GPAs among the sample population, there was not a statistically significant relationship between the variables and GPA. The standard deviation between the GPAs of the survey participants was only 0.2112. Since the results of the statistical analysis were not significant, it is not possible to draw conclusions from the survey results and make recommendations specifically for PA students. Since it has been well established in the literature that caffeine, sleep and exercise have remarkable ramifications on academic performance in the undergraduate student population, further research is warranted to investigate this subject in the graduate student population.

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# Chapter 1: Introduction

## Introduction

Caffeine is the most widely consumed stimulant drug in the world and is consumed by nearly ninety percent of North Americans (Mednick et al., 2008). In recent years, there has been an increasing correlation between the number of individuals consuming caffeine and the rise of insufficient sleep (Mednick et al., 2008). Since caffeine is a highly consumed drug amongst a wide variety of demographics, it is important to consider the ramifications of caffeine on a person's general well-being. Specifically, this study will look at the impact of caffeine consumption related to Physician Assistant (PA) students. This study will focus on identifying the influence of caffeine, adequate sleep, and exercise on the academic performance among Physician Assistant students. To begin, it is important to understand the magnitude of the caffeine epidemic as well as sleep deprivation and inadequate exercise among students. By identifying a link between increased caffeine consumption, sleep and exercise and academic performance, providers will be able to make healthy recommendations to their patients who are students.

## Background

### Caffeine culture

In the United States, 80% of the population "regularly consumes caffeine with a mean daily caffeine consumption of 285 mg/day" (Mednick et al., 2008, p. 79). To give a reference, two 8-ounce cups of brewed coffee is about 240 mg and "16 ounces of Starbucks coffee contains 372 mg" (Mednick et al., 2008, p. 79). A recommended daily caffeine intake is regarded as not exceeding 400 mg (Górnicka, Pierzynowska,

Kaniewska, Kossakowska, & Woźniak, 2013). Interestingly, the energy drink beverage market is the fastest growing sector of the beverage industry in the United States (Mednick et al., 2008). A 5-Hour Energy drink has 200 mg in a 2-oz. serving size and Monster Energy, another popular energy drink, has 160 mg of caffeine in a 16-oz. serving (Center for Science in the Public Interest, n.d.). In 2013, in North America, energy drink sales were nearly $20 billion dollars (Azagba, Langille, & Asbridge, 2014). Specifically, among college students, energy drinks have become an exceedingly popular option to get the desired effects of caffeine (Trunzo et al., 2014). Many college students "consume energy drinks to increase their energy, to study, or to complete academic work, and many students drink as much as two or more energy drinks while studying or engaging in other academic activities" (Trunzo et al., 2014, p. 396). Although students consume energy drinks with the goal of improving their academic performance, energy drink users have actually been associated with poorer sleep, increased anxiety, and lower GPAs (Trunzo et al., 2014). In addition, since daytime sleepiness is also a growing concern amongst students, it is important to identify a correlation between excessive caffeine consumption and sleep deprivation.

**Sleep deprivation amongst college students**

According to the American Sleep Association, it is recommended that the average adult, who does not have a sleep disorder, sleeps about 7 to 8 hours a night (American Sleep Association, 2007). About 70.6% of college students report less than 8 hours of sleep, meaning that the majority of students are sleep deprived (Hershner & Chervin, 2014). Interestingly, a study performed at an Architecture School in the Midwest found that "only 4% of students obtained at least 7 hours of sleep at night; the average sleep

duration was 5.7 hours, with 2.7 “all-nighters” per month” (Hershner & Chervin, 2014, p. 74). An “all-nighter” is when the individual stays up all night without going to sleep. In addition, the majority of the students ranked sleep deprivation as one of the major factors that negatively impacted their academic performance (Hershner & Chervin, 2014).

### The benefits of exercise

Along with adequate sleep, exercise is essential to a person’s overall well-being and can provide significant benefits to a student’s academic performance. For instance, according to McNerney & Radvansky (2014), “over time, exercise can lower the risk for age-related decline in cognition” and also that “intensive exercise may benefit certain types of memory consolidation” (McNerney & Radvansky, 2014, p. 1722). Also, according to van Dongen, Kersten, Wagner, Morris, & Fernandez, (2016), performing exercise shortly after taking a memory test was found to improve memory retention. The process of laying down new memory requires dopamine, noradrenaline, and brain-derived neurotrophic factor and exercise has been found to release several of these factors (van Dongen et al., 2016). van Dongen’s study suggests that “appropriately timed physical exercise can improve long-term memory and highlight the potential of exercise as an intervention in educational and clinical setting (van Dongen et al., 2016, p. 1722).

## Problem Statement

According to numerous studies, many students consume caffeine and do not get the recommended amount of sleep and exercise. Therefore, it is important to investigate whether there is a correlation between caffeine, sleep and exercise, and academic success (Trunzo et al., 2014; Hershner & Chervin, 2014). There is a deficit in research that compares the effects of caffeine, sleep and exercise on the academic performance of

graduate students. In addition, there is a lack of research that looks specifically at the Physician Assistant student population. It is important to identify the potential repercussions of these behaviors since academic performance has been found to be negatively associated with increased caffeine consumption and sleep deprivation (Trunzo et al., 2014; Hershner & Chervin, 2014).

**Purpose**

The purpose of this study is to investigate the best strategy to improve academic performance amongst Physician Assistant students. It is important to identify whether the habits of caffeine consumption, sleep and exercise have a positive or negative correlation with academic performance. This study will examine whether these habits have an influence on a student's GPA.

**Significance of the Problem as it Relates to the PA Profession**

Due to the wide consumption of caffeine as a society, health care providers should understand the risks and benefits of caffeine. In order to properly educate patients, providers should explain the appropriate amount of caffeine, sleep and exercise for healthy living. Since procrastination and participating in "all-nighters" has become a significant trend amongst undergraduate and graduate students, it is relevant to investigate the health risks of this behavior and make appropriate recommendations (Hershner & Chervin, 2014). In order to promote health, providers need to understand the role of sleep and exercise in order to improve the general health of their patients who are students.

**Research Questions**

The following research questions will be addressed in this study:

1. What is the significance of the effects of caffeine, sleep and exercise amongst Physician Assistant students on academic performance?
2. What amount of caffeine consumption, if any, has an influence on the grade point average of Physician Assistant students?
3. What amount of sleep, if any, has an influence on the grade point average of Physician Assistant students?
4. What amount of exercise, if any, that a Physician Assistant student participates in during an average week has an influence on their grade point average?
5. What percentage of Physician Assistant students meet the recommendations for caffeine, sleep and exercise?

**Significance of the Study**

Since the majority of the undergraduate and graduate student population consumes caffeine and many are sleep deprived, it is important to investigate the link to their academic performance (Mednick et al., 2008; American Sleep Association, 2007). According to Mednick (2008), a study comparing the effects of caffeine and naps, found that "caffeine significantly impaired motor learning compared to placebo and nap" and "findings provide evidence of the limited benefits of caffeine for memory improvement compared with napping" (Mednick et al., 2008, p. 79). Studies have examined the effects of sleep and caffeine and their influence on memory, however, they do not focus on the graduate student population. Since there is a lack of research which investigates the

correlation between caffeine, sleep and exercise in Physician Assistant students, or graduate students in general, this study will investigate these potential correlations.

**Limitations of Study**

**Delimitations**: This study is specifically looking at PA students in Minnesota with class sizes ranging between 19-32 students. PA students who are attending Bethel University, St. Catherine's University or Augsburg University and are in the first year of the program will be surveyed.

**Limitations**: One of the major limitations of the study is the demographics of the student population. For example, the student population consists of primarily Caucasian students in the approximate age range of 23-33 years old. Also, the sample size is small and will contain between 30-90 students. Some of the students may choose not to take the survey due to their busy schedule or for personal reasons. In addition, since PA students are focused on academic success, they may be more likely to select what they consider to be the correct answer rather than answering honestly. These limitations will influence the sample size and results of the surveys. In addition, the students will be asked to self-report their GPA. Students may overestimate or underestimate their GPAs. Finally, since these students will most likely be aware of the health recommendations for caffeine, sleep, and exercise, they may be biased in their responses and not be honest about their own personal habits.

**Definitions**

There are several terms that need to be defined concerning the study population as well as the variables that will be measured.

- A Physician Assistant student is a student enrolled in an accredited Physician Program. The Accreditation Review Commission on Education for the Physician Assistant (ARC PA) accredits these programs. These graduate programs award either a master's degree in Physician Assistant Studies, Health Science, or Medical Science. These graduate programs require a bachelor's degree at the time of entry into the program.
- Academic performance is defined as overall grade point average (GPA).
- Stimulant drugs are defined as drugs prescribed for the treatment of ADHD such as methylphenidate (Ritalin, Concerta), dextroamphetamine (Dexedrine), and mixed-salts amphetamine (Adderall) (Greenhall et al., 2002).
- An "All-nighter" is an event that occurs when an individual refrains from sleeping all night.
- Sleepiness is defined as "the inability or difficulty in maintaining alertness during the major wake period of the day, resulting in unintended lapses into drowsiness or sleep" (Hershner & Chervin, 2014, p. 73).
- Exercise is defined as "planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective" (World Health Organization, n.d.a., p. 3).

- Physical activity is defined as “any bodily movement produced by skeletal muscles that requires energy expenditure” (World Health Organization, n.d.a., p. 1).
- Exercise intensity refers to the degree at which the activity is being performed. In addition, it refers to the magnitude of the exertion required to perform an activity or exercise (World Health Organization, n.d.c.).
- Moderate Exercise includes: walking fast, water aerobics, riding a bike on level ground or with few hills, doubles tennis, pushing a lawn mower, hiking, skateboarding, rollerblading, volleyball, and basketball (Clemente et al., 2016).
- Strength Exercise includes: lifting weights, working with resistance bands, doing exercises that use your own body as weight, such as push-ups and sit-ups, heavy gardening, and yoga (Clemente et al., 2016).
- Vigorous Exercise includes: jogging or running, swimming fast, riding a bike fast or on hills, singles tennis, football, rugby, skipping rope, hockey, aerobics, gymnastics, and martial arts (Clemente et al., 2016).

**Summary**

In order to make healthy recommendations to PA students, it is important to determine the correlation between caffeine, sleep and exercise as they are related to academic performance. This study is significant because there is a lack of research which compares these factors to academic performance in PA students. By surveying PA students from three different MN programs and by comparing their caffeine, sleep and exercise habits to their academic success, this study will be able to draw conclusions about the best strategies for improved academic performance. The next chapter will

investigate what is appropriate caffeine consumption, sleep and exercise as well as what values and behaviors would be deemed inappropriate or excessive. In addition, the literature review will investigate how the activities of caffeine consumption, sleep and exercise are related to academic performance among students. By establishing a link between these habits and academic performance, this study can propose healthy recommendations to graduate students.

# Chapter 2: Literature Review

## Introduction

In the United States, more than 80 percent of the American population consumes caffeine, with an average intake of around 200 mg daily (Mitchell, Knight, Hockenberry, Teplansky, & Hartman, 2014). Modest caffeine intake of about 200-300 mg a day is actually beneficial to health by increasing mental performance and by decreasing fatigue and tension in the smooth muscles of the vasculature (Górnicka et al., 2013). However, excessive daily intake of over 400 mg may lead to agitation, sleep disturbances, anxiety, irritability, nervousness and insulin resistance (Górnicka et al., 2013). According to Górnicka et al. (2013), long-term and excessive caffeine intake "may lead to addiction and adverse health consequences" (p. 114). In addition, an inadequate and irregular sleep cycle has also been identified as a major cause of poor academic performance (Eliasson, Lettieri, & Elliasson, 2009). Furthermore, physical activity and exercise has been found to have a significant positive correlation on memory retention and consolidation (van Dongen et al., 2016). This literature review will investigate how these three common habits influence the academic performance of students. In addition, this review will outline the recommendations for appropriate caffeine consumption, sleep habits, and adequate exercise. We will also define what is excessive or inadequate caffeine consumption, sleep, and exercise. Finally, we will define how these factors influence academic performance in students.

## Caffeine Usage

Caffeine is one of the most widely used neurologic stimulant drugs in the world (Mednick et al., 2008). Caffeine increases wakefulness, concentration, and helps

individuals to focus better (Mayo Clinic, 2014). Caffeine is consumed mostly in the form of drinks such as tea, coffee, chocolate products, energy drinks, red bull, energy shots, and over the counter caffeine pills (Mclellan, Caldwell, & Lieberman, 2016). A safe daily caffeine intake is regarded as one not exceeding 400 mg (Górnicka et al., 2013). Mclellan et al. (2016) agrees and states, "up to 400 milligrams (mg) of caffeine a day appears to be safe for most healthy adults which is equivalent to about four cups of brewed coffee, 10 cans of cola or two 'energy shot' drinks" (p. 4). The stimulant effect of caffeine is dependent on the dosage and/or the individuals' energy state. Caffeine has been found to consistently improve the individual's mood, reaction time, and vigilance when alertness is reduced, and therefore, caffeine is particularly useful in fatiguing circumstances (Mclellan et al., 2016). Interestingly, individuals who are well rested obtain the stimulating effect of caffeine from a lower dose of 200 mg of caffeine whereas a higher dose ranging from 200-600 mg is required in a sleep deprived individual (Mclellan et al., 2016). However, addiction or dependence may occur with repetitive caffeine use. Individuals who are undergoing caffeine withdrawal may experience symptoms such as "headache, irritability, inability to concentrate, drowsiness, and insomnia" which may appear within 12 to 24 hours after discontinuation of caffeine intake (Pandejpong, Paisansudhi, & Udompunthurak, 2014, p. 190). While excessive caffeine consumption is prevalent among the population, sleep deprivation is also a very common incidence.

**Sleep Habits**

Adequate sleep is very important for a person to be healthy and maintain optimum body functioning. The amount of adequate sleep varies based on the individual's age. For example, adults are recommended to sleep at least seven to nine hours each night (Olson,

2016). Sleep deprivation is a very common health phenomenon among a wide variety of age groups in the United States (American Sleep Association, 2007). A study performed by the Center for Disease Control and Prevention found that "about 7–19 percent of adults in the United States reported not getting enough rest or sleep every day" (PubMed Health, 2014, p. 12). Sleep deprivation makes an individual less productive and interferes with their personal, professional and social life. One of the other significant influences on an individual's daily functioning, is the amount of exercise that they participate in during an average week.

**Adequate Exercise**

Regular physical activity and exercise is essential for good physical and mental health and healthy living. First, there is a significant difference between the terms "physical activity" and "exercise." Physical activity is defined as "any bodily movement produced by skeletal muscles that requires energy expenditure" (World Health Organization, n.d.a., p. 1). Physical activity ranges from planned physical activities of aerobic exercise, to strength training, and to daily activities such as walking, cycling, house work, and gardening (World Health Organization, n.d.b.,). Exercise, is a subcategory of physical activity that is defined as "planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective" (World Health Organization, n.d.a., p. 3).

Another component of exercise that is important to consider is the intensity of the activity. According to the World Health Organization, intensity refers to the degree at which the activity is being performed. In addition, it refers to the magnitude of the

exertion required to perform an activity or exercise (World Health Organization, n.d.c.). The intensity of a similar physical activity may vary from person to person based on their age, physical build, weight and previous exercise experience (World Health Organization, n.d.c.). In order to maintain optimum health, both moderate and intense physical activity is necessary. According to the World Health Organization, it is recommended that adults between the ages of 18-64 should do at least 150 minutes of moderate-intensity aerobic physical activity a week (n.d.c.). In addition, it is recommended that people in this age group "complete at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate-and-vigorous-intensity activity" (World Health Organization, n.d.c.).

**Students' Caffeine Consumption**

Students are notorious for excessively consuming caffeine (Azagba et al., 2014). As a central nervous system stimulant, caffeine works to augment alertness and increase muscle performance (Pandejpong et al., 2014). College students are enticed by caffeine's properties to increase alertness, improve mood, and enhance mental and physical energy (Azagba et al., 2014). However, subsequently caffeine may "activate dopaminergic-reward system in the brain and thence could lead to addiction" (Górnicka et al., 2013, p. 114). Therefore, caffeine could directly affect the portions of the brain that are responsible for performance, planning, and emotional control (Górnicka et al., 2013). Also, most energy drinks contain caffeine in conjunction with other chemicals such as guarana, taurine, inositol, group B vitamins, glucuronolactone which further enhance the action of caffeine (Górnicka et al., 2013). In addition, a study performed in Thailand on Siriraj pre-clinical year medical students found that "more than half of all respondents

admitted that they used caffeine specifically for energy-boosting purpose (Pandejpong et al., 2014, p. 191). While there are studies that focus on the effect of caffeine in the student population, there were not any studies that focused on the Physician Assistant student population, nor were there studies that were conducted in the United States. Although caffeine usage aids an individual in staying awake and alert, it also disrupts the normal sleep cycle, often causing daytime fatigue and sleepiness.

**Daytime Sleepiness in Students**

Students with a habit of excessive caffeine consumption also commonly complain of daytime sleepiness (Hershner & Chervin, 2014). According to Hershner and Chervin (2014), 50% of college students experience daytime sleepiness whereas 36% of adolescents and adults report daytime sleepiness (Hershner & Chervin, 2014). Of the college students surveyed, 60% of the students reported that they were "dragging, tired or sleepy" at least 3 days a week (Hershner & Chervin, 2014, p. 73). Sleepiness is defined as "the inability or difficulty in maintaining alertness during the major wake period of the day, resulting in unintended lapses into drowsiness or sleep" (Hershner & Chervin, 2014, p. 73). Daytime sleepiness can have numerous adverse side effects on the student's overall health. For example, daytime sleepiness has been found to be associated with "reduced emotional intelligence, impaired constructive thinking skills, poor academic performance, job loss, headaches, and obesity" (Tran et al., 2014, p. 2). Another study confirmed that daytime sleepiness was associated with "lower academic performance, impaired social relationships, more risk-taking behavior, and poorer overall health" (Sanchez et al., 2013, p. 2). In a study examining Thai college students, researchers determined that students with daytime sleepiness were more likely to have poorer overall

health (Tran et al., 2014). For instance, the students were more likely to be cigarette smokers, alcohol drinkers, obese, physically inactive, and stimulant beverage consumers (Tran et al., 2014). Due to the high demands and stresses of college, most undergraduates sacrifice sleep and substitute with caffeine for the sake of their academic performance (Tran et al., 2014). Also, increased light exposure due to keeping the lights on late at night while studying, leads to melatonin suppression (Tran et al., 2014). Increased light exposure paired with caffeine's role of blocking adenosine receptors promotes sleepiness (Tran et al., 2014). Tran et al. concluded that Thai students who participated in this behavior had prolonged wakefulness and decreased sleep duration resulting in daytime sleepiness (Tran et al., 2014).

Caffeine consumption has been found to be a common habit that coincides with sleep deprivation. According to Hershner & Chervin (2014), the effects of caffeine "lasted 5.5–7.5 hours, suggesting that caffeine consumed even in the afternoon could impair the ability to fall asleep" (p. 76). Afternoon caffeine intake therefore reduces sleep and perpetuates wakefulness. A study of Peruvian college students found that "students who consumed different types of caffeinated beverages including popular energy drinks had higher odds of poor sleep quality compared with those who abstained from caffeine" (Sanchez et al., 2013, p. 1). Also, "insufficient sleep time, with associated sleepiness, fatigue, and inattentiveness, has been identified as a major cause of poor academic performance among high school and college-aged students" (Eliasson et al., 2009). For this reason, it is essential to identify the issue of daytime sleepiness in students since this can have an influence on their academic performance.

**Students and Inadequate Exercise**

On top of inadequate sleep, due to the high demands of college life and lack of free time, most students do not get enough exercise in a given week. According to the World Health Organization as cited in Clemente, Nikolaidis, Martins, & Mendes (2016), adults ranging from 18 to 64 years old are recommended to have at least 150 minutes of moderate exercise or 75 minutes of vigorous aerobic exercise weekly (Clemente et al., 2016). University students do not meet these recommendations for physical activity and were found to be less active (Clemente et al., 2016). In a study that surveyed 23 countries, the authors found that 40% of university students were deemed physically inactive (Clemente et al., 2016). Some of countries were more physically inactive than others with scores "ranging from 21.9% in Kyrgyzstan to 80.6% in Pakistan […] 60% to 72.6% of Spanish university students" (Clemente et al., 2016, p. 2). Also, a recent study by Deliens, Deforche, De Bourdeauhuij, & Clarys (2015), determined that nearly 40-50% of college students are deemed physically inactive. On average, university students spent up to eight hours a day on sedentary activities which included "studying, watching television, gaming, and computer activities" (Deliens et al., 2015, p. 1). A more recent study highlighted the importance of exercise and found that a "single session of physical exercise after learning to exogenously boost memory consolidation and thus long-term memory" (van Dongen et al., 2016). In this study, the experimental group that performed a memory test four hours after moderate exercise was found to perform better on the test than the control group (van Dongen et al., 2016) This study found that "physical exercise acutely stimulates the release of several consolidation-promoting factors in humans" and therefore exercise could be used to improve memory retention (van Dongen et al., 2016).

Therefore, recommending students to follow the World Health Organization exercise guidelines could positively influence their overall academic performance. For this reason, it is important to determine whether students are staying active and achieving the recommended amount of weekly exercise.

**Effects of these Habits on Academic Performance**

Most students participate in the habits of caffeine intake, sleep and exercise, with the ultimate goal of improving their academic performance. However, interestingly, an excess or deficit of these habits has been found to have negative consequences on academic performance.

Trunzo et al., (2014) found that high school and college students who used stimulant drugs had significantly lower GPAs than non-stimulant users. Greenhill et al. (2002) defined stimulant drugs as prescription stimulants for the treatment of ADHD such as methylphenidate (Ritalin, Concerta), dextroamphetamine (Dexedrine), and mixed-salts amphetamine (Adderall). By the end of their first year in college, stimulant users had lower GPAs (Trunzo et al., 2014). Researchers also found a correlation between energy drink users and poor sleep, increased anxiety, and lower GPAs (Trunzo et al., 2014). They also determined that energy drink consumers had poorer problem solving skills (Trunzo et al., 2014). These authors suggested that people with higher problem-solving skills used energy drinks at a lower rate because they were better equipped to make informed decisions about their health and had more mature study habits (Trunzo et al., 2014). Trunzo et al. determined that energy drink usage was the most significant negative predictor of academic performance even compared to overall drug use, which consisted of alcohol, marijuana, and other stimulant drugs (Trunzo et al.,

2014). Therefore, college students should recognize the risks associated with energy drinks or excessive caffeine consumption, since students assume that these stimulants will help them stay awake to study and therefore improve their academic success. Behaviors of excessive caffeine consumption and forgoing sleep actually hinder academic performance which is contrary to student's beliefs (Trunzo et al., 2014). For this reason, students should be educated on study strategies and behaviors that have a positive correlation to academic performance. Despite a thorough literature review, there were no studies that specifically focused on how the habits of caffeine, sleep and exercise are related to Physician Assistant Students. In addition, there were no studies that investigated how these habits were related to the academic performance of Physician Assistant students.

**Summary**

Inappropriate caffeine, or inadequate sleep and exercise has a significant impact on a student's academic performance and mood (Hershner & Chervin, 2014). Since several studies have supported this relationship, this study investigates whether this association is present in the graduate PA student population. Specifically, this study will investigate how these three habits are related to academic performance amongst PA student cohorts from three separate schools. The next chapter will explain the procedure and the validity and reliability of the surveys.

# Chapter 3: Methodology

## Introduction

This quantitative, descriptive, cross sectional study looked at the relationship between academic performance and caffeine, sleep and exercise in Minnesota PA students. The research questions addressed as a part of this research are:

1. What is the significance of the effects of caffeine, sleep and exercise amongst Physician Assistant students on academic performance?
2. What amount of caffeine consumption, if any, has an influence on the grade point average of Physician Assistant students?
3. What amount of sleep, if any, has an influence on the grade point average of Physician Assistant students?
4. What amount of exercise, if any, that a Physician Assistant student participates in during an average week has an influence on their grade point average?
5. What percentage Physician Assistant students meet the recommendations for caffeine, sleep and exercise?

This chapter contains information concerning the study population, materials and instrumentation, procedures, statistical analysis and validity and reliability of the study.

## Study Population

The participants of this study were PA students from Bethel University, St. Catherine's University and Augsburg University. First, emails were sent to the Program Directors of each of the schools to request their student's participation in the survey

(Appendix A). In order to participate, students had to be currently enrolled in one of these PA schools. These three PA schools are in St. Paul or Minneapolis in the state of Minnesota. First year PA students were surveyed after they had completed at least one semester of PA school. In order to participate in this study, students must voluntarily agree to the consent statement prior to the start of the survey (Appendix B). Participants needed to also confirm that they are at least 18 years of age or older.

**Materials and Instrumentation**

In order to answer the research questions of this study, a survey using Qualtrics Survey Software was created. Qualtrics is an online survey tool which allows for researchers to generate their own survey and then send their survey directly to their subjects. This software immediately and anonymously records the responses of the participants right after the survey is submitted. This survey was emailed to each of the participant's student email addresses by the Program Directors of the PA schools. All survey responses were initially recorded on the Qualtrics website which is username and password protected.

The survey was organized into five sections. Section One inquired about the students' ages. Section Two asked about their caffeine consumption, Section Three asked about their sleep duration and Section Four asked the students about their exercise habits. Finally, Section Five asked the students to write their cumulative GPA at the end of their last completed semester of PA school. The survey questions are listed in Appendix C. According to the Qualtrics website, the survey took approximately 3-5 minutes for the participant to complete. The goal was to survey 90 students in order to increase statistical significance. A minimum of 30 students would be surveyed.

**Procedure**

This study examined the influence of caffeine, sleep and exercise on the academic performance of PA students. Academic performance was measured by asking for the students' cumulative GPA at the end of their last completed semester of PA school. In this research study, the dependent variable is the GPA of each student. The independent variables are the student's caffeine, sleep, and exercise habits. This study hypothesized that changes in the caffeine, sleep, or exercise habits of the PA students would have an influence on the students' GPA.

First, after the creation of the survey using Qualtrics Survey Software, the researchers received feedback about the survey questions from an expert panel. This panel consisted of Bethel University Psychology Graduate students. First, the participation of the students to participate in this survey was requested and then approved by the Program Director of Bethel University's Counseling Psychology graduate program. The Program Director disseminated the survey to the Psychology Graduate students (Appendix D & E). The students took the same survey that was intended to be sent to the study population. However, at the end of the survey, there was an additional question which requested feedback about their survey experience. The psychology graduate students confirmed that the questions were easy to understand and they made recommendations about questions that needed to be added, deleted or modified. Feedback was received from six Psychology Graduate students (Appendix F). The most common criticism of the survey questions was that there was not an option for weekly caffeine usage. Some of the students did not drink caffeine daily but only had a few cups of coffee or tea a week. The survey was updated so that there would be an option for both daily and

weekly caffeine consumption for each of the caffeine categories. This student population was selected to take part in the expert panel because this population was similar to the study population. These students are in graduate school, are in a similar age range, and attend a school in the area where the survey was conducted on the study population.

After the appropriate changes were made to the survey, the Program Directors of Bethel University, St. Catherine's University, and Augsburg University were contacted. Approval from Bethel University, St. Catherine's University and Augsburg University are in Appendix G. Once approval was obtained from the Bethel IRB, the Program Directors of each PA program disseminated the survey (Appendix H). They sent a Qualtrics link of the survey to each of their students as well as instructions on how to complete the survey (Appendix I). Participants were asked to complete the survey within four weeks of receiving the email. A reminder email was sent out two weeks after they initially receive the survey (Appendix J).

At the start of the survey, participants read the consent statement. This statement affirms that each of the student's private responses will remain confidential and their responses will be anonymous. Participants were not asked to disclose their name nor for any identifying information such as the PA school that they attend. If the student agreed to participate in the research study, they selected the "Yes" option after reading the Informed Consent prior to starting the Qualtrics survey. If the student chose not to participate, they selected "No," and the survey concluded and they were not able to answer any survey questions. The response data was be initially collected and stored on the Qualtrics website which was username and password protected. Next, the data was downloaded onto the researchers' personal computers and analyzed using Microsoft

Excel. These personal computers are username and password protected. After the research project concluded the data was stored on a locked external storage device at the Bethel Physician assistant program at the Anderson Center for a minimum of 5 years.

**Statistical Analysis**

In the statistical analysis, several separate unpaired, two-sample T-tests were performed in order to determine the statistical significance between the three measured variables and the students' GPA. For the caffeine section of the survey, the total amount of caffeine that the student consumed on an average day was calculated and it was determined if there is a statistical significance between their caffeine habits and their GPA. Next, it was determined if there was a statistical significance between hours of sleep on a week night, weekend night, number of "all-nighters" and the students' GPA by running separate unpaired, two-sample T-tests. In the exercise section, it was determined whether participants met the World Health Organization recommendations for weekly exercise and whether there was a significance between their GPA and the amount of exercise that they participate in on a weekly basis. By using unpaired, two-sample T-tests, it was possible to determine the significance of the variables as they are related to the GPA of PA students and thereby answer the research questions.

**Validity and Reliability**

Neither the validity nor the reliability of this study can be determined since this was a new survey tool. This study cannot determine the consistency or the accuracy of the survey results since this survey tool has not been used in a prior study. If this research tool were to be used in a subsequent study, it would be possible to determine the validity and reliability by comparing the results of both studies.

**Summary**

In conclusion, the goal of this study was to assess the relationship between caffeine, sleep and exercise and the academic performance of Physician Assistant students. In addition, this study determined whether PA students from Bethel University, St. Catherine's University and Augsburg University met the recommendations for caffeine consumption, sleep duration and exercise. The survey consisted of five sections which collected information concerning the students' age, caffeine, sleep and exercise habits. Finally, the survey asked for the students' GPAs from the last completed semester of PA school. Once the responses were obtained, unpaired, two-sample t-tests were used to determine whether there was a statistical significance between the caffeine, sleep, and exercise habits of students and their GPA. The next two chapters will include the analysis of the survey data as well as the findings and limitations that were encountered. Finally, recommendations were made if this type of study were to be repeated.

# Chapter 4: Results

## Introduction

The purpose of this study was to determine the significance of caffeine consumption, sleep and exercise habits on PA student academic performance. By determining if there is a significance between these variables, recommendations could be provided to advance academic performance amongst PA students. A Qualtrics survey was created to identify whether the habits of caffeine consumption, sleep and exercise had a correlation to PA students' academic performance. This chapter explains the data that was collected from the Qualtrics survey from three PA schools in Minnesota. Tables and graphs are used to display trends from the numerical data regarding caffeine, sleep and exercise habits. The process of data collection and analysis are discussed in this chapter.

## Demographics

In order to maintain confidentiality, the Qualtrics survey did not ask for any identifiable information from the survey participants including the participant's name, age, or the PA program he/she is attending. There were fifty students who consented to participate in the survey which constitutes 56% of the total 90 possible participants. The average age of the participants was 26.5 years old. The youngest student was 22 years old and the oldest student was 46 years old.

## Setting Parameters

The variables which were evaluated in this study are caffeine, sleep and exercise. In order to determine if there is a relationship between these variables and the participant's academic performance, parameters were set for each variable. These parameters were set based on the daily recommendations for caffeine consumption, sleep

**Recommendation Parameters Defined**

and exercise. For example, a recommended daily caffeine intake is regarded as not exceeding 400 mg (Górnicka et al., 2013). It is also recommended to have at least 7 hours of sleep each night (American Sleep Association, 2007). Finally, according to the World Health Organization, it is advised to participate in:

> "Option 1: at least 150 minutes of moderate-intensity aerobic physical activity a week (cycling, walking) and Strength exercise 2 or more days a week OR Option 2 at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week (running, biking fast, aerobics) and Strength exercise 2 or more days a week" (World Health Organization, n.d.c.).

Based on these daily recommendations, parameters were set and each variable was divided into two categories. For instance, caffeine consumption over the daily recommended maximum consumption was deemed "Excessive" and under the recommended amount was "Acceptable." These categories are described in Table 1. The participants' GPAs for each variable were then organized into the appropriate category.

In order to answer the research questions, unpaired, two-tailed T-tests were run in Excel to compare the GPAs of the categories for each variable. These T-tests were run to determine if there was a statistically significant difference in the participants' GPAs if they met or exceeded the recommendations.

| Variable | CAFFEINE | | SLEEP | | EXERCISE | |
|---|---|---|---|---|---|---|
| Category | Acceptable | Excessive | Adequate | Deficient | Adequate | Inadequate |
| Parameter | < 400 mg | ≥ 401 mg | > 7 hours | ≤ 6.9 hours | Met Option 1 or 2 | Did NOT meet Option 1 or 2 |

Table 1. Recommendation Parameters Defined. Table describing the parameters set for each variable based on recommendations made by Gornica et al., 2013, the American Sleep Association, 2007 and the World Health Association, n.d.c.

**Influence of Caffeine on GPA**

The caffeine section of the Qualtrics survey inquired about the amount of caffeine that the students consumed on a daily basis. Students were asked to disclose whether they consumed caffeine pills, coffee, caffeinated tea, soda and/or energy drinks. In order to determine whether caffeine consumption had an influence on the grade point average of Physician Assistant students, it was necessary to calculate the average mg of caffeine consumed on a daily basis. First, the average milligrams of caffeine in the caffeinated products was determined (Table 2). Then, average daily caffeine consumption was calculated by adding the total daily milligrams of caffeine consumed. Also, participants were asked to disclose whether they used caffeine to compensate for sleep. 82% of participants admitted to using caffeine to compensate.

| Caffeine Product | Volume of Beverage | Average mg of Caffeine (mg) |
|---|---|---|
| Caffeine Pills | NA | 200 mg |
| Brewed Coffee | 8 oz | 130 mg |
| Caffeinated Black Tea | 8 oz | 36.5 mg |
| Caffeinated Soda | $\frac{35\ mg\ caffeine}{237\ mL\ of\ Cola} = \frac{0.15\ mg\ caffeine}{1\ mL\ of\ Cola}$ | |
| Monster Energy Drink | 8 oz | 86 mg |

Table 2. Mg of Caffeine per volume. Table indicating the average mg of caffeine per volume in various caffeinated beverages. Average mg of caffeine for caffeinated soda was calculated by determining the mg per 1 mL of Cola.

After the total daily mg of caffeine was calculated for each participant, the caffeine data was organized into the appropriate category. The GPAs of participants who consumed less than or equal to 400 mg of caffeine were designated to the "Acceptable" group and those who consumed greater than or equal to 401 mg of caffeine was assigned to the "Excessive" group. An unpaired, two-tailed T-test was performed in order to determine if there was a statistically significant correlation between the GPAs of participants who consumed "Acceptable" caffeine and those who consumed "Excessive" caffeine. This T-test was chosen in order to ascertain if the null hypothesis could be accepted or rejected. The null hypothesis is that there was no significance between daily caffeine consumption and the PA student's GPA. It was determined that there is no statistical difference between "Acceptable" caffeine consumption GPAs (3.708 $\pm$ 0.1616; mean $\pm$ SD) and "Excessive" caffeine consumption GPAs (3.686 $\pm$ 0.3134; T-Test, p=0.4143) (Table 3). Since the p-value is greater than 0.05, this data is insignificant, meaning that there was not a significant difference in the GPAs of students who exceeded the recommended daily maximum of caffeine consumption.

| **Variable** | CAFFEINE | |
|---|---|---|
| **Category** | **Acceptable** | **Excessive** |
| **Parameter** | $\leq$ 400 mg | $\geq$ 401 mg |
| **Mean GPA** | 3.708 | 3.686 |
| **# of Participants** | 44 | 5 |
| **Standard Error** | 0.0244 | 0.140 |
| **P-Value** | **0.4143** | |

| Statistically Significant? | NO |
|---|---|
| Average of All Participants | 258.2 mg |
| Average of Participants Meeting Recommendation | 225.4 mg |
| Average of Participants NOT Meeting Recommendation | 513.5 mg |
| Percentage of Participants Meeting Recommendations | 88% |

Table 3. Relationship Between Caffeine Consumption and GPA. Unpaired (2-sample) T-Test of caffeine consumption vs. GPA. "Acceptable" caffeine GPA ($\bar{x}$= 3.708, SD= 0.1616) and "Excessive" caffeine GPA ($\bar{x}$= 3.708, SD= 0.3134) have a p value of 0.4143.

In addition, when the total daily caffeine consumption for each participant was plotted against their respective GPAs, the slope of the trendline was only 0.0002 (Figure 1). This indicates that there was not a lot of variability between the GPAs of the students who were surveyed.

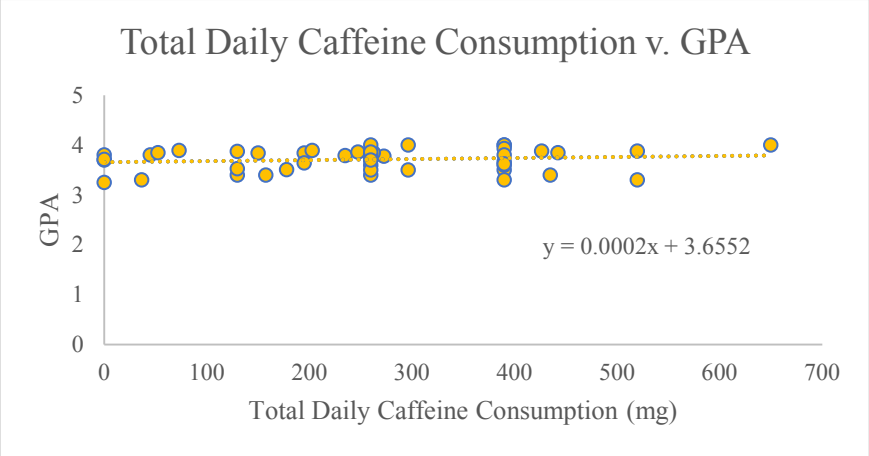


Figure 1. Total Daily Caffeine Consumption vs. GPA. Total daily caffeine consumption (mg) is plotted against the student's GPA. The standard deviation is 147.83. The slope of the line is 0.0002.

**Influence of Sleep on GPA**

Next, the sleep portion of the survey was assessed to determine if sleep had an influence on student's GPA. The survey inquired about the average hours of sleep that the participant got on a week night and weekend night. It also inquired if the PA students

participated in “All Nighters” and if so, how many times a month. First, the “Week Night” sleep GPAs were organized into the appropriate category. The GPAs of participants who slept greater than or equal to 7 hours was designated to the “Adequate” group and those who slept less than or equal to 6.9 hours was assigned to the “Deficient” group. An unpaired, two-tailed T-test was performed in order to determine if there was a statistically significant correlation between the GPAs of participants who slept an “Adequate” amount and those who had “Deficient” sleep. There is no statistical difference between “Adequate” sleep GPAs on a week night (3.712 $\pm$ 0.2087) and “Deficient” sleep GPAs (3.696 $\pm$ 0.2350; T-Test, p=0.4210) (Table 4). Also, there was no statistical difference between “Adequate” sleep on weekend night (3.713 $\pm$ 0.2097) and “Deficient” sleep GPAs (3.630 $\pm$ 0.3253; T-Test, p=0.2967) (Table 4). Since the p-values are greater than 0.05, this data is insignificant, meaning that there was not a significant difference in the GPAs of students who were deficient in sleep on a week night or weekend night. Finally, there was no statistically significant difference in students who participated in All Nighters (3.649 $\pm$ 0.1941) and those who did not (3.715 $\pm$ 0.2138; T-Test, p=0.2780) (Table 4).

| Variable | Week Night SLEEP | | Weekend Night SLEEP | | "All Nighters" | |
|---|---|---|---|---|---|---|
| **Category** | **Adequate** | **Deficient** | **Adequate** | **Deficient** | | |
| **Parameter** | ≥ 7 hours | ≤ 6.9 hours | > 7 hours | ≤ 6.9 hours | **NO** | **YES** |
| **Mean GPA** | 3.712 | 3.696 | 3.713 | 3.630 | 3.715 | 3.649 |
| **# of Participants** | 41 | 9 | 48 | 2 | 46 | 1 |
| **Standard Error** | 0.032598 | 0.078322 | 0.03027 | 0.23 | 0.0315 | 0.09704 |
| **P-Value** | **0.4210** | | **0.2967** | | **0.2780** | |
| **Statistically Significant?** | **NO** | | **NO** | | **NO** | |
| **Average of All Participants** | 7.36 hours | | 8.15 hours | | | |
| **Average of Participants Meeting Recommendation** | 7.720 hours | | 8.260 hours | | | |
| **Average of Participants NOT Meeting Recommendation** | 5.722 hours | | 5.50 hours | | | |
| **Percentage of Participants Meeting Recommendations** | 82% | | 96% | | | |

Table 4. Relationship Between Sleep and GPA. Unpaired (2-sample) T-Test of Week Night Sleep vs. GPA. "Adequate" sleep GPA ($\bar{x}$= 3.712, SD= 0.2087) and "Deficient" sleep GPA ($\bar{x}$= 3.696, SD= 0. 2350) have a p value of 0. 4210. Unpaired (2-sample) T-Test of Weekend Night Sleep vs. GPA. "Adequate" sleep GPA ($\bar{x}$= 3. 713, SD= 0. 2097) and "Deficient" sleep GPA ($\bar{x}$= 3. 630, SD= 0. 3253) have a p value of 0. 2967. Unpaired (2-sample) T-Test of All Nighters vs. GPA. No All Nighter GPA ($\bar{x}$= 3. 715, SD= 0. 2138) and All Nighter GPA ($\bar{x}$= 3. 649, SD= 0.1941) have a p value of 0. 2780.

In addition, when the total hours of sleep for each participant was plotted against their respective GPAs for a week night and weekend night, the slope of the trendline was -0.018 and -0.00056 respectively (Figure 2 & 3). This indicates that there was not a lot of variability in the GPAs of the students who were surveyed.

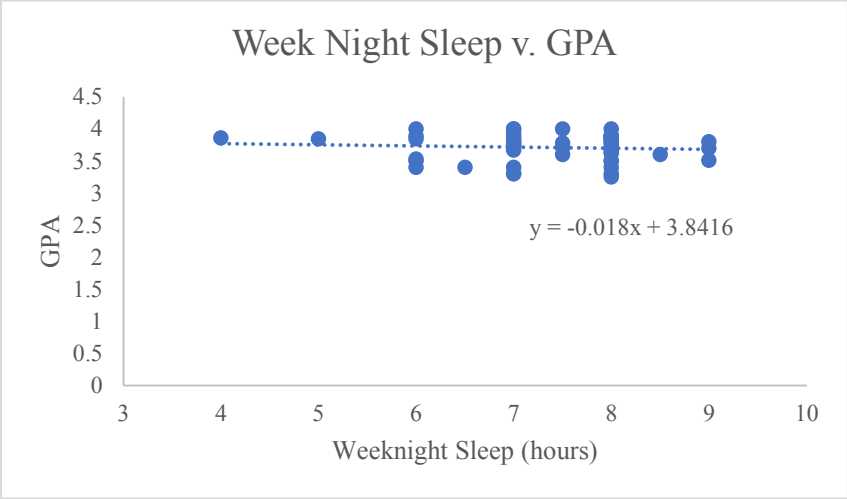


Figure 2. Week Night Sleep vs. GPA. Week night sleep (hours) is plotted against the student's GPA. The standard deviation is 0.9899. The slope of the line is -0.018.

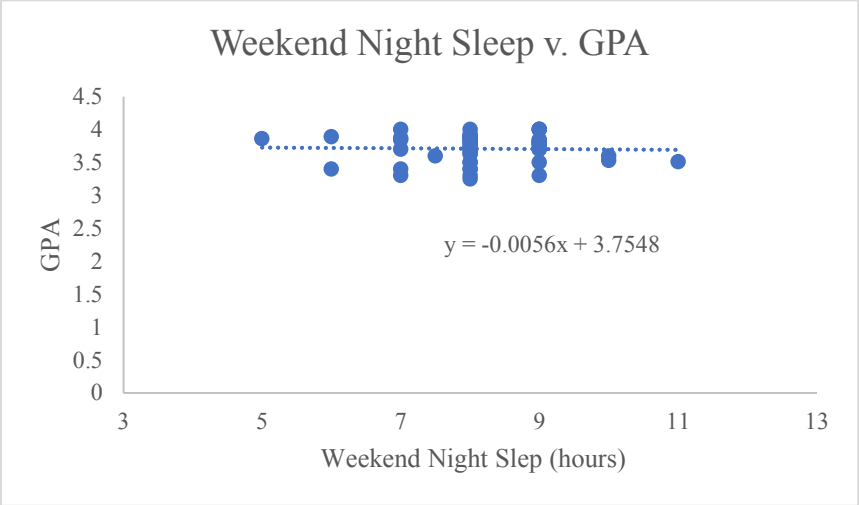


Figure 3. Weekend Night Sleep vs. GPA. Weekend night sleep (hours) is plotted against the student's GPA. The standard deviation is 1.041. The slope of the line is -0.0056.

**Influence of Exercise on GPA**

Participants were then asked detailed questions about their exercise habits in order to determine if they were meeting the weekly exercise recommendations as proposed by the World Health Organization (World Health Organization, n.d.c.). They were asked to disclose the average weekly minutes they participated in moderate, vigorous and strength

exercise. Each student's exercise profile was examined and determined if they met Option 1 or Option 2 of the World Health Organization recommendations. The GPAs of participants who met Option 1 or 2 were designated to the "Adequate" category and those who did not were in the "Inadequate" category. Only 16 participants met Option 1 or 2 and 34 participants did not meet the recommendations (Figure 4).

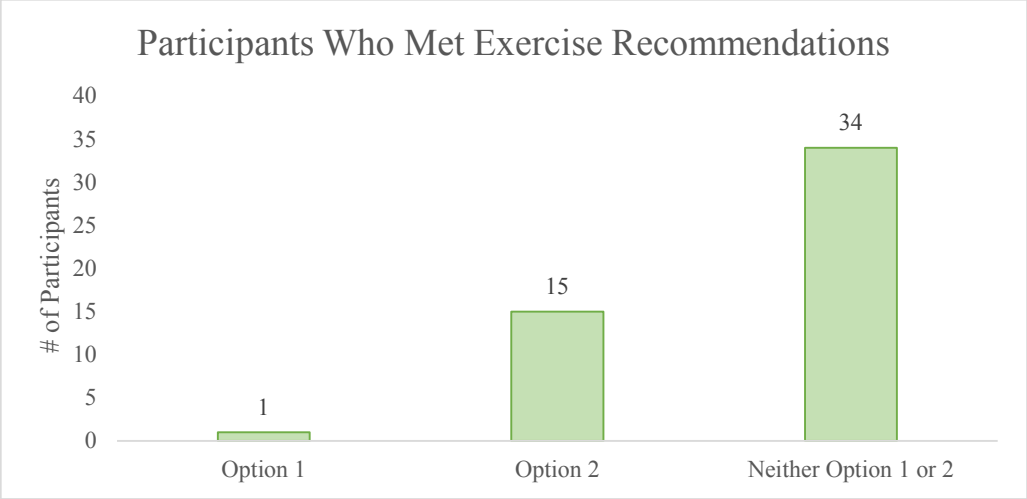


Figure 4. Participants Who Met Exercise Recommendations. Figure depicting the number of participants who met Option 1, Option 2 or Neither Option 1 or 2. Only 16 participants met the recommendations for Option 1 or Option 2 as set by the World Health Organization. 34 participants did not meet these recommendations.

An unpaired, two-tailed T-test was performed in order to determine if there was a statistically significant correlation between the GPAs of participants who met the exercise recommendations and those who did not. There is no statistical difference between "Adequate" exercise GPAs ($3.671 \pm 0.2216$) and "Inadequate" exercise GPAs ($3.727 \pm 0.2071$; T-Test, $p=0.1931$) (Table 5). Since the p-values are greater than 0.05, this data is insignificant, meaning that there was not a significant difference in the GPAs of students who had inadequate weekly exercise.

| Variable | EXERCISE | | |
|---|---|---|---|
| **Category** | **Adequate** | **Inadequate** | |
| **Parameter** | Met Option 1 or 2 | Did **NOT** Meet Option 1 or 2 | |
| **Mean GPA** | 3.671 | 3.727 | |
| **# of Participants** | 16 | 34 | |
| **Standard Error** | 0.05539 | 0.03552 | |
| **P-Value** | **0.1931** | | |
| **Statistically Significant?** | **NO** | | |
| **Type of Exercise** | **Moderate** | **Vigorous** | **Strength** |
| **Average of All Participants** | 133.3 min | 98.9 min | 68.74 min |
| **Average of Participants Meeting Recommendation** | 102.19 min | 160.63 min | 87.19 min |
| **Average of Participants NOT Meeting Recommendation** | 147.94 min | 69.85 min | 60.059 min |
| **Percentage of Participants Meeting Recommendations** | 32% | | |

Table 5. Relationship Between Exercise and GPA. Unpaired (2-sample) T-Test of Exercise vs. GPA. "Adequate" exercise GPA ($\bar{x}$= 3.671, SD= 0.2216) and "Inadequate" exercise GPA ($\bar{x}$= 3.727, SD= 0.2071) have a p value of 0.1931.

**Participants Meeting Recommendations**

Finally, it was determined if caffeine, sleep and exercise had an influence on GPA in the PA students surveyed. The GPAs of students who met all the caffeine, sleep and exercise requirements (3.681 $\pm$ 0.2071) were compared to the GPAs of students who did not meet all of the recommendations (3.717 $\pm$ 0.2144; T-Test, p=0.3097) (Table 6).

| Variable | MET RECOMMENDATIONS | |
|---|---|---|
| **Parameter** | **Met ALL** | **Did NOT Meet ALL** |
| **Mean GPA** | 3.681 | 3.717 |
| **# of Participants** | 11 | 39 |
| **Standard Error** | 0.06244 | 0.03432 |
| **P-Value** | **0.3097** | |
| **Statistically Significant?** | **NO** | |

Table 6. Relationship Between Meeting Recommendations and GPA. Unpaired (2-sample) T-Test of Meeting Recommendations vs. GPA. Meeting All Recomendations GPA ($\bar{x}$= 3.681, SD= 0.2071) and Not Meeting All Recommendations GPA ($\bar{x}$= 3.717, SD= 0.2144) have a p value of 0.3097.

Since the p-value is greater than 0.05, this data is insignificant, meaning that there was not a significant difference in the GPAs of students who met all requirements. Only 22% of participants met all the caffeine, sleep and exercise requirements (Table 7).

| Variable | CAFFEINE | Week Night SLEEP | Weekend Night SLEEP | EXERCISE | Met All Recommendations |
|---|---|---|---|---|---|
| # of Participants | 44 | 41 | 48 | 16 | 11 |
| Percentage of Participants that Met Recommendations | 88% | 82% | 96% | 32% | 22% |

Table 7. Percentages of Participants Meeting Recommendations. Table indicating the percentage of participants who met the requirements for each variable

There was not a statistical significance between the GPAs of students who met the requirements of any variable (Table 8).

| Variable | CAFFEINE | | Week Night SLEEP | | Weekend Night SLEEP | | "All Nighters" | | EXERCISE | | Met ALL Recommendations | Did NOT Meet All Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Acceptable | Excessive | Adequate | Deficient | Adequate | Deficient | NO | YES | Adequate | Inadequate | | |
| Mean GPA | 3.708 | 3.686 | 3.712 | 3.696 | 3.713 | 3.630 | 3.715 | 3.649 | 3.671 | 3.727 | 3.681 | 3.717 |
| # of Participants | 44 | 5 | 41 | 9 | 48 | 2 | 46 | 4 | 16 | 34 | 11 | 39 |
| P-Value | 0.4143 | | 0.4210 | | 0.2967 | | 0.2780 | | 0.1931 | | 0.3097 | |
| Statistically Significant? | NO | | NO | | NO | | NO | | NO | | NO | |

Table 8. Comparing All Variables. Table indicating the results of the unpaired two-sample T-Tests assuming equal variances for each variable. Since the p-values for each t-test are greater than the significance level of 0.05, the null hypothesis cannot be rejected. Therefore, there is no statistical significance between each variable and the participant's GPA.

Figure 5 illustrates the percentage of students who met the requirements for each variable.

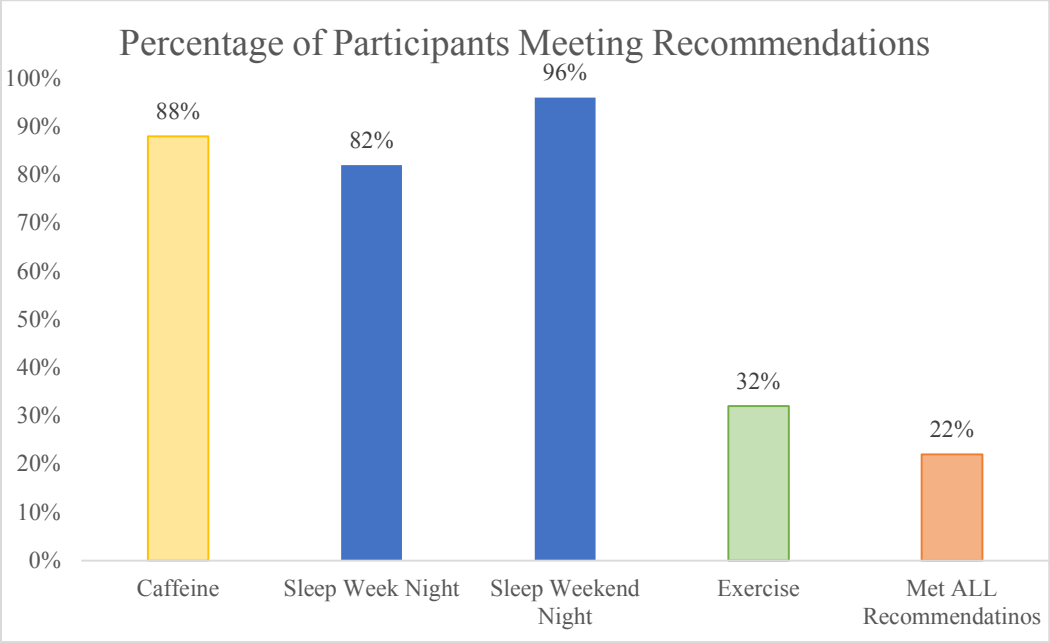


Figure 5. Percentage of Participants Meeting Requirements. Figure displaying the percentage of students who met the requirements for each variable.

## Summary

In conclusion, the survey data was analyzed to determine the relationship between caffeine, sleep, and exercise and the academic performance of Physician Assistant

students. Only 22% of participants in this study met the recommendations for caffeine consumption, sleep and exercise. Unpaired, two-sample t-tests were used to determine whether there is a statistical significance between the caffeine, sleep, and exercise habits of students and their GPA. There was no relationship to the participants' GPA, regardless of the amount of caffeine, sleep and exercise obtained by the student. The next chapter will include the discussion of these results as well as the limitations that were encountered. Recommendations will also be made if this study were to be repeated.

# Chapter 5: Discussion

## Introduction

It has been established that most students participate in excessive caffeine consumption and forfeit sleep and exercise during their college years. However, as discussed in Chapter 2, these habits have consequences on student's academic performance. This study sought to further develop the link between these variables and student's GPA. This chapter will draw conclusions from the statistical analysis. In addition, it will remark on the limitations of this study as well as recommendations for further research.

## Caffeine Consumption Influence on GPA

This study sought to answer if caffeine consumption had an influence on PA Student GPA. Eighty-two percent of students admitted to consuming caffeine in order to compensate for lack of sleep and participants consumed an average of 258.23 mg of caffeine on an average day. Ninety-two percent of the participants consumed caffeine on an average day. An unpaired, two-sample T-Test was run and had a p-value of 0.4143. Since this p-value is greater than 0.05, the null hypothesis cannot be rejected and there is no statistical significance between the group of students who consumed "Acceptable" caffeine and those who consumed "Excessive" caffeine. Although this study was not statistically significant, there has been substantial research which has examined the risks of energy drink usage in young adults. Energy drinks are widely consumed by young adults because they are "thought to enhance performance and alertness" (Manchester, Eshel, & Marion, 2017). In a 2017 study, researchers surveyed service members and found that "those who drank three or more energy drinks a day also were more likely to

report sleep disruption related to stress and illness and they were more likely to fall asleep during briefings or on guard duty" (Manchester et al., 2017). Another study identified in their survey results that among their sample population, 81% of participants had at least one energy product daily (Manchester et al., 2017). Of the respondents who used energy drinks, "83% experienced some degree of insomnia and 28% were using a prescription or over-the-counter sleep aid" (Manchester et al., 2017). Specifically related to academic achievement, another study examined undergraduate college students and their energy drink usage. They found that although "students report using energy drinks for school-related reasons, findings suggest that greater energy drink consumption is associated with a lower GPA, even after controlling for potential confounding variables" (Champlin, Pasch, & Perry, 2016). These confounding variables included "gender, race, weekend and weekday sleep duration, perceived stress, perceived stress management, media use, and past month alcohol use" (Champlin et al., 2016). Therefore, although the results of this study were not statistically significant, several other studies emphasize the negative correlation between excessive caffeine consumption and academic performance.

**Sleep Influence on GPA**

In regards to sleep, this study sought to determine if sleep had an impact on the student's GPA. In the survey, students were asked to disclose the hours of sleep they got on an average week night and weekend night. They were also asked to answer if they participated in "All-Nighters." In order to determine if week night sleep had an influence on the participant's academic performance, an unpaired, two-sample T-Test was run which had a p-value of 0.4210. Again, since this value is greater than 0.05, this relationship is not statistically significant. Participants slept an average of 7.36 hours on a

week night. Similarly, a T-test was run comparing the students who received "Adequate" sleep on a weekend night and "Deficient" sleep on a weekend night. The p-value was 0.2967 and also statistically insignificant. Participants in the survey slept 8.15 hours on a weekend night. Finally, the group of students who participated in "All Nighters" was compared to the group of students who did not participate in "All Nighters." The p-value of the T-Test was 0.2780. Only four students participated in one "All Nighter" a month. Although none of the T-tests were statistically significant, according to Hershner & Chervin (2014), students "who obtained more sleep (long sleepers, ≥9 hours) had higher GPAs than short sleepers (≤6 hours): GPAs were 3.24 vs 2.74 on average, respectively" (p. 78). Also, later bedtimes were associated with lower GPAs (Hershner & Chervin, 2014). In a future study, it would be valuable to ask what time the students went to bed and what time they typically wake up in the morning.

**Exercise Influence on GPA**

For the exercise portion of the survey, participants were asked specific questions about their weekly exercise routine. These questions were developed based on the World Health Organization exercise recommendations. Each participant was asked specific questions about the amount of time (minutes) that they participated in moderate, vigorous and strength exercise. Then, it was determined if each participant met the recommendations for Option 1, Option 2 or neither Option 1 or 2. The participants who had "Adequate" weekly exercise were compared to the GPAs of participants who had "Inadequate" weekly exercise. An unpaired, two-sample T-test was run which had a p-value of 0.1931. Again, the p-value was not statistically significant. A meta-analysis performed in 2018 looked at 31 studies which also examined the link between exercise

and academic performance. They found that acute physical activity had a positive influence on attention in preadolescent children and longitudinal physical activity programs had a positive influence on executive functions (de Greeff, Bosker, Oosterlaan, Visscher, Hartman, 2018). They examined three subdomains of academic performance: mathematics, spelling and reading. Interestingly, they found that continuous, regular physical activity had the greatest influence on academic performance (de Greeff et al., 2018). Again, despite insignificant results, additional studies support the importance of exercise and its relationship to academic performance.

**Meeting All Recommendations Influence on GPA**

The final research question sought to answer whether there is a relationship between caffeine, sleep and exercise and PA student academic performance. The GPAs of participants who met the recommendations for caffeine, sleep and exercise were compared to the GPAs of the participants who did not meet the recommendations for all three variables. The p-value of the unpaired, two-sample T-test was 0.3097. This p-value is statistically insignificant. Only 22% of the participants met the recommendations for all three variables.

**Addressing Limitations**

Several limitations were encountered after analyzing the data acquired from the survey. As mentioned in Chapter 3, this study only examined PA students in the state of MN who were attending Bethel University, St. Catherine's University or Augsburg University. All students were in the first year of their program. The study population primarily consisted of young, Caucasian students. The average age of respondents was 26.5 years old.

New limitations that were encountered was a smaller than anticipated sample size. Perhaps due to this small sample size, the results of the unpaired, two-sample T-Tests were not statistically significant. This small sample size could have been due to the time of year that the surveys were sent out. Surveys were disseminated to the sample population near the end of the semester. For this reason, due to student's busy schedules, they may have chosen not to participate in the survey. Finally, the standard deviation between all GPAs submitted was only 0.2112. Since there is not a lot of variation between the GPAs of students surveyed it was difficult to find a correlation between the variables and the student's GPA. Since all students are in a rigorous graduate program, all students had high GPAs with an average GPA of 3.709. Due to the narrow distribution of GPAs among the sample population, it was difficult to determine if there is a correlation between the variables and the student's GPA.

**Further Research Suggestions**

There are several recommendations to be made if this type of study were to be repeated. For instance, there was a small sample size, only 50 students, in this study. Although the survey was sent to 90 PA students in the Twin Cities of MN, only 50 chose to respond in the allotted time. In addition, PA students were only surveyed from schools in the state of Minnesota. It would be helpful to survey students from other schools in the country to have more diverse demographics in the sample population. Also, it would be interesting to compare the habits of caffeine consumption, sleep and exercise in the undergraduate student population to the graduate student population. The majority of studies have been conducted in the undergraduate student level. Perhaps there is a

statistically significant correlation between caffeine, sleep and exercise in the undergraduate population but not the graduate student population. In addition, in order to improve the accuracy of the data that was collected, it would have been helpful to ask specific questions about caffeine consumption. Rather than asking about coffee, tea and soda consumed, it would have been more accurate to ask for specific brand names so that it would be possible to more accurately determine total daily mg of caffeine consumed. Finally, it would be interesting to examine how these habits change over time. For example, rather than asking for an average daily consumption of caffeine and participation in sleep and exercise, it would be helpful to see how these habits change over the course of a month. It would be beneficial to see how these variables change depending on exam schedules and school workload. This would allow the researchers to collect a more accurate account of caffeine consumed and sleep and exercise performed by students over time.

**Conclusion**

The goal of this study was to determine if there is a relationship between caffeine, sleep and exercise and the academic performance of Physician Assistant students. Since previous studies have examined the influence of these variables on academic performance in the undergraduate student population, this study sought to investigate how these habits influenced PA students. By identifying a link between these habits and academic performance, it would be possible to make healthy recommendations to students. This study identified the recommendations that adults should be meeting for caffeine, sleep and exercise and compared these recommendations to the survey data that was collected. Only 22% of participants in the study were found to meet all of the

recommendations for caffeine, sleep and exercise. Due to the small sample size and narrow distribution of GPAs among the sample population, there was not a statistically significant relationship between the variables and GPA.

Although the results of this study were not significant, it has been well established that increased caffeine consumption and lack of sleep and exercise have significant ramifications on academic performance. Since the results of the statistical analysis were not significant, it is not possible to draw conclusions from the survey results and make recommendations specific to PA students. Due to the high demands and stresses of college and graduate school, it is not surprising that many students sacrifice sleep and substitute with caffeine for the sake of their academic performance. Most students are unaware of the potential repercussions of these behaviors. Since it has been well established in the literature that caffeine, sleep and exercise have remarkable ramifications on academic performance in the undergraduate student population, further research is warranted to investigate this subject in the graduate student population.

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# APPENDICES

# APPENDIX A

## Request for Survey Participation from PA Schools

**Bethel University Participation Request**

Dear Wallace Boeve,

We are first year Physician Assistant Students from Bethel University. We are conducting a survey for our Master's Research Project and we would appreciate your students' participation. We would like to survey your first-year PA students who have completed at least one semester of PA school. The survey will consist of questions regarding caffeine consumption, sleep, and exercise habits. We are investigating a link between these behaviors and academic performance. We will also be asking for your students' cumulative GPA.

All responses will remain anonymous and we will not be asking for any identifiable information from the students.

If you would like more background information regarding our research study, we would be more than happy to provide it to you.

Please let us know if you would be willing to disseminate this survey to your students.

Thank you so much and we look forward to hearing back from you!

Sincerely,

Saira Haq. Bethel PA-S
Katelyn Walsh, Bethel PA-S

**St. Catherine's University Participation Request**

Dear Heather Bidinger,

We are first year Physician Assistant Students from Bethel University. We are conducting a survey for our Master's Research Project and we would appreciate your students' participation. We would like to survey your first-year PA students who have completed at least one semester of PA school. The survey will consist of questions regarding caffeine consumption, sleep, and exercise habits. We are investigating a link between these behaviors and academic performance. We will also be asking for your students' cumulative GPA.

All responses will remain anonymous and we will not be asking for any identifiable information from the students.

If you would like more background information regarding our research study, we would be more than happy to provide it for you.

Please let us know if you would be willing to disseminate this survey to your students.

Thank you so much and we look forward to hearing back from you!

Sincerely,

Saira Haq, Bethel PA-S
Katelyn Walsh, Bethel PA-S

**Augsburg University Participation Request**

Dear Alicia Quella,

We are first year Physician Assistant Students from Bethel University. We are conducting a survey for our Master's Research Project and we would appreciate your students' participation. We would like to survey your first-year PA students who have completed at least one semester of PA school. The survey will consist of questions regarding caffeine consumption, sleep, and exercise habits. We are investigating a link between these behaviors and academic performance. We will also be asking for your students' cumulative GPA.

All responses will remain anonymous and we will not be asking for any identifiable information from the students.

If you would like more background information regarding our research study, we would be more than happy to provide it to you.

Please let us know if you would be willing to disseminate this survey to your students.

Thank you so much and we look forward to hearing back from you!

Sincerely,

Saira Haq, Bethel PA-S
Katelyn Walsh, Bethel PA-S

# APPENDIX B

## Informed Consent

**Consent for Participation in Survey Research**

I volunteer to participate in a research project conducted by Katelyn Walsh and Saira Haq, Physician Assistant Students from Bethel University, St. Paul, Minnesota. I understand that the project is designed to gather information about the caffeine consumption, sleep and exercise habits of first year Physician Assistant Students. I will be one of approximately 90 people being surveyed for this research.

**1.** My participation in this project is voluntary. I understand that I will not be paid for my participation. I may withdraw and discontinue participation at any time without penalty. If I decline to participate or withdraw from the study, this will not affect my future relations with Bethel University or my university in any way.

**2.** I understand that if I feel uncomfortable in any way when answering the questions, I have the right to decline to answer any question or leave the survey.

**3.** Participation involves answering questions in this online survey. It will take **approximately 3-5 minutes** to answer the following questions.

**4.** I understand that the information obtained from this survey is entirely anonymous. The researcher will only use aggregate data, and my confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions. I understand that the researcher will not ask for any identifiable information and I will not disclose the PA school I am currently attending.

**5.** Faculty and administrators from my campus will neither be present nor have access to my answers. There will not be any negative repercussions from my individual comments.

**6.** I understand that this research study has been reviewed and approved by the Institutional Review Board (IRB) at Bethel University. For research problems or questions regarding subjects, please contact the researchers Saira Haq PA-S, or Katelyn Walsh PA-S.

**7.** I have read and understand the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

For further information, *please contact*:

**Saira Haq**

Student of MS in Physician Assistant Program, Bethel University, St. Paul, Minnesota

Email: sah69852@bethel.edu

**Katelyn Walsh**

Student of MS in Physician Assistant Program, Bethel University, St. Paul, Minnesota

Email: kmw38523@bethel.edu

**Lisa Naser, PA-C**

Assistant Professor, Bethel University Minnesota

Email: l-naser@bethel.edu

***"I have thoroughly read and understand the above consent statement, I certify that I am 18 years old or older, and, by selecting "Yes" below, I indicate my willingness to voluntarily take part in this study."***

- YES, I willingly give my consent to participate in this study
- NO

# APPENDIX C

## Survey Tool

I. **Introduction:**
   a. Please enter your age: ____

II. **Caffeine:**
   a. Do you use any form of **caffeine** (Caffeine pills, coffee, caffeinated tea, soda, energy drinks, etc.)
      i. YES
      ii. NO
         1. If the participant selects "NO" the survey will skip ahead **to Section III: Sleep**
   b. How many **caffeine pills** (200 mg) do you consume?
      i. NONE
      ii. Enter the # of pills consumed **in an average day:** ____
      iii. Enter the # of pills consumed **in an average week:** ____
   c. How many cups of **coffee** do you drink? Average cup of coffee is 8 oz.
      i. NONE
      ii. Enter the # of cups consumed **in an average day:** ____
      iii. Enter the # of cups consumed **in an average week:** ____
   d. How many cups of **caffeinated tea** do you drink? Average cup of tea is 8 oz.
      i. NONE
      ii. Enter the # of cups consumed **in an average day:** ____
      iii. Enter the # of cups consumed **in an average week:** ____

   e. How many mL of **soda** do you drink? Use the graphic below for your reference.
      i. NONE
      ii. Enter the # of mL consumed **in an average day**: _____
      iii. Enter the # of mL consumed **in an average week**: _____


   f. If you use **energy drinks,** please specify the brand and the number of cans/bottles consumed.
      i. NONE
      ii. Enter **Brand Name #1** and number of cans/bottles in an average **day**: _____
      iii. Enter **Brand Name #1** and number of cans/bottles in an average **week**: ____

iv. Enter **Brand Name #2** and number of cans/bottles in an average **day**: _____
v. Enter **Brand Name #2** and number of cans/bottles in an average **week**: ____

**III. Sleep:**

a. How many hours of sleep do you get on the average **week night**?
   i. Enter the # of hours of sleep: _____
b. How many hours of sleep do you get on the average **weekend night**?
   i. Enter the # of hours of sleep: _____
c. Have you ever used caffeinated products to compensate for inadequate sleep?
   i. YES
   ii. NO
d. Have you ever pulled an "all-nighter" for the purpose of studying, homework, or writing a paper etc.? An "all-nighter" is when you stay up all night without going to sleep.
   i. YES
   ii. NO
      **1.** If the participant selects "NO" they will skip to the next **Section IV: Exercise**
e. How many "all-nighters" would you participate in during an average **month**.
   i. 1
   ii. 2
   iii. 3
   iv. 4
   v. 5 or more

**IV. Exercise:**

a. Do you exercise or participate in sports?
   i. YES
   ii. NO
      **1.** If the participant selects "NO" they will skip ahead to **Section V: GPA.**
b. Please select the following activities that you participate in:
   i. Walking
   ii. Jogging
   iii. Running
   iv. Biking
   v. Swimming
   vi. Yoga
   vii. Sports such as tennis, skateboarding, rollerblading, volleyball and basketball
   viii. Sports such as football, rugby, hockey, gymnastics
c. How many minutes a week do you participate in **moderate** exercise? Examples of moderate exercise include walking fast, water aerobics, riding a bike, hiking, doubles tennis, volley ball and basketball. Moderate exercise could also include activities of daily living like pushing the lawn mower, raking leaves, gardening or snow blower.
   i. NONE
   ii. Enter the number of **minutes** per week: ___

d. How many minutes a week do you participate in **vigorous aerobic** exercise? Examples of vigorous aerobic exercise include jogging, running, swimming fast, riding a bike fast, rugby, hockey, aerobics, and gymnastics. It could also include activities of daily living such as heavy gardening, such as digging and shoveling.
    i. NONE
    ii. Enter the number of **minutes** per week: ___
e. How many times a week do you participate in **strength** exercise that works all the major muscles (legs, hips, back, abdomen, chest, shoulders and arms)? Examples of strength exercise include lifting weights, working with resistance bands, pushups and sit-ups, heavy gardening and yoga.
    i. NEVER
    ii. Enter the number of **minutes** per week: ___

**V. Grade Point Average:**

a. What is your overall GPA as of the last completed semester of PA school? *Reminder, this entry is entirely anonymous*
    i. Please enter your GPA: ____

VI. **Thank You!**

a. Thank you for taking the time to participate in this survey. We greatly appreciate your responses.
    i. Sincerely, Saira Haq PA-S, and Katelyn Walsh PA-S

# APPENDIX D

## Expert Panel Participation Request

Dear Dr. Jennifer Nelson,

We are first year Physician Assistant Students at Bethel University. We are writing to ask permission if 5 or so students from your Psychology Graduate class would be willing to fill out a brief survey and give their feedback on the survey experience. We would like your students to be part of our expert panel before we officially send out the survey to our sample population. Our research project is entitled "Examining the Effects of Caffeine, Sleep, and Exercise on the Academic Performance of PA Students."

We would like them to take the survey and at the end of the survey there will be an open ended question about their survey experience. We would like to make appropriate changes to our survey and confirm that the format was easy to understand before formally sending it out to our sample population.

We will be asking your students a few questions about their caffeine consumption, sleep, and exercise patterns as well as their GPA. The purpose of this expert panel is to get their feedback on the formatting of the survey. Their responses will not be included in the data collection of our project. All of their responses will remain confidential and we will not ask for any identifiable information.

Please let us know if you would be willing to disseminate this survey to your students and if your students would be willing to participate in this expert panel.

Sincerely,

Saira Haq Bethel PA-S
Katelyn Walsh Bethel PA-S

# APPENDIX E

## Expert Panel Permission Approval

# Expert Panel Permission Approval

**Dr. Jennifer Nelson** Mar 22

to me

Katie,

I apologize for not responding sooner. I was out last week and am catching up on email. I would be willing to disseminate it if I could just email it to students in our program. Please let me know if this would be an appropriate way of disseminating it to them.

Please let me know if this would be something you would be interested in.

Blessings,

Jennifer Nelson, Ph.D.
Associate Professor
Program Director and Clinical Director, M.A. Counseling Psychology
Bethel University
3900 Bethel Dr.
St. Paul, MN 55112
651-635-8819
651-287-0824 (fax)

BETHEL UNIVERSITY

# APPENDIX F

## Expert Panel Feedback

## Expert Panel Feedback

**Qualtrics Survey Feedback Question -** Please give us your feedback about the survey experience. For example: Did you find any questions difficult to understand? Is there anything that you would recommend changing, adding or deleting? Please give us your feedback below.

| Please respond: |
| --- |
| Everything looked good - it was easy to understand and move from one page to the next. |
| Nice job on the survey- quick and easy to answer! Good luck! |
| I think it would be better to average the amount per week of consumed caffeine. I do not use caffeinated products every day, but it is probably more around 2-3 times a week |
| Loved the graphics-it was a good supplement to the question. Questions were easy to read; liked the use of bold print. I would recommend eliminating "Q1" in the first page to delineate the consent from the questionnaire. Some surveys provide a graphics header of the supporting university at the beginning of the survey- I think it looks more professional...just a thought. also, suggest changing wording "and Conact" in the informed consent: "Dr. Peter Jankowski Bethel IRB Chairperson and Contact pjankows@bethel.edu". Easy to use, quick survey. Great job! Good luck with your research. |
| Easy to understand, it would be nice if there was a smaller amount of caffeine to select. For example, I chose 1 cup of tea a day but it's maybe only 2-3 cups a week |

| Please respond: |
| --- |
| I would have an option for saying I don't drink soda or energy drinks. Survey was easy to understand. |

# APPENDIX G

## PA Schools' Permission Granted

## Bethel University Permission Approval

**Wallace Boeve** Mar 9

to Saira, me

Katie & Saira;

I would be happy to disseminate the survey to the Bethel PA students.

Respectfully;

Wallace Boeve, EdD, PA-C
Program Director
Physician Assistant Program
Bethel University

## St. Catherine's University Permission Approval

**Heather Bidinger** 10:41 AM (9 hours ago)

to me

Dear Katie,

Sorry for the delay and thank you for providing additional information for review. Because you are not asking specifically for the students to identify from which program they attend, I would be happy to forward the survey to our students. (Because I don't recall off hand)- please remind me if this is first years, second years or both. Looking forward to hearing of your results!

Sincerely,

Heather Bidinger

## Augsburg University Permission Approval

**Quella, Alicia** 8:45 PM (12 hours ago)

to me

sure- please send me link- thanks Alicia

# APPENDIX H

## IRB Approval

May 10, 2017

Katie & Saira,

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

Sincerely;

Wallace Boeve, EdD, PA-C

Program Director

Physician Assistant Program

Bethel University

w-boeve@bethel.edu

651 308-1398 cell

651 635-1013 office

651 635-8039 fax

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

# APPENDIX I

## Instructions for the Participant

**Instructions for the Participant**

Dear Fellow PA Student,

We are first year Physician Assistant Students from Bethel University.

Being enrolled in a PA program is certainly a life changing experience! During the last few semesters of PA school, we have witnessed ways in which our fellow classmates have changed and accommodated their lifestyles. In order to endure the demanding work load and schedule of PA school, fellow classmates have changed their caffeine consumption, sleep and exercise patterns.

For our Master's Research Project, we are conducting a study regarding PA student's caffeine consumption, sleep habits and physical activity.

We are interested in seeing how the amount of caffeine consumption, sleep pattern and exercise habits impacts the academic performance of PA students. Based on our results, we will be able to make healthy recommendations to our fellow classmates, incoming PA students and future patients.

**It should take approximately 3-5 minutes to complete the survey**. All responses will be anonymous and confidential.

Thank you for taking the time to take our survey!

Here is the link to our survey: Caffeine, Sleep and Exercise Survey

Sincerely,

Saira Haq, Bethel University Physician Assistant Student
Katelyn, Walsh, Bethel University Physician Assistant Student

# APPENDIX J

## Reminder Email to Participant

**Reminder Email to Participant**

Dear Potential Participant,

We are first year Physician Assistant Students from Bethel University. We are sending a friendly reminder email to take our survey.

Again, i**t should take approximately 3-5 minutes to complete the survey**. All responses will be anonymous and confidential.

Thank you for taking the time to take our survey!

Here is the link to our survey: Caffeine, Sleep and Exercise Survey

Sincerely,

Saira Haq, Bethel University Physician Assistant Student
Katelyn, Walsh, Bethel University Physician Assistant Student