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Prevalence of Caffeine Use and Knowledge of Its Benefits, Side Effects, and Withdrawal Symptoms Among Pre-PA Students, PA Students, and Clinically Practicing PAs

Kjerstin Grace Durie
Bethel University

Chelsie Nicole Horner
Bethel University

Greta Sowles
Bethel University

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BY
KJERSTIN DURIE, PA-S
CHELSIE HORNER, PA-S
GRETA SOWLES, PA-S

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KJERSTIN DURIE, CHELSIE HORNER, GRETA SOWLES

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GRADUATE RESEARCH APPROVAL:

Committee Chair: Wallace Boeve, EdD, PA-C

Committee Member: Jeanne Szarzynski, PA-C

Committee Member: Rebecca Katchmark, D.C.

ABSTRACT

Caffeine is consumed daily by eighty percent of the world's population, making it the most widely used stimulant drug. Caffeine has various benefits, side effects, and withdrawal symptoms associated with its use, but there is a lack of research that studies how much caffeine users know about these effects.

This research study assessed the use of caffeine for academic and professional purposes and the knowledge about the benefits, side effects, and withdrawal symptoms of caffeine among pre-PA students, PA students, and practicing PAs in Minnesota.

To do so, a paper copy of a survey was given to pre-PA students and didactic year PA students Bethel University. An online copy was sent to clinical year PA students and practicing PAs from Bethel University. An online copy of the survey was also sent to pre-PA students, current PA students, and practicing PAs who had recently graduated from St. Catherine University and Augsburg College.

Various demographic statistics were gathered. The statistics did show that practicing PAs used caffeine for academic purposes significantly less than the three other groups. PA students in their clinical year use caffeine significantly more for professional purposes than both pre-PA students and PA students in their didactic year. Additionally, practicing PAs used significantly more caffeine, generally, than PA students in their didactic year. As far as caffeine knowledge, data collected revealed that PA students in their clinical year had significantly more "very good" knowledge on the benefits of caffeine than the three other groups. Results were limited due to sample size.

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Background

Eighty percent of the world's population consumes caffeinated beverages daily, making it the single most widely used stimulant drug. "Caffeine's popularity is attributed to its perceivable and acute benefits for physiological, psychomotor and cognitive performance, as well as its beneficial effects on mood" (Einöther & Giesbrecht, 2013, p. 252). As a stimulant, caffeine is pharmacologically active through the antagonism of adenosine (A1) receptors. This mechanism combats adenosine's tendency to slow down neural activity and promote wake-sleep cycles. Caffeine stimulates the release of dopamine, which has shown to improve cognitive alertness and executive functioning. Additionally, caffeine competes with adenosine at the A2 receptors to enhance psychomotor activity and stimulate vasoconstriction (Einöther & Giesbrecht, 2013, p. 253).

Caffeine is a psychoactive substance. This means that its overuse and acute decrease in ingestion may cause adverse effects. In a study conducted by Pandejpong, Paisansudhi & Udompunthurak (2014) on caffeine use in Thai medical students, addiction and dependence may occur with heavy use of caffeine and may cause withdrawal symptoms, such as "headache, irritability, inability to concentrate, drowsiness and insomnia," peaking at 48 hours post-use. In said study, 13 percent of participants developed caffeine dependency and 28 percent of those who used more than 400 mg per day developed caffeine withdrawal symptoms (Pandejpong, Paisansudhi, & Udompunthurak, 2014, p. 191). In Juliano & Griffith's critical review of caffeine withdrawal (2004), headaches were reported as the most common symptom in 77 percent

of the studies that analyzed withdrawal symptoms. The study suggested that withdrawal symptoms can last anywhere from two to nine days following discontinuation of use. Another study on the health effects of caffeine suggests that chronic caffeine use might cause restlessness, exacerbation of pre-existing anxiety or other psychiatric symptoms, as well as tachycardia, and gastrointestinal disturbances. Unfortunately, there is currently no reference value established for acceptable daily caffeine use, and differences in caffeine metabolism make it difficult to quantify an upper toxicological limit (Gasper & Ramos, 2016).

Because of caffeine's widely accepted role in general arousal, students use it in attempts to enhance cognitive abilities and remain awake for extended periods of time. A study conducted by Lee et al. (2009) on medical students' use of caffeine for academic purposes mentioned that "the widespread use of caffeine may be due to the fact that its habitual consumption has been significantly related to increased self-reported alertness, improved performance of vigilance tasks and fewer lapses of attention, improved long-term memory and faster locomotor speed" (Lee et. al 2009, p. 322). However, caffeine can only reliably improve cognitive performance when dosage intervals are spread at least eight hours apart. If not used with caution, overuse can result in various adverse effects and withdrawal symptoms. Lee's study maintained, "the majority of participants were using caffeine without sufficient knowledge of its benefits, side-effects and withdrawal symptoms" (Lee et. al 2009, p. 326).

Although studied quite frequently, caffeine's widespread effects on the body and the complexity of factors that shape its use make it one of the most inadequately understood drugs. Multiple studies have been conducted on the widespread physiological

and psychological effects of caffeine, but much less time has been devoted to the study of misconceptions about caffeine's benefits, side effects, and withdrawal symptoms. This study attempted to manipulate Lee's 2009 study among pre-physician assistant (pre-PA) students, physician assistant students, and physician assistants (PAs) in practice to analyze the use of caffeine for academic or professional purposes and overall knowledge of its properties.

Problem Statement

There is a general lack of information regarding the benefits, side effects, and withdrawal symptoms associated with acute and chronic caffeine ingestion. Many studies have focused on the physiological components of caffeine (Einöther & Giesbrecht, 2013, Pandejpong, Paisansudhi, & Udompunthurak, 2014), but few studies approach caffeine use among higher learners from the lenses of purpose of use and misconceptions. There is almost no research conducted on caffeine use and knowledge among pre-PA students, PA students, and practicing PAs. Thus, research must be conducted on the role of caffeine use in the physician assistant field and misconceptions about its benefits, adverse side effects, and withdrawal symptoms associated with its use.

Purpose

The main purpose of this study was to assess the use of caffeine for academic and professional purposes, as well as the knowledge about the benefits, side effects, and withdrawal symptoms of caffeine among pre-PA students, PA students, and practicing PAs in Minnesota. Additional purposes included determining the most commonly used caffeine products, how frequently caffeine is used for academic and professional

purposes, and the differences in frequency of caffeine usage among prospective PAs and practicing PAs.

Research Questions

Through this study the following questions were addressed:

1. What is the prevalence of caffeine use for academic and professional purposes in pre-PA students, PA students, and practicing PAs in Minnesota?
2. What, if any, differences are there in the frequency of caffeine use for academic and professional purposes between pre-PA students, PA students, and practicing PAs in Minnesota?
3. What is the level of knowledge among these individuals on the benefits, side effects, and withdrawal symptoms of caffeine?

Significance of the Study

With caffeine being one of the most commonly used drugs in the world, it is important for users to have sufficient knowledge of its pharmacological features. The findings of this study provide information about the prevalence of caffeine use for academic and professional purposes and addresses whether there is a need to educate individuals about the physical, cognitive, and psychological benefits and side effects of caffeine. Based on the results of the study and the determined need for caffeine education, information can be disseminated on the benefits, side effects, and withdrawal symptoms of caffeine, providing individuals with sufficient and accurate information.

Limitations of the Study

While the research was meticulously organized in order to reach its aims, there were several unavoidable limitations. Due to the inability of distributing a paper copy of

the survey in-person to all subjects, there was a paper versus computer administration limitation. An online version of the survey was distributed to all groups with the exception of Bethel pre-PA students and Bethel PA students in their didactic year, who were given a paper version. Regardless of whether the survey was given online or in-person there was no control over the response rate from all subjects. However, an online version of the survey could result in a lower response rate. The researchers did everything in their power to reduce coercion for the in-person survey. It had to be assumed that all subjects honestly responded to the survey questions without guessing or cheating. The main delimitation of this study was that subjects were limited to pre-PA students, current PA students, and practicing PAs in the state of Minnesota. In addition, practicing PAs were limited to those who graduated from one of the following institutions: Augsburg College, Bethel University, or St. Catherine University.

Definition of Terms

Pre-Physician Assistant Student: Eligible students are members of a pre-physician assistant club at Bethel University, St. Catherine University, Augsburg College, the University of Minnesota Twin Cities, the University of Minnesota Duluth, or the College of St. Scholastica. In addition, students who have been accepted into the PA program at Bethel University, St. Catherine University, or Augsburg College, but have not yet started classes are eligible as pre-PA students.

Physician Assistant Student: PA students enrolled in an accredited or provisionally accredited PA program in Minnesota are eligible.

Practicing Physician Assistants: A certified practicing physician assistant that has graduated within the last five years from Bethel University, St. Catherine University, or Augsburg College.

Caffeine: A central nervous system stimulant of the methylxanthine class of drugs that is found in coffee, tea, cola nuts, mate and guarana (Weinberg & Bealer, 2001).

Caffeine Withdrawal: Physical and psychological symptoms occurring from acute lowering of caffeine ingestion in a mild to moderate user, usually occurring within 12 -24 hours of discontinuing use.

Caffeine Use for Academic Purposes: The use of caffeine in order to lengthen study time, stay awake during class, improve academic performance, and/or increase efficiency on assignments and studying.

Caffeine Use for Professional Purposes: The use of caffeine in order to stay awake while working with patients and completing paperwork, improve work performance, and/or increase productivity on work-related duties.

Chapter 2: Literature Review

Introduction

Caffeine is a psychoactive organic compound present in coffee, tea, cola, and cocoa that easily permeates cell membranes and the blood brain barrier causing various effects in the body and the central nervous system (Weinberg & Bealer, 2001). It is consumed for pleasure of taste or to promote wakefulness and enhance cognition and focus (Weinberg & Bealer, 2001). While beneficial in many ways, caffeine has side effects and the potential to produce withdrawal symptoms. This literature review outlines the current research on the common benefits, side effects, and withdrawal symptoms of caffeine, as well as misconceptions in these areas.

Use of Caffeine

Research has shown that caffeine use has certain patterns. Lack of specific research in caffeine use has lead to broad generalizations that may not necessarily be reflective of the population as a whole. Caffeine use has shown to increase with age, stabilizing around middle age and decreasing slightly with old age (Weinberg & Bealer, 2001). There appears to be no significant difference in caffeine use between genders, but as women tend to weigh less than men, they will likely be exposed to higher levels of caffeine and may experience stronger effects (Weinberg & Bealer, 2001). Today, 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; Weinberg & Bealer, 2001).

A study by Astrid Nehlig (1999) began to outline some of the dietary sources of caffeine, including tea, coffee, cocoa beverages, candy bars, and soft drinks. The highest

use of caffeine was found in Sweden and Finland, where 80-100% of caffeine intake comes from coffee (Nehlig, 1999). The United Kingdom had a level of intake similar to some of the Scandinavian countries, but 70 percent of caffeine intake in the UK comes from tea (Nehlig, 1999). This study mentioned that caffeine is consumed by children via soft drinks, chocolate foods, beverages, and tea (Nehlig, 1999). In 2005, Frary, Johnson, and Wang presented a study on caffeine intake in a representative population of the United States. The study suggested that there was an increased percentage of Americans, of all ages, who consume caffeine. The study also mentioned a small shift in sources of caffeine with a higher prevalence of soft-drink consumption in relation to tea. Coffee remains the primary source of caffeine in individuals two years and older (Frary, Johnson, & Wang, 2005).

With the addition of various other caffeinated beverages and the prevalence of energy drinks among youth, a population-based study of caffeine intake was necessary to re-evaluate America's overall use of caffeine. A survey conducted by Mitchell et al. (2014) affirmed the assumption that caffeine is consumed by over 80% of the United States population, echoing various past findings on the use of caffeine (Barone & Roberts, 1996; Frary, Johnson, & Wang, 2005; Knight, C., Knight, I., Mitchell, & Zepp, 2004; Mitchell et. al, 2014). One notable finding in Mitchell's 2014 survey was that the most common sources of caffeine were carbonated soft drinks, coffee, and tea, which were consumed by over half of the population of caffeine consumers. A surprisingly low number of consumers reported use of energy drinks and energy shots (Mitchell et al., 2014). According to the survey, only 4.3% of caffeine consumers reported energy drink use (Mitchell et al., 2014). Even among the highest population of energy drink

consumer, teenagers and young adults, only 5-7 % of their caffeine intake came from energy drinks (Mitchell et al., 2014). In addition, Mitchell et al. (2014) noted that the highest use of caffeine was in adults aged 50-64. While consuming slightly less in volume, nearly 100% of individuals over 65 consume caffeine. The study's final conclusion was that newer caffeinated beverages, including energy drinks, energy shots, and chocolate milk contribute little to the overall increase in caffeine among various age groups (Mitchell et al., 2014).

While most of the current research on caffeine use provides general information on the population, research regarding caffeine intake among college-aged or graduate students tends to focus on sleep deprivation or the combination of caffeine and alcohol. Much of the research discusses why caffeine is consumed, rather than who is consuming it. For various reasons, caffeine is highly consumed and, if consumed in moderation, studies below will show that it can be quite beneficial for the consumer's overall health.

Benefits of Caffeine

Caffeine may be utilized for its beneficial effects. These benefits include increased alertness, improved vigilance, increased ability to concentrate, better long-term memory, increased speed of neurological activity, and reaction time. These are all benefits that could be resulting in the widespread use of caffeine (Christopher, Sutherland, & Smith, 2005; Hameleers et al., 2000). Researchers have looked into a variety of benefits associated with caffeine use; this literature review will only focus on the five benefits that are incorporated into this study. These benefits include increased vigilance, increased long-term memory, prevention of Alzheimer's disease, prevention of Parkinson's disease, and prevention of Type II Diabetes Mellitus.

The ability of caffeine to block the inhibitory action of adenosine allows it to increase the activity of the central nervous system (Smith, 2002). While this general mechanism of action is used to explain how caffeine can impact vigilance and long-term memory, the underlying mechanisms are still unidentified and are being researched today. Inconsistencies are found in the literature addressing caffeine's effects on vigilance and long-term memory. These inconsistencies could be explained by noting the differences in methodology, the time at which the study was performed, and whether confounding factors were being controlled (Nawrot, Hugenholtz, Feeley, Eastwood, Jordan, & Rostein, 2003).

In 1987, Lieberman, Wurtman, Emde, Roberts, and Coviella performed a study in which participants were administered caffeine dosages ranging from 32 mg to 256 mg and then given eight different performance tests, three of which tested vigilance. Results from this study showed that regardless of caffeine dosage all participants had significant improvement in auditory and visual vigilance, which was based on the modified Wilkinson vigilance test (Lieberman et al., 1987). The study found improvements in the four-choice reaction time task, in comparison to the placebo group (Lieberman et al., 1987). Frewer and Lader (1991), Mitchell and Redman (1992), and Fine et al. (1994) conducted additional studies that confirmed caffeine's positive effects on psychomotor speed and vigilance. Another study by Hameleers et al. (2000) showed a similar increase in vigilance, which was tested via a Visual Verbal Learning Test, Motor Choice Reaction Test, Letter-Digit Substitution Test, Fluency Test, Concept Shifting Test, and Stroop Color – Word Test, all of which differed from Lieberman's tests. Not only did

participants have an increased response rate, but the study found a direct relationship between the rate of response and the amount of caffeine used (Hameleers et al., 2000).

Heatherley, Hayward, Seers, and Rogers (2005) realized research was lacking on the effects of caffeine following periods of abstinence. This guided their research team to conduct a study to determine the effect of caffeine on several measures, including cognitive performance following 4-8 hour periods of caffeine abstinence. The study concluded that cognitive performance could only be reliably improved if the consumer abstains from caffeine for eight hours prior to additional doses (Heatherley et al., 2005). Overall, the literature implies that caffeine use results in improved performance on vigilance and simple tasks requiring continual response; while these effects are most clearly seen when there is reduced alertness, evidence shows benefits occurring when an individual does not have reduced alertness (Smith, 2002).

Similar to the effects of caffeine on vigilance, some incongruity exists in regards to whether caffeine has an impact on an individual's memory. Past studies have shown contradicting results, in which some researchers found acute ingestion of caffeine to improve memory functioning (Terry and Phifer, 1986), while others found it to have no effect (Foreman, Barraclough, Moore, Mehta, & Madon, 1989; Mitchell and Redman, 1992). In Wing Hong Loke's (1988) study, "Effects of Caffeine on Mood and Memory," he tested participants' delayed recall performance by giving them three lists of words and then testing their ability to remember those words 70 minutes following caffeine use. Loke (1988) did not inform the participants about the delayed recall test prior to administration. His results revealed habitual caffeine users consuming moderate-to-high amounts (387.5-927.5 mg/week) were capable of recalling more words than low amount

users (less than 387.5 mg/week) (Loke, 1988). These results were backed by the results of Jarvis' 1993 study, in which four tests all resulted in a direct relationship between higher habitual caffeine use and enhanced memory performance and reaction time. A more recent study conducted by Hameleers et al. (2000) found that higher habitual caffeine use had a positive association with improved long-term memory. Again, no significant association was found between caffeine use and improved short-term memory. From the studies investigating this relationship, a person could imply that habitual caffeine use is linked to improved storage or recovery from one's long-term memory. Not only does caffeine have an effect on long-term memory, but it has an impact on one's risk of Alzheimer's disease.

Alzheimer's disease (AD) is a neurodegenerative disease that results from "progressive cognitive impairment and elevated levels of β-amyloid (Aβ) protein" (Arendash et al., 2006, p. 941). Researchers suggest that caffeine use may reduce the risk of AD and may be useful as a therapeutic agent by helping slow the progression of cognitive decline. Caffeine reduces Presenilin 1 and β-secretase, which subsequently results in the reduction of Aβ production (Arendash et al., 2006). Arendash et al. (2006) conducted a study to prove that long-term caffeine use may protect mice against cognitive impairment and may prevent or delay AD onset. Mice were administered the human equivalent of 500 mg of caffeine (1.5 mg), and the study found that there was a significant difference in cognitive task performance between the mice given caffeine and those from whom it was withheld (Arendash et al., 2006). In addition to these findings, the researchers also found that a 32-37% reduction in the hippocampal levels of Aβ was seen in caffeine treated mice in comparison to untreated mice (Arendash et al., 2006).

Arendash et al. (2009) continued researching this topic to determine if caffeine could have beneficial effects in aged mice already experiencing cognitive impairment. The study concluded that caffeine-treated aged mice had a 40% reduction of Aβ production in the hippocampus and also recovered a level of working memory comparable to that of aged mice not experiencing cognitive impairments (Arendash et al., 2009). Additionally, the level of working memory restored was greater than that of untreated, cognitively impaired aged mice (Arendash et al., 2009). Arendash and Cao (2010) effectively demonstrated that no cognitive benefits were provided by long-term administration of theophylline, a xanthine derivative similar to caffeine, and that decaffeinated coffee has no effect on the levels of Aβ, indicating that caffeine, rather than its derivatives, had effects on cognitive impairment. The literature suggests that moderate caffeine intake has the potential to provide protection against and therapy for AD.

Caffeine has been found to reduce the risk of developing Parkinson's disease (PD). Parkinson's disease is a chronic, progressive degenerative disease involving the dysfunction and death of dopamine producing neurons. Dopamine is involved in movement control and coordination (National Institute of Neurological Disorders and Stroke [NINDS], 2015). As patients with PD progress, they are unable to control movements due to decreased dopamine production in the brain (NINDS, 2015). Researchers suggest that consuming caffeine could decrease the risk of PD, due to caffeine's antagonistic action (Schwarzschild, Chen, & Ascherio, 2002). A study conducted by Ross et al. (2000) consisting of over 8,000 Japanese-American men between 45-68 years old, found that male non-coffee drinkers were five times more likely

to develop PD over the subsequent 24-30 years than those who consumed at least 28 ounces daily.

An alternative study found that men who consume more than four cups of coffee daily have half the risk of developing PD over the next 10 years than men who did not drink coffee (Ascherio, Chen, Schwarzschild, Zhang, Colditz, & Speizer, 2003). Ascherio, Zhang, Hernán, Kawachi, Colditz, and Speizer (2001) found that the lowest risk for developing PD in women was found in those drinking 1-3 cups of coffee daily. Ascherio et al. (2001) suggests that estrogen accounts for the overall lower risk of PD in women in comparison to men, but a difference is also shown in the caffeine-PD risk relationship between genders. According to a meta-analysis conducted by Hernán, Takkouche, Caamaño-Isorna, and Gestal-Otero (2002), the overall risk of developing PD is 30% lower for those consuming coffee compared to non-coffee drinkers. The research concluded "every additional cup of coffee per day is associated with a risk reduction of 10%, although the magnitude of this reduction may differ by gender" (Hernán et al., 2002, p. 281). While there is a difference in the amount of coffee that needs to be consumed between men and women to decrease PD risk, one can still deduce from the research that the two are inversely related. With that information, more knowledge needs be acquired on the relationship prior to recommending increased caffeine intake as a therapeutic means of preventing PD (Higdon & Frei, 2006).

Lastly, caffeine use has a positive effect on the risk for Type II Diabetes Mellitus (DM). Type II DM is characterized by an increase in blood glucose levels due to insulin resistance (American Diabetes Association, 2009). According to Higdon and Frei (2006), several possible mechanisms exist by which coffee decreases the risk for Type II

DM. These mechanisms include the inhibitory effect of chlorogenic acid (a component in coffee) on the glucose-6-phosphatase system and intestinal glucose absorption, the increase in magnesium absorption, as well as an increase in energy expenditure and weight loss (Higdon & Frei, 2006). In a 2002 prospective study, van Dam and Fenskens concluded that individuals drinking a minimum of seven cups of coffee a day had a 50% lower risk of developing Type II DM in comparison to the risk of individuals drinking no more than two cups. Similarly, the study of Tuomilehto, Hu, Bidel, Lindström, and Jousilahti (2004) made up of over 14,000 participants and spanning roughly 12 years found that men who consumed 10 or more cups of coffee daily had a 55 % less risk of developing type II DM than that of men who had consumed no more than two cups daily. Additionally, women who consumed a minimum of 10 cups of coffee daily had a risk that was 80% less than that of women who had consumed two cups or less (Tuomilehto et al., 2004). A study piloted by Rosengren, Dotevall, Wilhelmsen, Thelle, and Johansson (2004) enhanced the finding of Tuomilehto et al. (2004) by studying Swedish women over 18 years and coming to the conclusion that women who consumed no more than two cups of coffee per day had a 44% greater risk of developing Type II DM than women who drank a minimum of three cups per day. In 2005, van Dam and Hu performed a systematic review of nine studies, including over 193,000 men and women. They examined the coffee relationship to Type II DM risk relationship. The review concluded that individuals who had a daily intake of at least six cups of coffee per day and individuals who had a daily intake between 4-6 cups had a 35% lower risk and a 28% lower risk, respectively, than those who drank no more than two cups daily (van

Dam & Hu, 2005). Overall, the literature has revealed a significant inverse association between coffee intake and Type II DM.

Aside from the benefits discussed above, the additional benefits of caffeine use are not noted because the survey used in the current study does not include them. The beneficial effects caffeine has on vigilance, long-term memory, and the lower risk of AD, PD, and Type II DM has been reinforced by the existing literature.

Side Effects of Caffeine

When consuming caffeine, individuals do not often think about the side effects associated with its use. Studies have been conducted on the cardiovascular health effects of chronic and acute caffeine use (Lee et al., 2009; Pincomb et al., 1985). As a stimulant, caffeine works directly on myocardial tissue, increasing cardiac output, force of contractility, and heart rate (Lee et al., 2009). A double-blind, placebo-controlled study by Pincomb et al. (1985) found that "caffeine increased ventricular ejection time and stroke work, while decreasing systolic ejection acceleration" (Pincomb et al., 1985, p. 121). This led to an increased afterload and the enhancement of vascular resistance.

A study by Doerner et al. (2015) on caffeine energy drinks containing taurine, an amino acid that supports neurologic development, found a subtle but significant increase in left ventricular contractility one hour after use in healthy volunteers. An increase in left ventricular contractility inadvertently causes an increase in heart rate and cardiac output (Doerner et al., 2015). The study mentioned that while caffeine is known to increase blood pressure and stimulate diuresis, the inotropic effect of caffeine is still a matter of controversy (Doerner et al., 2015). Additional studies have affirmed that while caffeine increases heart rate, caffeine use has no significant association with arrhythmias

and moderate use of caffeine does not appear to negatively affect cardiovascular health (Gasper & Ramos, 2016; Tofalo, Renda, De Caterina, & Suzzi, 2016).

More extensive research has been done on the relationship between caffeine and hypertension. A study by Shepherd, Absi, Whitsett, Passet, and Lovallo (2000) on additive pressor effects of caffeine and stress in medical students, found that caffeine increases blood pressure and cortisol responses during times of increased mental stress. However, Tofalo et al.'s (2016) review of the health effects of coffee reflected a meta analysis of cohort and randomized control trials that long-term coffee use has no increased risk in hypertensive consumers. Despite caffeine's acute tendency to raise heart rate and blood pressure, chronic moderate caffeine use does not pose any major threat to cardiovascular health (Tofalo et al., 2016).

As previously discussed, caffeine use will result in an increased heart rate and force of contraction. These effects coincide with the effect caffeine has on respiratory rate. There are several mechanisms that have been suggested which include "an increase in pulmonary blood flow, an increased supply of air to the lungs … an increase in sensitivity of the medullary respiratory center to carbon dioxide, … and an increase in cardiac output" (Arnaud, 2005, p. 251). According to Benowitz (1990), the sensitization of the medullary center to carbon dioxide is likely what causes the increase in respiratory rate. D'Urzo (1990), who had found a 20% increase in respiratory rate due to coffee intake, supported the above mechanism. Caffeine has been used to treat asthma in children due to its function as a potent bronchodilator without adverse central nervous system side effects, but with other potential effects on growth and development, the use of caffeine in young children is still controversial (Weinberg & Bealer, 2001).

An additional side effect of caffeine use is sleep disturbances. Caffeine is beneficial in allaying fatigue and drowsiness, but caffeine can induce disruptions, resulting in a lower quality of sleep (Landolt, 2015). Brezinova's 1974 study investigated caffeine's effect on sleep. It discovered that participants who consumed caffeine 15 minutes prior to sleep had an average of a two hour reduction in mean total sleep time. Caffeine caused a 66-minute increase in the mean sleep latency and increased number of awakenings throughout the night. The study observed a change in sleep patterns in which there was a decrease in the amount of stage three sleep during the first three hours and an increase in the amount of stage two sleep (Brezinova, 1974). The effects of ingesting caffeine 30-60 minutes prior to bedtime generally leads to an increased latency in sleep onset, shorter duration in sleep, and more disturbed sleep (Nehlig, Daval, & Debry, 1992). Paterson, Wilson, Nutt, Hutson, and Ivarsson (2007) found a 155% increase in sleep onset in volunteers who were administered 150 mg of caffeine prior to bedtime in comparison to the placebo group. Puckeridge, Fulcher, Phillips, and Robinson (2011) sought to use a quantitative model to further investigate the effect caffeine has on sleep loss and sleep onset. The study found that caffeine causes an increase in sleep loss and sleep onset. Moreover, Puckeridge et al. (2011) disclosed that large doses of caffeine and doses taken right before bedtime had the greatest disturbance effects. Small amounts of caffeine use (no more than one cup of coffee) have no significant impact on sleep loss, but the use of large doses (about 800 mg) can result in a sleep deficit of an hour (Puckeridge et al., 2011). In addition to Puckeridge et al., Hans Peter Landolt (2015) explained that the high occurrence of sleep issues following caffeine use may be linked to the interference caffeine has on the circadian clock.

In conclusion, the literature suggests that caffeine use is associated with various cardiovascular, respiratory, and sleep-related side effects that can be detrimental to health if not properly managed.

Caffeine Withdrawal Symptoms

Withdrawal of nervous system stimulation can result in the production of many temporary psychiatric changes including difficulty concentrating, depressed mood, headache, fatigue, drowsiness, irritability, decreased alertness, nausea, vomiting, and others (Pandejpong, Paisansudi, & Udompunthurak, 2014). Many of these withdrawal symptoms arise 12-24 hours after an acute abstinence of caffeine and may reach peak intensity anywhere between 20-51 hours following abstinence (Juliano and Griffiths, 2004). For the purpose of this literature review and our study, the focus will be on five withdrawal effects — headaches, fatigue, drowsiness, decreased alertness, and mood disturbances.

Headaches are reported as the most common symptom of caffeine withdrawal (Juliano and Griffiths, 2004). Silverman, Evans, Strain, and Griffiths (1992) performed a double blind study on the cessation of caffeine use. Each participant filled out a series of questionnaires at baseline, was given caffeine capsules or placebo twice a day over two, two-day periods, and then reassessed. After reassessment, many of the items on the withdrawal questionnaire were statistically significant. Report of a headache was the most significant withdrawal effect with 52% of participants indicating a moderate to severe headache during caffeine withdrawal. Only 2% indicated any headache during at baseline, and 6% of participants indicated a headache during the periods of caffeine administration (Silverman et. al, 1992). Similarly, Rubin and Smith (1999) developed a

study that focused specifically on headaches and caffeine withdrawal. The study revealed that there was no significant difference in reports of a headache at baseline compared to the number of headaches during caffeine use, but a significant increase was shown in headaches reported during the periods of decaffeinated coffee use. Evans and Griffiths (1999) studied how different increments of substituted doses of caffeine impacted the severity of a headache when compared to a baseline level. They found that not only was the onset of a headache common, but the severity and incidence of headaches also increased as the substituted dose of caffeine decreased (Evans and Griffiths, 1999).

van Dusseldorp and Katan (1990) studied the effects of long-term cessation of caffeine. In a double-blind experiment, two groups were matched for sex, age, and overall general health. All participants were regular coffee users consuming 4-6 cups per day. The first group was given five cups of coffee each day (84 mg caffeine/cup), for six weeks, while the second group was given five cups of decaffeinated coffee each day (3mg caffeine/cup) for six weeks (van Dusseldorp and Katan, 1990). At the end of six weeks, each group was switched to either caffeinated or decaffeinated coffee for another six weeks. About 42% of participants complained of an increase in headaches in the first week of taking decaffeinated coffee, as compared to the other 11 weeks of the study. On average the headaches started within 1-2 days and lasted from 1-6 days (van Dusseldorp and Katan, 1990). The results of these studies support headaches as a common occurrence in those who abstain from caffeine in acute and long-term settings. The severity of a headache may have some correlation to the level of caffeine tolerance prior to withdrawal.

Drowsiness and fatigue are also common in those who experience caffeine withdrawal. Rogers, Heatherly, Mullings, and Smith (2012) looked at the effects of caffeine withdrawal and the effects of caffeine re-administration. Rogers et. al (2012) found that caffeine withdrawal has a significant effect on increasing levels of drowsiness in people who had medium-high levels of caffeine use prior to withdrawal of the caffeine. Caffeine withdrawal had little effect on drowsiness in those who were moderate or high-dose consumers of the drug, which was likely due to their lower levels of tolerance to caffeine (Rogers et. al, 2012).

In a double blind, placebo controlled, crossover study, Phillips-Bute and Lane (1997) studied how short-term withdrawal from caffeine may produce various withdrawal symptoms, including fatigue. Short-term withdrawal was defined as abstaining four hours beyond a normal intake of coffee in the morning. Then, they were then given a series of questionnaires asking about their current mood and withdrawal symptoms. Participants were asked to perform a simple task of reaction time and cognitive functioning. On the mood questionnaire, participants indicated a significant increase in fatigue. Fatigue was one of only two categories that were statistically significant, with the other category being a decrease in vigilance/activity. On the withdrawal symptom questionnaire, increased sleepiness and yawning were the only two categories out of 17 total that had a significant change (Phillips-Bute and Lane, 1997). Juilano, Huntley, Harrell, and Westerman (2012) and Hughs et al. (1991) also found a significant increase in fatigue after periods of caffeine abstinence.

The intake of caffeine has been found to enhance alertness, the ability to achieve, and sensitivity to incoming stimuli, mainly by its interactions with the central

dopaminergic systems of the brain (Einöther and Giesbrecht, 2013). Withdrawal of caffeine can elicit opposite effects of decrease in mental alertness, particularly in those who are medium-high consumers of caffeine. No significant decrease was found in alertness of those who do not consume caffeine or consume it in low doses (Rogers et al, 2012). Evans and Griffiths (1999) found that a decrease in mental alertness might be correlated to the amount of caffeine that was consumed prior to withdrawal. In a 73-day study, no evidence suggested a decrease in alertness when the maintenance dose of caffeine was 100 mg prior to withdrawal. A significant decrease in mental alertness was found when the maintenance dose of caffeine was 300mg and 600mg prior to withdrawal. However, a study done by Phillips-Bute and Lane (1997) did not find this to be true, since no significant effect on mental alertness was revealed in their study on caffeine withdrawal symptoms. This contraindication found by Phillips-Bute and Lane (1997) was likely due to different methodologies.

Withdrawal of caffeine has been shown to elicit an overall disturbance in mood such as increased irritability, depressed feelings, and a decrease in social disposition, self confidence, well being, and feelings of being content (Griffiths et al., 1990). Garrett and Griffiths (1998) studied a similar effect through a "caffeine challenge." During the first phase of the experiment, participants were placed on a placebo two times a day, or caffeine (300mg/70kg, twice daily) for twelve days, and then were switched in a second phase to the opposite condition for another twelve days (Garrett and Griffiths, 1998). The first two days were used to gradually stabilize the doses in those who were placed in the initial caffeine group, while the first three days were used to slowly stabilize those who were placed in the initial placebo group in order to minimize caffeine

withdrawal effects (Garrett and Griffiths, 1998). On the last two days of each phase, participants were given either a placebo or caffeine, providing four conditions: caffeine challenge after chronic caffeine administration, placebo challenge after chronic caffeine administration, caffeine challenge after chronic placebo administration, and placebo challenge after chronic placebo administration (Garrett and Griffiths, 1998). Through a series of questionnaires, a disturbed, or depressed mood was found to be a significant withdrawal effect during the placebo challenge after chronic caffeine administration. It was noted that participants were willing to forfeit small sums of money ($2.14) to avoid receiving this placebo challenge again (Garrett and Griffiths, 1998).

Misconceptions About Caffeine

Although much research has been done on how caffeine use and withdrawal affect the body, there appear to be misconceptions within the general population on the actual effects. Anderson, Juliano, and Schulkin (2009) studied how much knowledge obstetricians and gynecologists had about caffeine and how these providers implemented this knowledge into their practice. Over 85% of participants either overestimated or underestimated the amount of caffeine in commonly used products such as espresso and Diet Coke and only 58% of these providers discuss the use of caffeine with their patients (Anderson, Juliano, and Schulkin, 2009).

Lee et al. (2009) studied misconceptions about caffeine in first, second, and third year medical students in South Africa. Students were surveyed on the benefits, side effects, and withdrawal symptoms of caffeine use. Although 93% of students were regular caffeine consumers, the results showed that the majority of these medical students did not have accurate knowledge of caffeine's effects. Many students (26.7%)

inaccurately identified “substitute for sleep” as a benefit for caffeine use. Hot flashes (21.9%) and acne (18.3%) were mistaken as side effects, and 27% of students wrongly identified aggression as a symptom of withdrawal (Lee et. al 2009).

A lack of further research on misconceptions regarding caffeine exists, particularly among graduate students; yet, accurate knowledge on the benefits, side effects, and withdrawal symptoms of caffeine is necessary as caffeine is the most widely consumed drug in the world.

Summary

While an abundance of information can be found on the benefits, side effects, and withdrawal symptoms of caffeine, a lack of research measures how much people know about these effects. The current study looks at the use and misconceptions in pre-physician assistant students, current physician assistant students, and practicing physician assistants. This study attempts to expand the knowledge in this area as it identifies what misconceptions people may have about caffeine and by doing so, expand on these misunderstandings already acknowledged by Lee et al. (2009).

Chapter 3: Methodology

Introduction

The main purpose of this study was to assess the use of caffeine for academic and professional purposes, as well as the knowledge about the benefits, side effects, and withdrawal symptoms of caffeine among pre-PA students, PA students, and practicing PAs in Minnesota. Additional purposes included determining the most commonly used caffeine products, how frequently caffeine is used for academic and professional purposes, and the differences in frequency of caffeine usage among prospective PAs and practicing PAs. The questions addressed as part of this research were:

1. What is the prevalence of caffeine use for academic and professional purposes in pre-PA students, PA students, and practicing PAs in Minnesota?
2. What, if any, differences are there in the frequency of caffeine use for academic and professional purposes between pre-PA students, PA students, and practicing PAs in Minnesota?
3. What is the level of knowledge among these individuals on the benefits, side effects, and withdrawal symptoms of caffeine?

This chapter contains information on the study population, materials and instrumentation, study design, procedures, statistical analysis, validity and reliability, limitations, and delimitations of the study.

Study Population

The participants of this study were pre-PA students, current PA students, and practicing PAs in the state of Minnesota. Eligible pre-PA students were members of a pre-PA club at Bethel University, St. Catherine University, Augsburg College, the

University of Minnesota Twin Cities, the University of Minnesota Duluth, and the College of St. Scholastica. In addition, students who had been accepted into the PA program at Bethel University, St. Catherine University, or Augsburg College, but had not yet started classes were considered pre-PA students. Current PA students were restricted to those enrolled in the Augsburg College, Bethel University, or St. Catherine University PA programs. The practicing PAs were graduates within the last five years from the PA program at Augsburg College, Bethel University, or St. Catherine University. A letter of intent was sent to Augsburg College, Bethel University, and St. Catherine University in order to receive permission to survey their students (see appendix A, B, and C). The estimated number of participants was 140 pre-PA students, 180 PA students (90 didactic year student and 90 clinical year students), and 100 practicing PAs.

Materials and Instrumentations

This study utilized a survey tool originally developed in a previous study by Lee et al. (2009) (see Appendix D). Although Lee et al.'s study was performed on medical students; this survey was most applicable to measure the same qualities among pre-PA students, PA students, and practicing PAs. Permission to use the survey and make any necessary changes was obtained from Dr. Carol Larson, one of the authors and correspondent of the study (see Appendix E). Small changes were made to manipulate the survey, applying it to pre-PA students, PA students, and practicing PAs. Changes were made to demographic questions to reflect the study sample. The word impotency (listed under side effects and withdrawal symptoms) was replaced by erectile dysfunction for better clarification. One side effect (increases gastric secretion was changed to increases sleep disturbances) and one withdrawal symptom (constipation was changed to

increases mood disturbance) was changed to reflect current literature, but the rest of the survey questions regarding knowledge of caffeine's benefits, side effects, and withdrawal symptoms remained unchanged (see Appendix F).

A paper copy of the survey was distributed in person to gather data from pre-PA students and didactic year PA students from Bethel University. An electronic survey software, Qualtrics®, was utilized to gather data from the remaining pre-PA students, didactic year PA students, clinical year PA students, and practicing PAs. Both surveys were exactly the same and were used to collect the following information:

1. Demographic data
2. Data regarding the use of caffeine
3. Data conveying whether or not the individual has knowledge on the benefits of caffeine
4. Data conveying whether or not the individual has knowledge on the side effects of caffeine
5. Data conveying whether or not the individual has knowledge on the withdrawal symptoms of caffeine

The electronic survey link was sent to a PA program faculty member of each school to be distributed to the proposed participants. These faculty members served only as distributors of the survey and did not participate in the study, unless they met the definition of a practicing PA.

Study Design

A quantitative study was conducted in order to assess use of caffeine and knowledge of its benefits, side effects, and withdrawal symptoms among pre-PA

students, current PA students, and practicing PAs. The study can be defined as a descriptive, survey-based study reflective of this population.

Procedure

A paper copy of the survey was handed out in person to Bethel pre- PA students at a pre-PA meeting and current Bethel didactic year PA students during class. The same survey was emailed (see Appendix G) to remaining pre-PA students, didactic year PA students, clinical year PA students, and practicing PAs. Participants were given a letter of informed consent, which acknowledged that submission of their survey indicates release of submitted data for professional use (see Appendix H). Participants of the study were not offered compensation for participating in this study, thus reducing the possibility of coercion.

Prior to starting the survey, the following statement was read to the participants taking the survey in person or displayed online for those taking the electronic version: "This study is being conducted by first year students in Bethel University's Physician Assistant program. The following survey will assess the participant's knowledge on the benefits, side effects, and withdrawal symptoms of caffeine. It should take no longer than 5 to 10 minutes to complete. You will not be asked about any personal information and only the researchers and their committee will have access to submitted data. You are NOT required participate in this survey. Should you choose to participate, your signature on the letter of informed consent will serve as an acknowledgement that submission of your survey indicates release of data for professional use."

In order to obtain an optimal response rate from the online surveys, participants were given a four-week period to complete the survey. A reminder email (see Appendix

I) with the survey link was also sent to the PA program faculty member two weeks after the survey opened to remind individuals to complete the survey.

After the electronic survey expired and all paper copies were compiled, the data was analyzed and discussed. Only the researchers and the research committee examined data collected from the surveys. Confidentiality was assured, as participants were not asked about personal information. Informed consent and Bethel IRB approval (see appendix J) was obtained to ensure participants' rights were be upheld. Data from the surveys completed electronically were kept secure on Qualtrics® under their "Privacy Policy." Data collected from the paper-copy surveys will be stored in a secure cabinet in the Physician Assistant program at Bethel University for five years.

Statistical Analysis

The prevalence of caffeine use was divided into four main groups for analysis: no caffeine use, caffeine use for academic purposes, caffeine use for professional purposes, and caffeine use for other purposes. The total number of respondents who answered "yes" to caffeine use on the survey were asked to reply to reasons for use of caffeine. These answers were totaled by group (Pre PA students, PA students in their didactic year, PA students in their clinical year, and practicing PAs) and reported as a percentage of the total number in each group that responded.

Participants indicated how frequently they used caffeine for academic and/or professional purposes. Data was analyzed for frequency of caffeine use for academic or professional purposes. This data was analyzed using a One-Way ANOVA. Due to statistical significance, a Tukey Post-Hoc test was performed as well to determine which groups were significantly different

During data analysis, the section regarding knowledge about caffeine was scored on a scale of 0-5. The participants were given two scores for each of the last three questions. The first score pertained to the number of correct options selected and the second score pertained to the number of incorrect options selected. For each correct response the participant received 1 point (maximum of 5 points) toward their first score. For each incorrect response the participant received 1 point (maximum of 5 points) toward their second score. The participants neither gained nor lost any points if a question went unanswered. Participants' scores were then calculated and categorized. The correct response scores were categorized as follows: 0 = without knowledge; 1 = very little knowledge; 2 = little knowledge; 3 = moderate knowledge; 4 = good knowledge; and 5 = very good knowledge. The incorrect response scores were categorized as follows: 0 = very good knowledge; 1 = good knowledge; 2 = moderate knowledge; 3 = little knowledge; 4 = very little knowledge; and 5 = without knowledge (See Appendix K for survey grading rubric).

Identical but separate analyses were done for each of the six knowledge categories: benefits correct, benefits incorrect, side effects correct, side effects incorrect, withdrawal symptoms correct and withdrawal symptoms incorrect. The coding for the six categories was applied to all four demographic groups: pre-PA students, PA students in their didactic year, PA students in their clinical year, and practicing PAs. For clarification, "benefits correct" and "pre PA students " is used as an example of coding for an analysis. If there were 19 out of 71 pre-PA students who scored a 0 (without knowledge) on the benefits of caffeine, SPSS was coded with 19 "1s" and 52 "0s" for the remainder of those who did not fall into the category of without knowledge. If there were

42 out of 71 pre-PA students who scored a 1 (very little knowledge), SPSS was coded with 42 "1s" and 29 "0s." This continued with scores 2-5 and applied to the four statistical groups.

Per the statistical analysis conducted by Lee et al. (2009), a Kruskall-Wallis test was used to analyze numerical data about participants' knowledge of caffeine (correct and incorrect) on each of the six categories: benefits correct, benefits incorrect, side-effects correct, side-effects incorrect, withdrawal symptoms correct, and withdrawal symptoms incorrect. For statistical significance, at least 40 participants from each group was necessary.

Validity and Reliability

The survey used in this study was obtained from a previous study (Lee et al., 2009) and was used with permission. The survey used in Lee et al.'s study was appropriately approved for validity through the use of a pilot study on twenty physiotherapy students from the same school. Results of Lee et al.'s study demonstrated that the survey questions provided accurate information about participants' knowledge of caffeine's benefits, side effects, and withdrawal symptoms among medical students. Small changes were made with permission, to allow the study to represent a population of pre-PA students, PA students and practicing PAs, rather than medical students that were originally studied. The survey was given only to pre-PA students, current PA students, and practicing PAs in Minnesota, and therefore, our results cannot be applied nationally. This affected the study's external validity.

To help ensure the reliability (specifically readability and understandability) of this research, the survey was reviewed by three certified PAs who have been in practice

for at least five years. These PAs served as an expert panel review before distribution of the survey to the study's participants. To confirm readability and understandability, minor changes were made to the survey, per suggestions of the panel.

Limitations and Delimitations

The following is a delimitation the researchers believed was a potential weakness in the study. Subjects were intentionally limited to pre-PA students, current PA students, and practicing PAs in the state of Minnesota. In addition, practicing PAs were limited to those who graduated within the last five years from one of the following institutions: Augsburg College, Bethel University, or St. Catherine University. For convenience sampling, researchers believed this gave the best sampling of the Minnesota PA population as these schools were the only accredited programs in the state of Minnesota at the time of this study.

The following are limitations the researchers believed to be potential weaknesses in the study. First, regardless of whether the survey was given in an email or as a paper copy in-person there was no control over the response rate from all subjects. An online version of the survey could have resulted in a lower response rate due to the large quantity of emails one receives in a day. It was possible that the email containing the survey could be disregarded, lost, or sent to spam, and may affect the final analysis. The goal was that all subjects would respond to the survey questions based on their own knowledge levels without using outside resources during the survey. However, the researchers had no control over the subjects' use of these resources.

While the research was precisely planned, these limitations were unavoidable. Several steps were taken in order to help avoid some of the limitations

stated above. In order to increase response rate from the online surveys, an initial email was sent requesting that individuals partake in the survey. Two weeks into the survey period, a reminder email was sent. Each participant was informed that his or her responses would be confidential and that honest responses would help provide more accurate results.

Conclusion

The listed methodology provided a comprehensive process to conduct this research project and assess the usage of caffeine for academic and professional purposes, as well as the knowledge about the benefits, side effects, and withdrawal symptoms of caffeine among pre-PA students, PA students, and practicing PAs in Minnesota. The methodology also determined the most commonly used caffeine products, how frequently caffeine is used for academic and professional purposes, and the differences in frequency of caffeine usage among prospective PAs and practicing PAs. The following chapters will examine results of the survey, statistical analysis, discussion of the results, and ideas for future studies associated with this research.

Chapter Four: Results

Introduction

Chapter four contains the results of data analysis and is organized by demographic information, research question responses, and statistical findings. The results section is designed to answer the aforementioned research questions. Survey population demographics are provided in written and graphical form for observation. This includes gender, age, and group identity (pre-PA, PA-S didactic, PA-S clinical, PA-C in practice). Similarly, caffeine use for academic, professional, and other purposes among groups is provided in written and graphical form for observation. Differences in frequency of caffeine use for academic, professional, and other purposes were analyzed for statistical significance. Caffeine products are provided in written and graphical form as a percentage of the total number of participants that responded to this question on the survey. Finally, caffeine knowledge was divided and analyzed separately by benefits, side effects, and withdrawal symptoms and among groups. Mean scores are recorded in graphical from and comparison analysis between groups is described.

Survey Population

In total, 182 surveys were collected, and six were deleted due to incompletion. For the most part, these particular participants answered the demographic data questions but then failed to complete the section that assessed the level of knowledge on caffeine; therefore, data was analyzed using 176 qualified surveys. Of the 176 surveys, 43 participants identified as male (24.4%) and 143 were female (75.6%). The majority of participants were either in the 15 to 24-year-old group (43.2%) or the 25 to 34-year-old group (51.1%). This was followed by 35-44 (4.0%) and 45-54

(1.7%). There were no participants in the 55-64 or 65+ age groups. Participation was largely divided between pre-PA students (40.3%) and PA students in their didactic year (33.5%). Fewer surveys were collected from PA students in their clinical year (16.5%) and practicing PAs (9.7%). Reasoning for these results will be reviewed in chapter five. These results are depicted below in simple graph form (Figures 1-3).

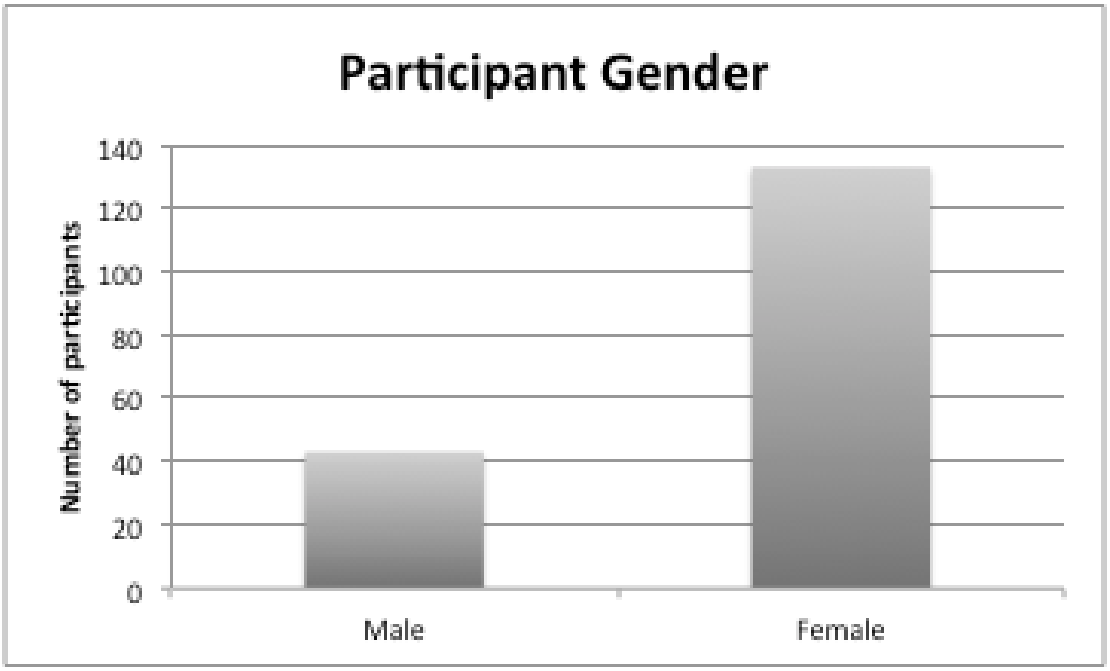

Figure 1. Participant Gender. Data was divided demographically by gender; 24.4 of the participants identified as male and 76.6 percent identified as female.

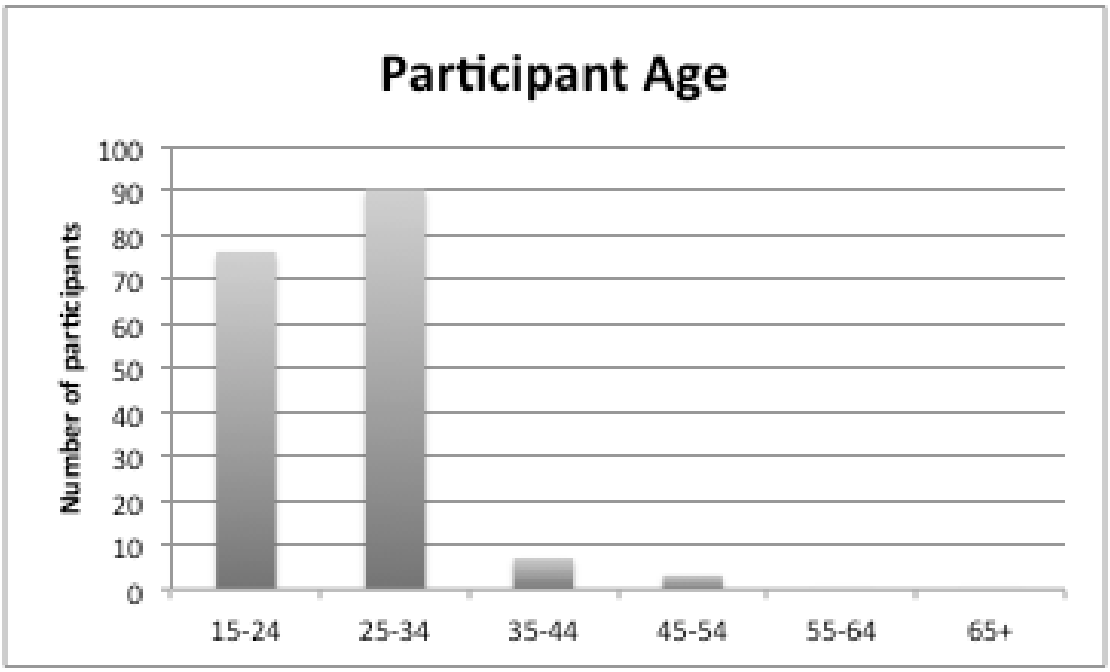

Figure 2. Participant Age. Data was divided demographically by age; the majority of participants were either in the 15 to 24-year-old age group or the 25 to 34-year old age group, at 43.2 percent and 51.1 percent, respectively.

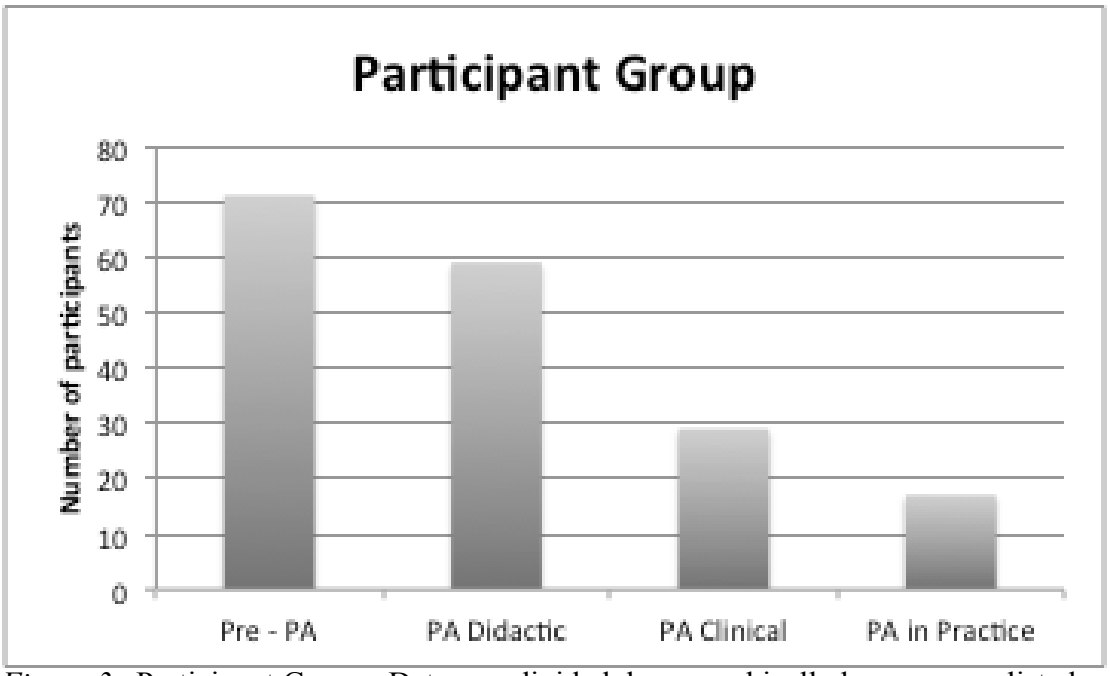

Figure 3. Participant Group. Data was divided demographically by group, as listed above. It was largely divided between pre-PA students (40.3%) and PA students in their didactic year (33.5%). Fewer surveys were collected from students in their clinical year or PAs in practice.

Prevalence of Caffeine Use for Academic and Professional Purposes Based on Group

The prevalence of caffeine use was divided into four main groups for analysis: no caffeine use, caffeine use for academic purposes, caffeine use for professional purposes, and caffeine use for other purposes. The research questions address caffeine use among pre-PA students, PA students, and clinically practicing PAs for academic and professional purposes; thus, caffeine use for other purposes will be addressed in a later section. The survey defined academic purposes as *the use of caffeine in order to lengthen study time, stay awake during class, improve academic performance, and/or increase efficiency on assignments and studying.* The survey defined professional purposes as *the use of caffeine in order to stay awake while working with patients and completing paperwork, improve work performance, and/or increase productivity on work-related duties.* The total number of respondents who answered "yes" to caffeine use on the survey were asked to reply to reasons for use of caffeine. These answers were totaled and reported as a percentage of the total number in each group that responded.

General caffeine use was high in every group. Among pre-PA students, only 1.4 percent reported no caffeine use; similarly, "no caffeine use" is low among PA students in their didactic year (10.2 percent), PA students in their clinical year (10.3 percent) and clinically practicing PAs (0 percent). As one might expect, as students left academia and started their clinical year or professional practice, they indicated a decrease in caffeine use for academic purposes and an increase in caffeine use for professional purposes. For example, among pre-PA students 83.1 percent reported caffeine use for academic purposes, compared to students in their didactic year (72.9 percent), clinical year (62.1

percent), and clinically practicing PAs (5.9 percent). Among pre-PA students, 33.8 percent reported caffeine use for professional purposes compared to 15.3 percent of PA students in their didactic year, 62.1 percent of PA students in their clinical year, and 58.8 percent of clinically practicing PAs.

These results are displayed below in Figure 4. Of note, some respondents did use caffeine for both academic and professional purposes or for other purposes solely, which is why the percentages do not sum to 100 percent.

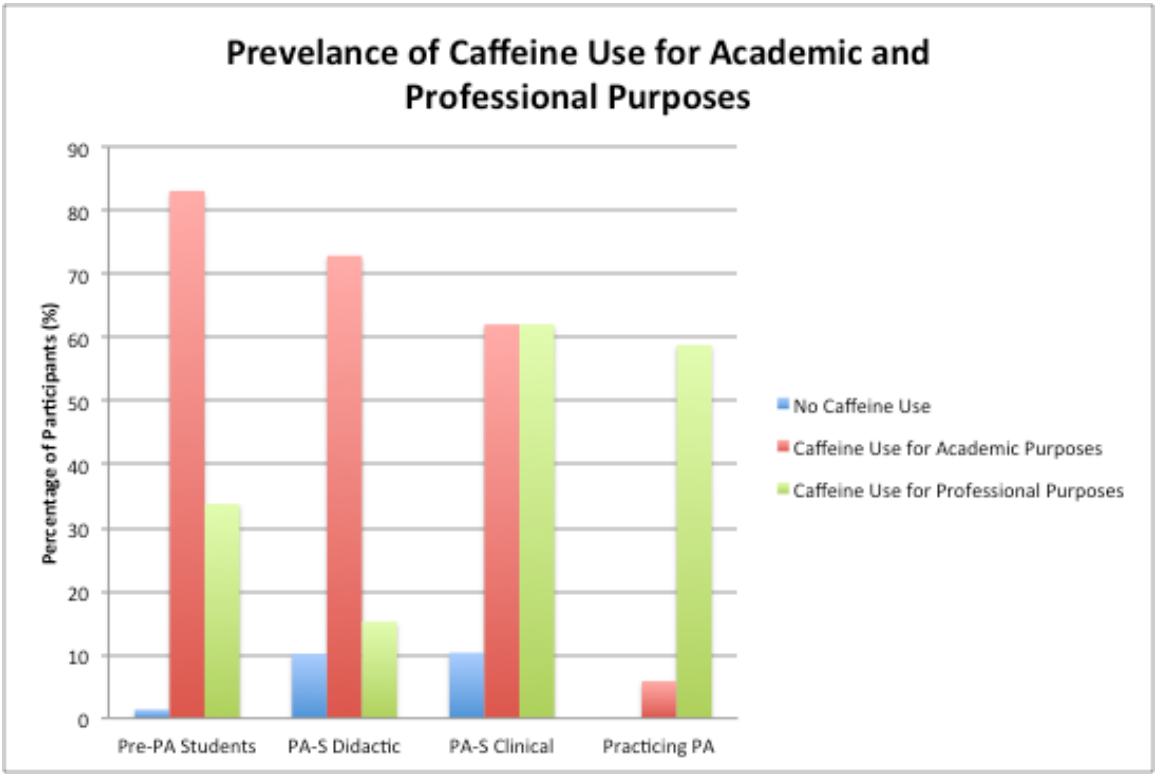

Figure 4. Prevalence of Caffeine Use for Academic and Professional Purposes. Practicing PAs drink significantly less caffeine for academic purposes than pre- PAs, PA students in their didactic year and PA students in their clinical year. PA students in their clinical year use caffeine significantly more for professional purposes that both Pre-PA students and PAs in their didactic year.

Prevalence of Caffeine Use for Other Purposes Based on Group

As mentioned previously, participants were able to indicate the use of caffeine for purposes other than academic or professional purposes. These additional purposes were to increase vigilance, for sport, for social reasons, to cure a hangover, and for the taste. Again, the results are reported as a percentage of the total participants in each group. A description of these purposes was located on the survey, as is as follows: sport — to enhance performance, social — drinking coffee socially, hangovers — to recover from heavy alcohol consumption, and taste — enjoying the taste of caffeine-related products.

Among all groups, it was most common for participants to use caffeine for social reasons and for taste. For example, 69 percent of pre-PA students use caffeine for social reasons, compared to PA students in their didactic year (47.5 percent), PA students in their clinical year (55.2 percent), and practicing PAs (70.6 percent). As many as 94 percent of clinically practicing PAs reported caffeine use for taste reasons. This was similarly elevated among pre-PA students (77.5 percent), PA students in their didactic year (67.8 percent), and PA students in their clinical year (67.8 percent). It was rare for participants to report caffeine use as a means of curing a hangover. This ranged from 0 percent among clinically practicing PAs to 8.5 percent among PA students in their didactic year. Full results are displayed in Figure 5. Of note, some respondents reported use of caffeine for multiple other purposes, which is why the percentages do not add up to 100 percent.

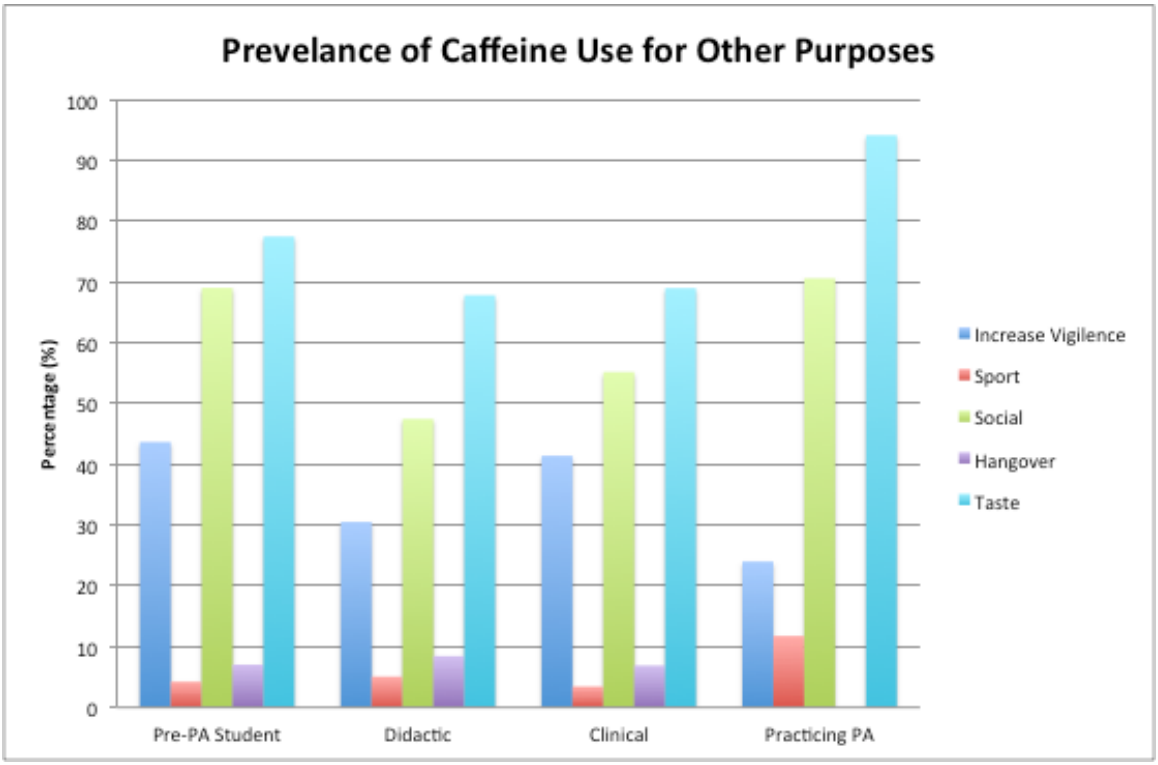

Figure 5. Prevalence of Caffeine Use for Other Purposes. Data is expressed as percentage of the total number of participants. Surprisingly, the largest percentage of participants who used caffeine for taste was practicing PAs. However, participants could indicate more than one reason for using caffeine, which explains why the total percentage was over 100.

Frequency of Caffeine Use for Academic and Professional Purposes Based on Group

Participants indicated the frequency of their use of caffeine for academic and professional purposes. The data analyzed using a one-way ANOVA indicated statistical significance in the difference in frequency of caffeine use for academic purposes ($F(3,172) = 16.401 = p<.001$) (Table 1*)*. A Tukey post-hoc test revealed that practicing PAs drink significantly less caffeine for academic purposes than pre-PAs ($p<.001$), PA students in their didactic year ($p<.001$) and PA students in their clinical year ($p<.001$). There is no significant difference in frequency of caffeine use between pre-

PAs, PA students in their didactic year, and PA students in their clinical year (p>.05) (Table 2).

One-way ANOVA also revealed statistical significance in the difference between groups in the frequency of caffeine use for professional purposes (F(3,172)=8.982 = p< .001) (Table 1*)*. A Tukey post-hoc test revealed that PA students in their clinical year use caffeine significantly more for professional purposes than both Pre-PA students and PA students in their didactic year (p=.024) and (p<.001) respectively. The Tukey post hoc test also revealed that practicing PAs use caffeine for professional purposes significantly more than PA students in their didactic year (p=.003). There is no significant difference in the use of caffeine between Pre-PA students and PA students in their didactic year (p =.090), Pre PA students and practicing PAs (p=.167), or between PA students in their clinical year and practicing PAs (p=.995) (Table 2*)*.

Table 1. Frequency of Caffeine Use For Academic and Professional Purposes. This table shows descriptive statistics for between groups and within groups, with significance shown for between groups. P-values < .001 for both groups.

		Sum of Squares	df	Mean Square	F	Sig.
Frequency Academic	Between Groups	8.411	3	2.804	16.401	.000
	Within Groups	29.402	172	.171		
	Total	37.813	175			
Frequency Professional	Between Groups	5.398	3	1.799	8.982	.000
	Within Groups	34.460	172	.200		
	Total	39.858	175			

Table 2. Tukey Post-Hoc Mean Comparisons. This table shows the mean comparisons from the Tukey Post-hoc test as well as significance.

Dependent Variable	Group	Group	Mean Difference	St. Error	Sig.
Frequency For Academic Purpose	Pre -PA	Didactic	.102	.073	.499
		Clinical	.210	.091	.100
		Practicing	.772*	.112	.000
	Didactic	Pre- PA	-.102	.073	.499
		Clinical	.108	.094	.657
		Practicing	.670*	.114	.000
	Clinical	Pre- PA	-.210	.091	.100
		Didactic	-.108	.094	.657
		Practicing	.562*	.126	.000
	Practicing	Pre- PA	-.772*	.112	.000
		Didactic	-.670*	.114	.000
		Clinical	-.562*	.126	.000
Frequency For Professional Purpose	Pre-PA	Didactic	.185	.079	.090
		Clinical	-.283*	.099	.024
		Practicing	-.250	.121	;167
	Didactic	Pre- PA	-.185	.079	.090
		Clinical	-.468*	.102	.000
		Practicing	-.436*	.123	.003
	Clinical	Pre- PA	.283*	.099	.024
		Didactic	.468*	.102	.000
		Practicing	.032	.137	.995
	Practicing	Pre- PA	.250	.121	.167
		Didactic	.436*	.123	.003
		Clinical	-.032	.137	.995

Frequency of Caffeine Use for Other Purposes Based on Group

In addition to indicating frequency of caffeine use for academic and professional purposes, participants were also able to indicate their frequency of caffeine use for other purposes including for increased vigilance, sport, social, to help with a hangover, and because of the taste. A One-Way ANOVA showed no statistical significance in the frequency of caffeine use for these purposes ($p>.05$).

Most Commonly Used Caffeine Products Based on Group

The total number of respondents who answered "yes" to caffeine use on the survey were asked to reply to what caffeine containing product(s) they use for academic or professional purposes. Of the 166 participants that responded "yes" to caffeine use, 30 did not respond to this particular question resulting in missing data. The answers from the remaining 143 surveys were totaled and reported as a percentage of the total number in each group that responded to the question.

The caffeine products analyzed in this study included coffee, tea/iced tea, cool drinks (such as Coke or Mountain Dew), energy concoctions, and energy drinks. Coffee was by far the most commonly used caffeine product. Among pre-PA students, 92.31 percent reported use of coffee; frequency of coffee as a caffeine product was similar among PA students in their didactic year (91.3 percent), PA students in their clinical year (90.9 percent), and practicing PAs (90 percent). Tea/iced tea was the second most commonly consumed caffeine product at 41.5 percent among pre-PA students, 45.7 percent among PA students in their didactic year, 45.5 percent among PA students in their clinical year, and 60 percent among clinically practicing PAs. Rarely, participants reported energy concoctions as a source of caffeine. Caffeine use from energy concoctions ranged from 0 percent among clinically practicing PAs and PAs in their clinical year to 4.35 percent among PA students in their didactic year. Full results are displayed below in Figure 6. Of note, some respondents reported use of multiple caffeine products, which is why the percentages do not sum to 100 percent.

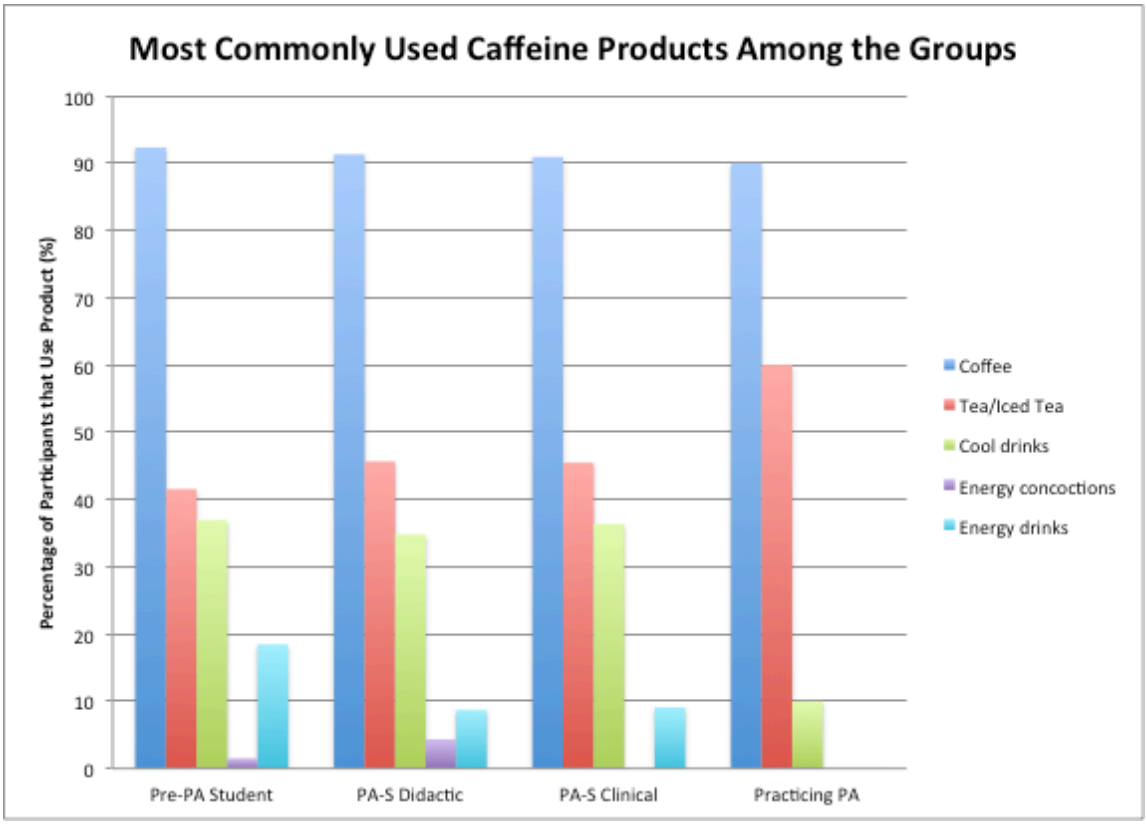

Figure 6. Most Commonly Used Caffeine Products Among Groups. Clearly, coffee is the most commonly used caffeine product among all of the groups. There were no clinically practicing PA participants who indicated using energy drinks or energy concoctions for a caffeine source.

Caffeine Knowledge Based on Group

The survey scoring system is described in Appendix K. Participants were given two scores for each of the three knowledge questions. The first score pertains to the number of correct options selected and the second to the number of incorrect options selected. One point was awarded for each correct response with a maximum score of five for each question. The correct response scores were then categorized as follows: 0 = without knowledge; 1 = very little knowledge; 2 = little knowledge; 3 = moderate knowledge; 4 = good knowledge; and 5 = very good knowledge. For the second score, one point was given for each incorrect response with a maximum score of five for each

question. The incorrect response scores will be categorized as follows: 0 = very good knowledge; 1 = good knowledge; 2 = moderate knowledge; 3 = little knowledge; 4 = very little knowledge; and 5 = without knowledge.

The data was initially analyzed for normality. The data was not normal so a Kruskal- Wallis test was performed on each of the six categories; benefits correct, benefits incorrect, side-effects correct, side-effects incorrect, withdrawal symptoms correct, and withdrawal symptoms incorrect. Extensive visual aide of caffeine knowledge is depicted in tables 3 and 4 below (refer to Appendix L for additional visual aide).

Table 3. Correct Benefit, Side Effect, and Withdrawal Response Scores. The table depicts the occurrence of the scores (recorded as percentage) for each knowledge section. PA students in their clinical year had significantly more knowledge on the benefits of caffeine when compared to the three other groups. P-value = <0.001. There were no other significant differences ($p < 0.05$) between groups.

	Group	Without	Very Little	Little	Moderate	Good	Very Good
Benefits	Pre-PA	26.76	59.15	11.26	1.41	1.41	0
	Didactic	15.25	55.93	20.34	5.08	3.39	0
	Clinical	13.79	62.07	20.69	0	0	3.45
	Practicing PA	5.88	76.47	11.76	0	5.88	0
Side Effects	Pre-PA	1.41	16.90	16.90	21.13	18.31	25.35
	Didactic	1.69	8.47	22.03	16.95	28.81	22.03
	Clinical	0	17.24	27.59	34.48	10.34	10.34
	Practicing PA	0	17.65	17.65	29.41	23.53	11.76
Withdrawal	Pre-PA	0	7.04	11.27	15.49	30.99	35.21
	Didactic	0	10.17	10.17	18.64	22.03	38.98
	Clinical	0	17.24	0	31.03	13.79	37.93
	Practicing PA	0	11.76	0	23.53	35.29	29.41

Table 4. Incorrect Benefit, Side Effect, and Withdrawal Response Scores. The table depicts the occurrence of the scores (recorded as percentage) for each knowledge section. There were no significant differences ($p < 0.05$) between groups.

	Group	Without	Very Little	Little	Moderate	Good	Very Good
Benefits	Pre-PA	0	2.82	0	5.63	47.89	43.67
	Didactic	0	0	0	6.78	38.98	54.24
	Clinical	0	0	0	10.34	44.83	44.83
	Practicing PA	0	0	0	11.76	29.41	58.82
Side Effects	Pre-PA	0	0	11.76	8.45	42.25	46.48
	Didactic	0	0	5.08	20.34	42.37	32.30
	Clinical	0	0	6.90	17.24	41.38	34.48
	Practicing PA	0	0	11.76	5.88	41.18	41.18
Withdrawal	Pre-PA	1.41	0	1.41	7.04	38.03	52.11
	Didactic	0	0	5.08	8.47	40.68	45.76
	Clinical	0	0	0	20.69	27.59	51.72
	Practicing PA	0	0	5.88	11.76	17.65	64.71

Nearly all of the data was statistically insignificant ($p > .05$) except for one category. The PA students in their clinical year had significantly more "very good" knowledge ($p < .001$) on the benefits of caffeine when compared to the other three groups (Table 5 and 6*)*. There was no significant difference in the other five levels of knowledge.

Table 5. Correct Benefit Response Kruskall-Wallis. P-value = <0.001.

	Without	Very Little	Little	Moderate	Good	Very Good
Chi- Square	5.746	2.388	2.707	3.390	2.229	175.000
df	3	3	3	3	3	3
Asymp. Sig.	.125	.496	.439	.335	.526	.000

Table 6. Correct Benefit Response Mean Ranks. This table depicts that the PA students in their clinic year have significantly more knowledge of the benefits of caffeine when compared to the three other groups.

	Group	N	Mean Rank
Without Knowledge	Pre- PA	71	95.55
	Didactic	59	85.42
	Clinical	29	84.14
	Practicing	17	77.18
	Total	176	
Very Little Knowledge	Pre-PA	71	87.56
	Didactic	59	84.72
	Clinical	29	90.12
	Practicing	17	102.79
	Total	176	
Little Knowledge	Pre-PA	71	84.42
	Didactic	59	92.40
	Clinical	29	92.71
	Practicing	17	84.85
	Total	176	
Moderate Knowledge	Pre-PA	71	87.74
	Didactic	59	90.97
	Clinical	29	86.50
	Practicing	17	86.50
	Total	176	
Good Knowledge	Pre-PA	71	87.74
	Didactic	59	89.49
	Clinical	29	86.50
	Practicing	17	91.68
	Total	176	
Very Good Knowledge	Pre- PA	71	74.00
	Didactic	59	74.00
	Clinical	29	162.00*
	Practicing	17	74.00
	Total	176	

Summary

This chapter contained the results of data analysis. Of the 176 surveys, 43 participants identified as male (24.4%) and 143 were female (75.6%). Participation was largely divided between pre-PA students (40.3%) and PA students in their didactic year

(33.5%). Fewer surveys were collected from PA students in their clinical year (16.5%) and practicing PAs (9.7%).

Prevalence of caffeine use was divided for analysis between academic and professional purposes and caffeine use for other purposes. Various percentages were reported to indicate whether or not the separate groups used caffeine or not and for what purposes participants in each of these groups were using caffeine.

An ANOVA test was used to determine the difference in the frequency of caffeine use for academic purposes between Pre- PA students, PA students in their didactic year, PA students in their clinical year, and practicing PAs. The ANOVA was significant, and a Tukey's post-hoc was performed to determine how it was significant. The Tukey's post-hoc test revealed that practicing PAs used caffeine for academic purposes significantly less than the other three groups ($p < .001$). There was no difference in caffeine use between pre-PAs, PA students in their didactic year, and PA students in their clinical year.

ANOVA and a Tukey's post-hoc were also performed to determine the difference of caffeine use between each group for professional purposes. Tukey's post-hoc test revealed that PA students in their clinical year use caffeine significantly more for professional purposes that both Pre-PA students and PAs in their didactic year ($p=.024$) and ($p<.001$) respectively and practicing PAs use caffeine significantly more frequently than PAs in their didactic year ($p=.003$). There is no significant difference in the use of caffeine between Pre-PA students and PA students in their didactic year ($p =.090$), Pre PA students and practicing PAs ($p=.167$), or between PA students in their clinical year and practicing PAs ($p=.995$).

Finally a Kruskall-Wallis test was used to analyze the data on the knowledge benefits, side effects, and withdrawal symptoms of caffeine between pre-PAs, PA students in their didactic year, PA students in their clinical year, and practicing PAs. The Kruskall-Wallis test revealed that the PA students in their clinical year had significantly more knowledge ($p < .001$) on the benefits of caffeine when compared to the other three groups. The rest of the analyses were insignificant with p values $> .05$. Chapter 5 provides interpretation and conclusions made from of all the results noted in chapter 4.

Chapter Five: Discussion and Conclusions

Introduction

This chapter draws conclusions from the data analysis. The project sought to determine the frequency of caffeine use for academic and professional purposes and then assess the level of knowledge on caffeine among the four participant groups. Level of knowledge was based on correct and incorrect responses on the survey questions that asked about the benefits, side effects, and withdrawal symptoms of caffeine.

Demographic Data

The average participant of the study's sample of 176 participants was a female between the ages of 15-34. Of the 176 participants, only 46 were PA students in their clinical year or clinically practicing PAs, which leaves 130 participants who were either pre-PA students or PA students in their didactic year. Given that the average PA student is 27 years old and female (Pasquini 2015), the data reflects national trends as a whole. Additionally, data was collected via a paper copy in person from Bethel pre-PA students and Bethel PA students in their didactic year, whereas the remainder of participants responded to the online survey. This method of collection resulted in a higher percentage of pre-PA students and PA students in their didactic year, which skews the data.

Prevalence of Caffeine Use for Academic and Professional Purposes

For analysis, the results from the survey were summarized as no caffeine, caffeine use for academic purposes, and caffeine use for professional purposes. In general, caffeine use was high among all groups, with the highest percentage of "no caffeine use" being among PA students in their clinical year (10.3 percent). As one might expect,

caffeine use for academic purposes decreased as students left the academic, or didactic, phase of school and began in the clinical phase or began practicing. For example, 83.1 percent of pre-PA students and 72.9 percent PA-students in their didactic year reported caffeine use for academic purposes. This percentage was much decreased in clinically practicing PAs, who reported only 5.9 percent of caffeine use for academic purposes.

Finally, caffeine use for professional purposes increased as students left the academic phase and began practicing in a professional environment; only 33.8 percent of pre-PA students reported caffeine use for professional purposes. Interestingly, 62.1 percent of PA students in their clinical year reported caffeine use for professional purposes, likely indicating a professional component to most clinical phases of PA school. In Lee et. al's study, 93.6 percent of participants reported caffeine use, indicating that caffeine remains one of the most commonly used substances in the world. Unfortunately, Lee et. al's study did not find similar trends in caffeine use for academic/professional purposes as students progressed in their studies. For example, first-year medical students reported the lowest caffeine use for academic purposes when compared to second and third year students (Lee et. al 2009). Clear conclusions cannot be drawn from our study, as they aren't adequately backed up by previous studies; however, it seems acceptable to assume that caffeine is used rampantly in academic and professional situations.

Prevalence of Caffeine Use for Other Purposes

Among all groups, it was most common for participants to use caffeine for social reasons or for taste. In fact, 67.8 percent (PA-didactic, PA-clinical) to 94 percent (practicing PAs) of participants indicated use because they enjoyed the taste. Because

participants could choose multiple reasons for caffeine use, it is likely that these participants used caffeine for academic/professional purposes and because they enjoyed the taste. Additionally, caffeine can be prepared in multiple ways, suggesting that a wide variety of caffeine taste preferences contributed to this value. An average of 60.6 percent of participants indicated caffeine use for social reasons. This value does not correlate as well with academic/professional purposes, as these might not be social situations and are more likely school or work related. Similar findings were found in Lee et al.'s study, as preference for taste and social were the most common reasons chosen by all of the participants (Lee et. al 2009).

Frequency of Caffeine Use for Academic and Professional Purposes

A one-way ANOVA indicated statistical significance in the difference in frequency of caffeine use between groups for both academic and professional purposes. A Tukey post-hoc test revealed that practicing PAs use significantly less caffeine for academic purposes than all other groups ($p<0.001$), while there was no significant difference between the three remaining groups. As mentioned above, one would expect the use of caffeine for academic purposes to decrease as participants leave academia and move forward into practice. While the percentages reflect this trend, there was only statistical significance in the case of practicing PAs.

A Tukey post-hoc test revealed that PA students in their clinical year use caffeine for professional purposes significantly more than both pre-PA students ($p=.024$) and PA students in their didactic year ($p<.001$). In addition, the research found that practicing PAs use caffeine for professional purposes significantly more than PA students in their didactic year ($p=.003$). No significant difference was noted in comparison between the

remaining groups. Over half of the PA students in their clinical year reported caffeine use for professional purposes, likely indicating a professional component to most clinical phases of PA school. Interestingly, there was no significance in the use of caffeine for professional purposes between practicing PAs and pre-PA students. This finding is likely explained by the skew in numbers of responses between the two groups (17 practicing PAs versus 71 pre-PA students). In addition, it is probable that pre-PA students responded using caffeine for professional purposes based on previous professional experience prior to PA school.

Most Commonly Used Caffeine Products

Multiple caffeine products were analyzed in this study, including coffee, tea/iced tea, cool drinks, energy concoctions, and energy drinks. Over 90 percent of participants in all four groups indicated coffee as a caffeine product used, demonstrating that coffee is the most commonly used product. This percentage is reflective of Lee et. al's study, in which coffee was the most commonly consumed product at 88.2 percent. Among the four research groups, an average of 48.2 percent of participants reported the tea/iced tea as a means of caffeine use. This value was much higher in this study when compared to Lee et. al's study, which indicated energy mixtures as the second most commonly used caffeine product (37.9 percent) (Lee et al. 2009). In this study, few participants indicated that they used energy mixtures as a caffeine product. These findings can potentially be attributed to the fact that coffee is one of the most readily available and cheapest forms of caffeine.

Participants' Knowledge on Caffeine

The following research question was addressed in this section: What is the level of knowledge among these individuals on the benefits, side effects, and withdrawal symptoms of caffeine?

A Kruskall Wallis test was performed on the data in this section. High p-values were obtained for five out of the six areas addressed including incorrect benefits of caffeine, correct side effects, incorrect side effects, correct withdrawal symptoms, and incorrect withdrawal symptoms. A significant p-value ($p < .001$) was obtained for correct knowledge of the benefits of caffeine. PA students in their clinical year had significantly more "very good" knowledge on the benefits of caffeine when compared to pre-PA students, PA students in their didactic year, and practicing PAs. No significant difference was found in the other levels of knowledge on the benefits of caffeine.

This significance may be skewed. Only one out of the 29 PA students in their clinical year scored "very good" on the benefits of caffeine. Technically, this is equal to three percent, as compared to pre-PA students, PA students in their didactic year, and practicing PAs, who scored zero percent in the category of "very good" on the benefits of caffeine. While three percent versus zero percent may be statically significant per the Kruskall-Wallis test, there was still only one person overall who had very good knowledge on the benefits of caffeine. Overall, it can be concluded that there is a lack in knowledge on the benefits of caffeine.

Data in the current study was analyzed differently from the data in the example study conducted by Lee et al. (2009); therefore, the results on knowledge cannot be adequately compared. The study by Lee et al. scored their results on a scale of 1-5; 0 =

without knowledge; 1 = very little knowledge; 2 = little knowledge; 3 = moderate knowledge; 4-5 = good knowledge. The average score for first, second, and third year medical student were then analyzed using a Kruskall-Wallis test.

The current study took this analysis one step further. The researchers decided that accurate knowledge was better described by comparing both answers correct and answers incorrect. This scoring system helped decrease the potential of a high score of correct knowledge by purely guessing or marking all the options on the survey as correct. In Lee et al.'s study, participants could theoretically mark all options in the benefits, side effects, and withdrawal symptoms; by doing so, they would guess the correct options by default. The current study attempted to lessen a high score due to guessing by deducting points for incorrect answers.

Limitations

This study had various limitations. One limitation being there was no control over the response rate of the survey. Pre-PA students had the highest response rate of 71 participants, while practicing PAs only had a response rate of 17 participants. Paper copies of the survey were given to Bethel University Pre-PA students and PA students in their didactic year, while an online version of was sent out to all other participants. Because of this, there was likely a higher response rate from the students from Bethel. It is likely that there was a lower response rate to the surveys sent out in email. This could be due to large volume of emails that are sent out in a day. The email can get lost, disregarded, or sent to spam. All participants were given the opportunity to decline the survey, regardless of whether the survey was given in person or via email.

Overall, 40 participants were needed in each group to have true statistical significance. This number of participants is also a limitation in the study as the researches did not have 40 participants in each group. There were 71 pre- PA students, 59 PA students in their didactic year, 29 PA students in their clinical year, and 17 practicing PAs. A larger and equal sample size among all groups would have provided a more accurate representation on the comparison of knowledge between groups.

One delimitation of the study was that subjects were intentionally limited to pre-PA students, current PA students, and practicing PAs in the state of Minnesota. In addition, practicing PAs were limited to those who graduated from Augsburg College, Bethel University, or St. Catherine University within the past five years. Therefore, the results of this research cannot be extended to the national PA population. The results also cannot be extended to practicing PAs who graduated from a Minnesota school more than five years ago.

Recommendations for Further Research

For means of future research, the researchers recommend larger sample size with a special focus on equal sample sizes between each of the research groups. There was a large range in the number of participants in each group (71 pre-PA students versus 17 practicing PAs), which likely skewed the results toward a specific population. Having equal numbers of participants in these groups would avoid this. Additionally, students came from various schools and participants were not required to indicate where they attended school. Although the researchers did not make a comparison between schools, the data could have been skewed if a larger number of students came from a certain school.

For further research, it would be interesting to compare caffeine use and knowledge among various professional, such as PAs, nurses, MDs, PTs, OTs, and pharmacists. This comparison would require intense surveying of various professionals in various medical settings and would be difficult to do. However, it would add to the current study that was limited to the PA profession.

Additionally, future research should note which benefits, side effects, and withdrawal symptoms were answered incorrectly most often. This comparison was made in Lee et. al's study, and it would further the conclusion that little is known about caffeine, despite it being a highly used product.

Conclusions

Based on the available data, the use of caffeine for academic and professional purposes was analyzed with the survey instrument. Participants in the academic phase of school used caffeine for academic purposes when compared to those out in practice. For example, 83.1 percent of pre-PA students, 72.9 percent PA-students in their didactic year, and 62.1 percent of students in their clinical year used caffeine for academic purposes. In contrast, only 5.9 percent of clinically practicing PAs reported caffeine use for academic purposes. Caffeine use for professional purposes increased as students left the academic phase and began practicing in a professional environment; only 33.8 percent of pre-PA students reported caffeine use for professional purposes, while 59 percent of clinically practicing PAs used caffeine for professional purposes.

Frequency of caffeine use for academic and professional purposes was also analyzed. One-way ANOVA indicated statistical significance in the difference in frequency of caffeine use for academic purposes. Tukey post-hoc test revealed that

clinically practicing PAs used caffeine for academic purposes significantly less than the other three groups. One-way ANOVA also revealed statistical significance in the difference between groups in the frequency of caffeine use for professional purposes. Tukey post-hoc revealed that PA students in their clinical year use caffeine significantly more for professional purposes that both Pre-PA students and PAs in their didactic year. Practicing PAs use caffeine significantly more than PAs in their didactic year. No other significance was found in caffeine use between groups for professional purposes.

Kruskall-Wallis was used to analyze the knowledge on the benefits, side- effects, and withdrawal symptoms of caffeine. This test revealed that PA students in their clinical year had significantly more knowledge ($p < .001$) on the benefits of caffeine when compared to the other three groups. All other analyses were insignificant.

A high percentage of participants indicated that they use caffeine; however, overall scores on the knowledge of caffeine benefits, side effects, and withdrawal symptoms were relatively low. This result may indicate that many participants were using caffeine without having sufficient knowledge of its benefits, side effects and withdrawal symptoms, and further education is necessary. The current study was limited in demographics and sample size. Further research is needed to improve and add onto the current study.

References

American Diabetes Association (2009). Diagnosis and classification of diabetes mellitus. *Diabetes Care, 32*(Suppl 1), S62-S67. doi: 10.2337/dc09-S062

Anderson, B. L., Juliano, L. M., & Schulkin, J. (2009). Caffeine's implications for women's health and survey of obstetrician-gynecologists' caffeine knowledge and assessment practices. *Journal of Women's Health, 18*(9), 1457-1466. doi:10.1089/jwh.2008.1186

Arendash, G. W., Schleif, W., Rezai-Zadeh, K., Jackson, E. K., Zacharia, L. C., & Cracchiolo, J. R., et al. (2006). Caffeine protects Alzheimer's mice against cognitive impairment and reduces brain β-amyloid production. *Neuroscience, 142*(4), 941-952. doi:10.1016/j.neuroscience.2006.07.021

Arendash, G. W., & Cao, C. (2010). Caffeine and coffee as therapeutics against alzheimer's disease. *Journal of Alzheimer's Disease, 20*, 117-126. doi:10.3233/JAD-2010-091249

Arendash, G. W., Moric, T., Cao, C., Mamcarz, M., Runfeldt, M., Dickson, A., et al. (2009). Caffeine reverses cognitive impairment and decreases brain amyloid-β levels in aged alzheimer's disease mice. *Journal of Alzheimer's Disease, 17*(3), 661-680.

Arnaud, M. J. (2005). Caffeine. In *Encyclopedia of Human Nutrition* (2nd ed.). Oxford: Elsevier, 247-253. doi:10.3233/JAD-2009-1087

Ascherio, A., Chen, H., Schwarzschild, M.A., Zhang, S. M., Colditz, G.A., & Speizer, F.E., (2003). Caffeine, postmenopausal estrogen, and risk of parkinson's disease. *Neurology, 60*(5), 790; 790-795; 795. doi:10.1212/01.WNL.0000046523.05125.87

Ascherio, A., Zhang, S. M., Hernán, M. A., Kawachi, I., Colditz, G. A., Speizer, F. E., et al. (2001). Prospective study of caffeine consumption and risk of parkinson's disease in men and women. *Annals of Neurology, 50*(1), 56-63. doi:10.1002/ana.1052

Barone, J., Roberts, H. (1996). Caffeine consumption. *Food and Chemical Toxicology 34*(1), 119–129. doi:10.1016/0278-6915(95)00093-3

Benowitz, N. L. (1990). Clinical pharmacology of caffeine. *Annual Review of Medicine, 41*(1), 277-288. doi:10.1146/annurev.me.41.020190.001425

Brezinova, V. (1974). Effect of caffeine on sleep: EEG study in late middle age people. *British Journal of Clinical Pharmacology, 1*(3), 203-208. doi:10.1111/j.1365-2125.1974.tb00237.x

Christopher, G., Sutherland, D., & Smith, A. (2005). Effects of caffeine in non-withdrawn volunteers. *Human Psychopharmacology: Clinical & Experimental, 20*(1), 47-53. doi:0.1002/hup.658

Doerner, J. M., Kuetting, D. L., Luetkens, J. A., Naehle, C. P., Dabir, D., Homsi, R., ... & Thomas, D. K. (2015). Caffeine and taurine containing energy drink increases left ventricular contractility in healthy volunteers. *The International Journal of Cardiovascular Imaging*, *31*(3), 595-601. doi: 10.1007/s10554-014-0577-7.

D'Urzo, A. D. (1990). Effect of caffeine on ventilatory responses to hypercapnia, hypoxia, and exercise in humans. *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology, 68*(1), 322; 322-328; 328. Retrieved from http://jap.physiology.org.ezproxy.lib.ndsu.nodak.edu/content/68/1/322

Einöther, S. J. L., & Giesbrecht, T. (2013). Caffeine as an attention enhancer: Reviewing existing assumptions. *Psychopharmacology, 225*(2), 251-274. doi:10.1007/s00213-012-2917-4

Evans, S. M., & Griffiths, R. R. (1999). Caffeine withdrawal: A parametric analysis of caffeine dosing conditions. *Journal of Pharmacology and Experimental Therapeutics, 289*(1), 285-294. Retrieved from http://jpet.aspetjournals.org.ezproxy.lib.ndsu.nodak.edu/content/289/1/285

Fine, B., Kobrick, J., Lieberman, H., Marlowe, B., Riley, R., & Tharion, W. (1994). Effects of caffeine or diphenhydramine on visual vigilance. *Psychopharmacology, 114*(2), 233-238. doi:10.1007/BF02244842

Foreman, N., Barraclough, S., Moore, C., Mehta, A., & Madon, M. (1989). High doses of caffeine impair performance of a numerical version of the Stroop task in men. *Pharmacology Biochemistry and Behavior, 32*(2), 399-403. doi:10.1016/0091-3057(89)90169-X

Frary, C.D., Johnson, R., & Wang, M. (2005). Food Sources and intakes of caffeine in the diets of persons in the United States. *Journal of the American Dietetic Association, 105*(1), 110-113. doi:10.1016/j.jada.2004.10.027

Frewer, L. J., & Lader, M. (1991). The effects of caffeine on two computerized tests of attention and vigilance. *Human Psychopharmacology: Clinical & Experimental, 6*(2), 119-128. Retrieved from http://web.a.ebscohost.com.libpdb.d.umn.edu:2048/ehost/detail/detail?sid=a4af3a43-36e3-486e-afe2-

b27183453ad1%40sessionmgr4003&vid=0&hid=4109&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=12365957&db=keh

Garrett, B. E., & Griffiths, R. R. (1998). Physical dependence increases the relative reinforcing effects of caffeine versus placebo. *Psychopharmacology, 139*(3), 195-202. doi:10.1007/s002130050704

Gasper, S., & Ramos, F. (2016). Caffeine: Consumption and health effects. *Encyclopedia of Food and Health.* Retrieved from http://dx.doi.org/10.1016/B978-0-12-384947-2.00099-4

Griffiths, R. R., Evans, S. M., Heishman, S. J., Preston, K. L., Sannerud, C. A., Wolf, B., & Woodson, P. P. (1990). Low-dose caffeine physical dependence in humans. *Journal of Pharmacology and Experimental Therapeutics, 255*(3), 1123-1132. Retrieved from http://jpet.aspetjournals.org.ezproxy.lib.ndsu.nodak.edu/content/255/3/1123

Hameleers, P. A. H. M., Van Boxtel, M. P. J., Hogervorst, E., Riedel, W. J., Houx, P. J., Buntinx, F., et al. (2000). Habitual caffeine consumption and its relation to memory, attention, planning capacity and psychomotor performance across multiple age groups. *Human Psychopharmacology: Clinical & Experimental, 15*(8), 573-581. doi:10.1002/hup.218

Heatherley, S. V., Hayward, R. C., Seers, H. E., & Rogers, P. J. (2005). Cognitive and psychomotor performance, mood, and pressor effects of caffeine after 4, 6 and 8 h caffeine abstinence. *Psychopharmacology, 178*(4), 461-470. doi:10.1007/s00213-005-2159-9

Hernán, M. A., Takkouche, B., Caamaño-Isorna, F., & Gestal-Otero, J. J. (2002). A meta-analysis of coffee drinking, cigarette smoking, and the risk of parkinson's disease. *Annals of Neurology, 52*(3), 276-284. doi:10.1002/ana.10277

Higdon, J. V., & Frei, B. (2006). Coffee and health: A review of recent human research. *Critical Reviews in Food Science and Nutrition, 46*(2), 101-123. doi:10.1080/10408390500400009

Hughes, J. R., Higgins, S. T., Bickel, W. K., Hunt, W. K., Fenwick, J. W., Gulliver, S. B., & Mireault, G. C. (1991). Caffeine self-administration, withdrawal, and adverse effects among coffee drinkers. *Archives of General Psychiatry, 48*(7), 611-617. doi:10.1001/archpsyc.1991.01810310029006

Jarvis, M. (1993). Does caffeine intake enhance absolute levels of cognitive performance? *Psychopharmacology, 110*(1), 45-52. doi: 10.1007/BF02246949

Juliano, L.M., and Griffiths, R.R (2004). A critical review of caffeine withdrawal: empirical validation of symptoms and signs, incidence, severity, and associated features. *Psychopharmacology 176*(1), 1-29. doi:http://dx.doi.org.ezproxy.lib.ndsu.nodak.edu/10.1007/s00213-004-2000-x

Juliano, L. M., Huntley, E. D., Harrell, P. T., & Westerman, A. T. (2012). Development of the caffeine withdrawal symptom questionnaire: Caffeine withdrawal symptoms cluster into 7 factors. *Drug and Alcohol Dependence, 124*(3), 229-234. doi:http://dx.doi.org.ezproxy.bethel.edu/10.1016/j.drugalcdep.2012.01.009

Knight, C.A., Knight, I., Mitchell, D.C., & Zepp, J.E. (2004). Beverage caffeine intake in US consumers and subpopulations of interest: estimates from the Share of Intake

Panel survey. *Food and Clinical Toxicology* 42, 1923-1930. doi:10.1016/j.fct.2004.05.002

Landolt, H. P. (2015). Caffeine, the circadian clock, and sleep. *Science*, 349(6254), 1289. doi:10.1126/science.aad2958

Lieberman, H. R., Wurtman, R. J., Emde, G. G., Roberts, C., & Coviella, I. L. G. (1987). The effects of low doses of caffeine on human performance and mood. *Psychopharmacology, 92*(3), 308-312. doi:10.1007/BF00210835

Lee, K., Human, G., Fourie, J., Louw, W., Larson, C., & Joubert, G. (2009). Medical students' use of caffeine for 'academic purposes' and their knowledge of its benefits, side-effects, and withdrawal symptoms. *South African Family Practice*, 322-327. Retrieved from http://www.tandfonline.com/doi/pdf/10.1080/20786204.2009.10873872

Loke, W. H. (1988). Effects of caffeine on mood and memory. *Physiology & Behavior, 44,* 367-372. doi:10.1016/0031-9384(88)90039-X

Mitchell, D.C., Knight, C.A., Hockenberry, J., Teplansky, R., & Hartman, T.J. (2014). Beverage caffeine intakes in the US. *Food and Chemical Toxicology*, 63, 126-142.

Mitchell, P., & Redman, J. (1992). Effects of caffeine, time of day and user history on study-related performance. *Psychopharmacology, 109*(1-2), 121-126. doi:10.1007/BF02245489

National Institute of Neurological Disorders and Stroke (2015). *Parkinson's disease: Hope through research* (NIH Publication No. 15-139). Retrieved from http://www.ninds.nih.gov/disorders/parkinsons_disease/parkinsons-disease-brochure.pdf

Nawrot, P., Hugenholtz, A., Feeley, M., Eastwood, J., Jordan, S., & Rotstein, J. (2003). Effects of caffeine on human health. *Food Additives and Contaminants, 20*(1), 1-30. doi:10.1080/0265203021000007840

Nehlig, A. (1999). Are we dependent upon coffee and caffeine? A review on human and animal data? *Nueroscience and Biobehavioral Reviews* 23, 563-576. doi:10.1016/S0149-7634(98)00050-5

Nehlig, A., Daval, J., & Debry, G. (1992). Caffeine and the central nervous system: Mechanisms of action, biochemical, metabolic and psychostimulant effects. *Brain Research Reviews, 17*(2), 139-170. doi:10.1016/0165-0173(92)90012-B

Pandejpong, D., Paisansudhi, S., & Udompunthurak, S. (2014). Factors associated with consumption of caffeinated-beverage among Siriraj pre-clinical year medical students, a 2-year consecutive survey. *Journal of the Medical Association of Thailand, 97*(3 SUPPL. 3), S189-S196. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/?term=Factors+associated+with+consumption+of+caffeinated-beverage+among+siriraj+pre-clinical+year+medical+students%2C+A+2-year+consecutive+survey

Pasquini, S (2015). "Who Gets Into PA School?" *The Physician Assistant Life.* Retrieved from http://www.thepalife.com/who-gets-in/.

Paterson, L., Wilson, S., Nutt, D., Hutson, P., & Ivarsson, M. (2007). A translational, caffeine-induced model of onset insomnia in rats and healthy volunteers. *Psychopharmacology*, 191, 943-950. doi: 10.1007/s00213-006-0672-0

Phillips-Bute, B. G., & Lane, J. D. (1997). Caffeine withdrawal symptoms following brief caffeine deprivation. *Physiology and Behavior, 63*(1), 35-39. doi:10.1016/S0031-9384(97)00384-3

Pincomb, G.A., Lovallo, W.R., Passey, R.B., Whitsett, T.L., Silverstein, S.M., & Wilson, M.F. (1985). Effects of caffeine on vascular resistance, cardiac output and myocardial contractility in young men. *The American Journal of Cardiology*, 56, 119-122. doi:10.1016/0002-9149(85)90578-8

Puckeridge, M., Fulcher, B. D., Phillips, A. J. K., & Robinson, P. A. (2011). Incorporation of caffeine into a quantitative model of fatigue and sleep. *Journal of Theoretical Biology, 273*(1), 44-54. doi:10.1016/j.jtbi.2010.12.018

Rogers, P., Heatherly, S., Mullings, E., & Smith, J. (2012). Faster but not smarter: Effects of caffeine and caffeine withdrawal on alertness and performance. *Psychopharmacology*, 229-240. doi: 10.1007/s00213-012-2889-4

Rosengren, A., Dotevall, A., Wilhelmsen, L., Thelle, D., & Johansson, S. (2004). Coffee and incidence of diabetes in swedish women: A prospective 18-year follow-up study. *Journal of Internal Medicine, 255*(1), 89-95. doi: 10.1046/j.1365-2796.2003.01260.x

Ross, G., Abbott, R. D., Petrovitch, H., Morens, D., Grandinetti, A., Tung, K.H., et al. (2000). Association of coffee and caffeine intake with the risk of parkinson disease. *The Journal of the American Medical Association, 283*(20), 2674-2679. doi:10.1001/jama.283.20.2674.

Rubin, G.J, & Smith, A. (1999) Caffeine withdrawal and headaches. *Nutritional neuroscience.* 2(2). 123-126.

Schwarzschild, M. A., Chen, J., & Ascherio, A. (2002). Caffeinated clues and the promise of adenosine A2a antagonists in PD. *Neurology, 58*(8), 1154; 1154-1160; 1160. doi: 10.1212/WNL.58.8.1154

Shepherd, J. D., Absi, M. A., Whitsett, T. L., Passet, R.B., & Lovallo, W.R. (2000). Additive pressor effects of caffeine and stress in male medical students at risk for hypertension. *American Journal of Hypertension* 13, 475-481. doi: 10.1016/S0895-7061(99)00217-4

Silverman, K., Evans, S., Strain, E., & Griffiths, R. (1992). Withdrawal syndrome after the double blind cessation of caffeine consumption. *New England Journal of Medicine, 327*(16), 1109-1114. Doi: 10.1056/NEJM199210153271601

Smith, A. (2002). Effects of caffeine on human behavior. *Food and Chemical Toxicology, 40*(9), 1243-1255. doi:10.1016/S0278-6915(02)00096-0

Terry, W. S., & Phifer, B. (1986). Caffeine and memory performance on the AVLT. *Journal of Clinical Psychology, 42*(6), 860-3.DOI: 10.1002/1097-4679(198611)42:63.0.CO;2-T

Tofalo, R., Renda, G., De Caterina, R., Suzzi, G. (2016). Coffee: Health effects. *Encyclopedia of Food and Health,* 237-243.

Tuomilehto, J., Hu, G., Bidel, S., Lindström, J., & Jousilahti, P. (2004). Coffee consumption and risk of type 2 diabetes mellitus among middle-aged finnish men and women. *The Journal of the American Medical Association, 291*(10), 1213-1219. doi:10.1001/jama.291.10.1213

van Dam R.M., & Hu, F. (2005). Coffee consumption and risk of type 2 diabetes: A systematic review. *The Journal of the American Medical Association, 294*(1), 97-104. doi:10.1001/jama.294.1.97

van Dam, R. M., & Feskens, E. J. (2002). Coffee consumption and risk of type 2 diabetes mellitus. *The Lancet, 360*(9344), 1477-1478. doi:10.1016/S0140-6736(02)11436-X

van Dusseldorp, M., & Katan, M. B. (1990). Headache caused by caffeine withdrawal among moderate coffee drinkers switched from ordinary to decaffeinated coffee: A 12 week double blind trial. *British Medical Journal, 300*(6739), 1558-1559.

Weinberg, B.A., & Bealer, B. (2001). *The World of Caffeine: The Science and Culture of the World's Most Popular Drug.* New York: Routledge, 198-302.

Appendix A: Augsburg College Approval

Quella, Alicia February 10, 2016 at 12:49 PM

To: Greta Sowles Cc: Kjerstin Dennis, Chelsie Manton, Wallace Boeve

Re: Participation in Bethel University Caffeine Study

QA

Hi all- Augsburg PA dept would like to participate- thanks for including us- Best regards, Dr. Quella

Alicia Quella PhD PA-C
Clinical Associate Professor
Program Director
Augsburg Physician Assistant Program
office 612-330-1325

See More from Greta Sowles

--

Greta Sowles February 10, 2016 at 11:23 AM

To: quella@augsburg.edu Cc: Kjerstin Dennis, Chelsie Manton, Wallace Boeve

Participation in Bethel University Caffeine Study

GS

Dear Ms. Quella,

My name is Greta Sowles, and I am a first-year student in Bethel University's PA program. Myself and two other students, in conjunction with Wally Boeve, have begun our research project on caffeine use among pre-PA students, current PA students, and practicing PAs, and we would like to use your students and alumni as participants.

Attached is our participation letter, which indicates our study's purpose and describes the role that your students would play in our research study. The letter also explains what assistance we need from you.

For Bethel IRB approval, we will need a response from you in order to proceed with our study. Please let me or Wally know if you have questions or concerns.

Thank you,

Greta Sowles

Participation Letter - 0210.docx

Appendix B: Bethel University Approval

Greta Sowles <g-sowles@bethel.edu>
to Wallace

2:50 PM (21 hours ago)

Dear Mr. Boeve,

My name is Greta Sowles, and I am a first-year student in Bethel University's PA program. Myself and two other students have begun our research project on caffeine use among pre-PA students, current PA students, and practicing PAs, and we would like to use your students and alumni as participants.

Attached is our participation letter, which indicates our study's purpose and describes the role that your students would play in our research study. The letter also explains what assistance we need from you.

For Bethel IRB approval, we will need a response from you in order to proceed with our study. Please let me know if you have questions or concerns.

Thank you,

Participation Lett...

Wallace Boeve
to me

8:14 PM (15 hours ago)

Bethel's PA program would be happy to participate in your study as best we are able. Let us know once approved and how we can best assist.

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 C: St. Catherine University Approval

ST. CATHERINE UNIVERSITY

February 11, 2016

Dear Ms. Manton, Ms. Sowles and Ms. Dennis,

I have reviewed your enclosed participation letter for your research project "in assessing the use of caffeine for academic and professional purposes, as well as the knowledge about the benefits, side effects, and withdrawal symptoms of caffeine among pre-PA students, PA students, and practicing PAs in Minnesota."

I would be happy to help facilitate our PA student participation in your study. Best of luck to you in your research endeavor. Please consider this letter as my approval and acknowledgement of your work with our PA students and in support of your IRB process.

Sincerely,

Heather KT Bidinger MMS, PA-C
Founding Program Director
MPAS Program; HSSH
St. Catherine University

Appendix D: Original Survey

The use and knowledge of caffeine

Instructions
Mark the appropriate block(s) with an X or write your answers in the space provided **To change your answer, draw a line across the X**

Please use a blue or black pen only

For office use only ☐☐☐ 1- 3

1. Year group
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☐ Other, specify _____ ☐ 21
☐ 7 Other, specify _____ ☐ 22

Please turn over

7. **How frequently** do you use **any** caffeine-containing products for **academic purposes**?

Only choose one option

1 serving e.g. 250ml cup coffee, 1 can of coke, 15ml of Bioplus®

1	7 or more servings in a week on a weekly basis	23
2	Less than 7 servings a week on a weekly basis	
3	Sporadically e.g. occasionally before tests/exams, stay awake in class	

Only mark the options that you think are correct in question 8, 9 and 10
Marks will be deducted for incorrect choice(s)

8. Which of the following are benefits of caffeine?

1	Increases vigilance	6	Increases short-term memory	24	25
2	Prevents type 2 diabetes mellitus	7	Increases long-term memory	26	27
3	Substitute for sleep	8	Prevents impotency	28	29
4	Increases alcohol tolerance	9	Prevents Alzheimer's disease	30	31
5	Prevents Parkinson's Disease	10	Slows down metabolism	32	33

9. Which of the following are side effects of caffeine?

1	Dry eyes	6	Slow beating of the heart	34	35
2	Increases cardiac output	7	Rapid beating of the heart	36	37
3	Hot flushes	8	Acne	38	39
4	Increases force of heart	9	Increases gastric secretion	40	41
5	Impotence	10	Increases respiration rate	42	43

10. Which of the following are withdrawal symptoms of caffeine?

1	Headache	6	Constipation	44	45
2	Fatigue	7	Hallucinations	46	47
3	Nasal congestion	8	Decreases alertness	48	49
4	Forgetfulness	9	Drowsiness	50	51
5	Skin itching	10	Aggression	52	53

Appendix E: Permission to Use Original Survey

Carol Larson
To: Chelsie Manton
RE: Study of Caffeine

Good morning Miss Manton

Thank you for your correspondence. You are welcome to use the questionnaire format (or an adapted version thereof) provided that you acknowledge the original source.

(Four undergraduate medical students performed this study and I was the study leader.)

I am sending you a PDF copy of the original questionnaire.

Best wishes for your research.

Kind regards

Carol Larson

Carol Olivia Larson
Senior Lecturer: Basic Medical Sciences
Senior Dosent: Basiese Mediese Wetenskappe
Faculty / Fakulteit: Health Sciences / Gesondheidswetenskappe
PO Box / Posbus 339, Bloemfontein 9300, Republic of South Africa / Republiek van Suid-Afrika
051 4017364
+27844000078
gnfscol@ufs.ac.za

See More from Chelsie Manton

Caffeine study Questionna…English.pdf

Appendix F: Survey for Present Study

Instructions
Mark the appropriate block(s) with an X or write your answers in the space provided. To change your answer, draw a line across the X. Please use a blue or black pen only.

1. Identify the group you fall under

   [1] Pre-PA Student [2] PA Student-Didactic Year [3] PA Student-Clinical Year [4] Practicing PA

2. If **'PRACTICING PA'**, what area of practice are you currently working in?
   _____

3. Gender

   [1] Male [2] Female

4. Age:

   [1] 15-24 [2] 25-34 [3] 35-44 [4] 45-54 [5] 55-64 [6] ≥ 65

5. Do you ever use any caffeine-containing products? e.g. coffee, tea, Coke®, Bioplus®, Stay Awake®, Redbull®, Play®, or other caffeine-containing products.

   [1] Yes [2] No

   If you answered **'YES'** continue with question 6
   If you answered **'NO'** go straight to question 9

6. For which purpose(s) do you use caffeine?

   You may choose more than one option

   [1] Academic purposes e.g. to extend study time, stay awake during class, improve academic performance, increase efficiency on assignments/studying
   [2] Professional purposes e.g. stay awake while working with patients and completing paperwork, improve work performance, increase productivity on work-related duties
   [3] Increase vigilance for driving e.g. long distant driving
   [4] Sport e.g. to enhance performance
   [5] Social e.g. drinking coffee socially
   [6] To recover from heavy alcohol consumption e.g. hangovers
   [7] I like the taste e.g. enjoy the taste of chocolates/tea
   [8] Other, specify _____

   If you do not use caffeine for academic or professional purposes go straight to Question 9

7. Which of the following caffeine containing product(s) do you use for **academic or professional purposes**?

You may choose more than one option

1	Coffee (caffeinated)
2	Tea / Iced tea (excluding Rooibos)
3	Cool drinks e.g. Coke®, Mountain Dew®
4	Energy concoctions e.g. Bioplus®, Stay Awake®, Superboost®
5	Energy Drinks e.g. Redbull®, Play®
6	Other, specify _____
7	Other, specify _____

8. **How frequently** do you use **any** caffeine-containing products for **academic or professional purposes**?

Only choose one option
1 serving e.g. 250ml cup coffee, one 12 oz. can of coke, 15ml of Bioplus®

1	7 or more sevings in a week on a weekly basis
2	Less than 7 servings a week on a weekly basis
3	Sporadically e.g. occasionally before tests/exams, stay awake in class or at work

Only mark the options that you think are correct in Questions 9, 10, and 11.

9. Which of the following are correct benefits of caffeine?

1	Increases vigilance
2	Prevents type 2 Diabetes Mellitus
3	Substitute for sleep
4	Increases alcohol tolerance
5	Prevents Parkinson's disease
6	Increases short-term memory
7	Increases long-term memory
8	Prevents erectile dysfunction
9	Prevents Alzheimer's disease
10	Slows down metabolism

10. Which of the following are correct side effects of caffeine?

1	Dry eyes
2	Increases cardiac output
3	Hot flushes
4	Increases force of heart
5	Erectile dysfunction
6	Slow beating of the heart
7	Rapid beating of the heart
8	Acne
9	Increases sleep disturbances
10	Increases respiration rate

11. Which of the following are correct withdrawal symptoms of caffeine?

1	Headache
2	Fatigue
3	Nasal congestion
4	Increases alcohol tolerance
5	Forgetfulness
6	Increases mood disturbance
7	Hallucinations
8	Decreases alertness
9	Drowsiness
10	Aggression

Appendix G: Initial Correspondence Email

Hello,

We are first year students in Bethel University's Physician Assistant program. We contacted you earlier this year to get approval for your students and recent graduates to participate in our study. The study will assess participants' use of caffeine and their knowledge on the benefits, side effects, and withdrawal symptoms of caffeine. Attached to this email is a link to the online survey. Can you please distribute the content below, with the survey link included, to your current clinical year students and your recent graduates (within the past 5 years, if applicable)?

This study is being conducted by first year students in Bethel University's Physician Assistant program. The following survey will assess the participant's knowledge on the benefits, side effects, and withdrawal symptoms of caffeine. It should take no longer than 5 to 10 minutes to complete. You will not be asked about any personal information and only the researchers and their committee will have access to submitted data. You are NOT required participate in this survey. Should you choose to participate, your signature on the letter of informed consent will serve as an acknowledgement that submission of your survey indicates release of data for professional use.

Survey link:

Thank you for your time. Please let us know if you have any questions or concerns.

Thank you,
Kjerstin Dennis, Chelsie Manton, Greta Sowles

Appendix H: Description of Study & Informed Consent

Dear Pre-Physician Assistant, Physician Assistant Student, or Physician Assistant:

We are three physician assistant students from Bethel University conducting research in partial fulfillment of the requirements for a Masters Degree in Physician Assistant Studies. Our study is investigating the use of caffeine among pre-physician assistant students, current physician assistant students, and practicing physician assistants and their knowledge about caffeine's benefits, side effects, and withdrawal symptoms. Bethel IRB approval was obtained to implement this study.

Attached is a survey to gather necessary information to complete the data collection of this research. You are NOT required to participate in this survey. Should you choose to participate, the survey will take approximately 10-15 minutes to complete. By completing this survey, you are indicating informed consent to participate in this study. Reports and subsequent data will not discuss individual responses, but will include only group data. Your identity will not be collected.

We understand that you have an extremely busy schedule and your time is limited. Please realize that your participation is vital to the success of this research. The information that you provide is essential to the validity of this study. Thank you in advance for your prompt response. Please complete the survey by **June 6, 2016**. If you have any questions, please contact Chelsie Manton at 218-316-4047 or Wallace Boeve at 651-308-1398.

Thank you again for your help.

Sincerely,

Greta Sowles, Chelsie Manton, and Kjerstin Dennis

Appendix I: Reminder Correspondence Email

Hello,

We are first year students in Bethel University's Physician Assistant program. We contacted you recently about distributing the survey link below. Can you please distribute the content below, with the survey link included, to your current clinical year students and your recent graduates (within the past 5 years, if applicable) to serve as a reminder to complete the survey?

This study is being conducted by first year students in Bethel University's Physician Assistant program. The following survey will assess the participant's knowledge on the benefits, side effects, and withdrawal symptoms of caffeine. It should take no longer than 5 to 10 minutes to complete. You will not be asked about any personal information and only the researchers and their committee will have access to submitted data. You are NOT required participate in this survey. Should you choose to participate, your signature on the letter of informed consent will serve as an acknowledgement that submission of your survey indicates release of data for professional use.

Survey link:

Thank you for your time. Please let us know if you have any questions or concerns.

Thank you,

Kjerstin Dennis, Chelsie Manton, Greta Sowles

Appendix J: Bethel University IRB Approval

Wallace Boeve Yesterday at 10:32 PM

To: Kjerstin Dennis, Greta Sowles, Chelsie Manton and 3 more...

Bethel IRB Level 3 Approval

WB

April 19, 2016

Kjerstin, Greta, & Chelsie;

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: "Prevalence of Caffiene Use and Knowledge of Its Benefits, Side Effects, And Withdrawal Symptoms Among Pre-PA Students, PA Students, and Clinically Practicing PAs." This approval is good for one year from today's date. You may proceed with data collection and analysis. Please let me know if you have any questions."

Sincerely;

Wallace Boeve, EdD, PA-C

Program Director

Physician Assistant Program

Bethel University

w-boeve@bethel.edu

651 308-1398 cell

651 635-1013 office

651 635-8039 fax

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

CC: Bethel IRB Chair

Faculty Chair Advisor

PA Program Research Coordinator

Appendix K: Survey Grading Rubric

Survey Grading Rubric
Question 9- Benefits:

- The participant will be given two scores for this question. The first score will pertain to the number of correct options selected and the second will pertain to the number of incorrect options selected. For each correct response the participant will receive 1 point (maximum of 5 points) towards their first score. For each incorrect response the participant will receive 1 point (maximum of 5 points) towards their second score. No points will be given or subtracted for answers that go unmarked.
- Correct options include: increases vigilance, prevents type 2 Diabetes Mellitus, Prevents Parkinson's disease, increases long-term memory, and prevents Alzheimer's disease.
- Incorrect options include: substitute for sleep, increases alcohol tolerance, increases short-term memory, prevents erectile dysfunction, and slows down metabolism.

Question 10- Side effects:

- The participant will be given two scores for this question. The first score will pertain to the number of correct options selected and the second will pertain to the number of incorrect options selected. For each correct response the participant will receive 1 point (maximum of 5 points) towards their first score. For each incorrect response the participant will receive 1 point (maximum of 5 points) towards their second score. No points will be given or subtracted for answers that go unmarked.
- Correct options include: increases cardiac output, increases force of heart, rapid beating of the heart, increases sleep disturbances, and increases respiration rate.
- Incorrect options include: dry eyes, hot flushes, erectile dysfunction, slow beating of the heart, and acne.

Question 11- Withdrawal symptoms:

- The participant will be given two scores for this question. The first score will pertain to the number of correct options selected and the second will pertain to the number of incorrect options selected. For each correct response the participant will receive 1 point (maximum of 5 points) towards their first score. For each incorrect response the participant will receive 1 point (maximum of 5 points) towards their second score. No points will be given or subtracted for answers that go unmarked.
- Correct options include: headache, fatigue, increases mood disturbance, decreases alertness, and drowsiness.

- Incorrect options include: nasal congestion, increases alcohol tolerance, forgetfulness, hallucinations, and aggression.

The highest score one can get on any of the above questions is 5 and the lowest score is 0. Scores will be kept separate for each question and the participants' scores will be categorized as follows:

Correct Response Score	Incorrect Response Score
0 = without knowledge	0 = very good knowledge
1 = very little knowledge	1 = good knowledge
2 = little knowledge	2 = moderate knowledge
3 = moderate knowledge	3 = little knowledge
4 = good knowledge	4 = very little knowledge
5 = very good knowledge	5 = without knowledge

Appendix L: Knowledge Graphs

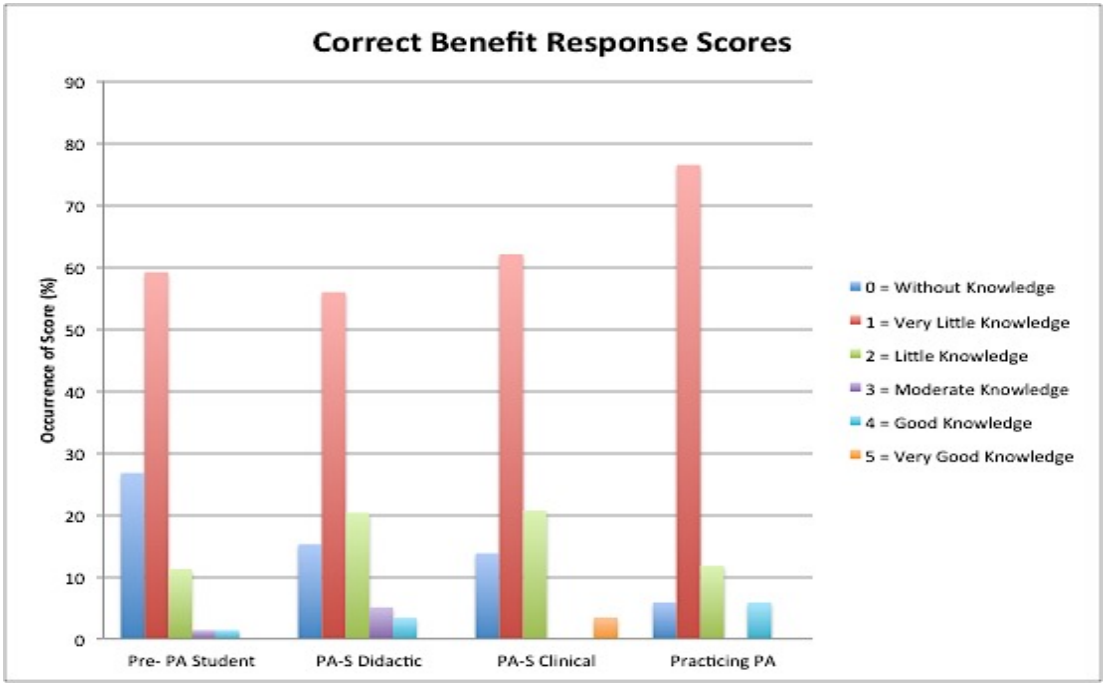

Figure 7. Correct Benefit Response Scores. The figure depicts the occurrence of the number of correct responses about the benefits of caffeine among groups. PA students in their clinical year had significantly more knowledge on the benefits of caffeine when compared to the three other groups. P-value = <0.001.

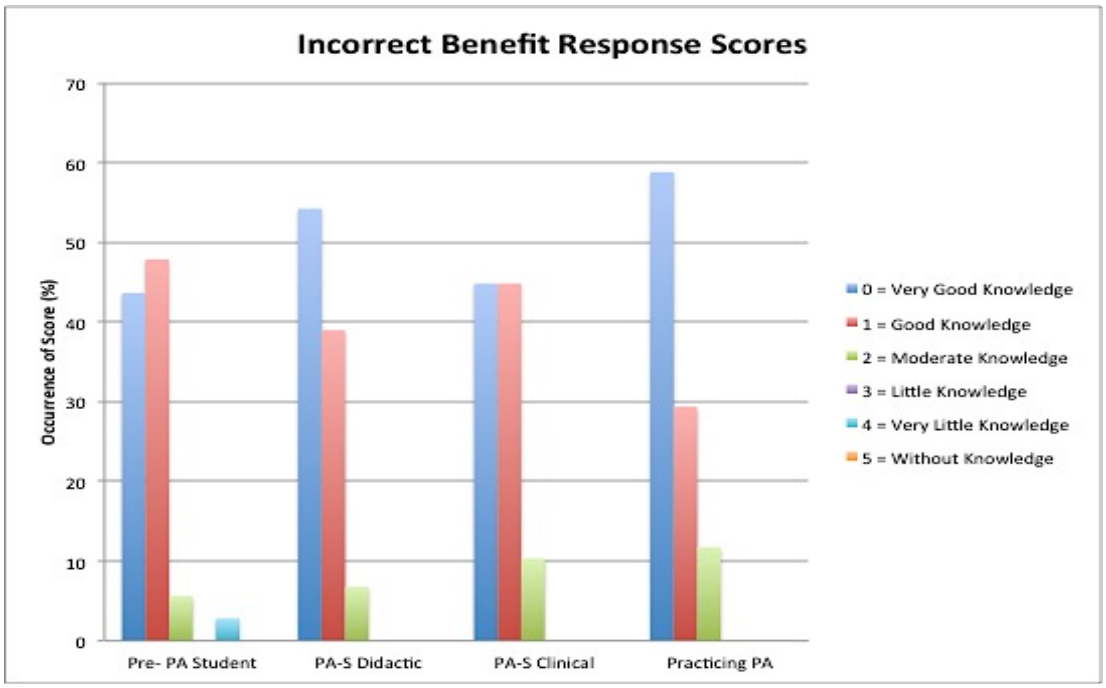

Figure 8. Incorrect Benefit Response Scores. The figure depicts the occurrence of the number of incorrect responses about the benefits of caffeine among all groups. There were no significant differences ($p < 0.05$) among groups.

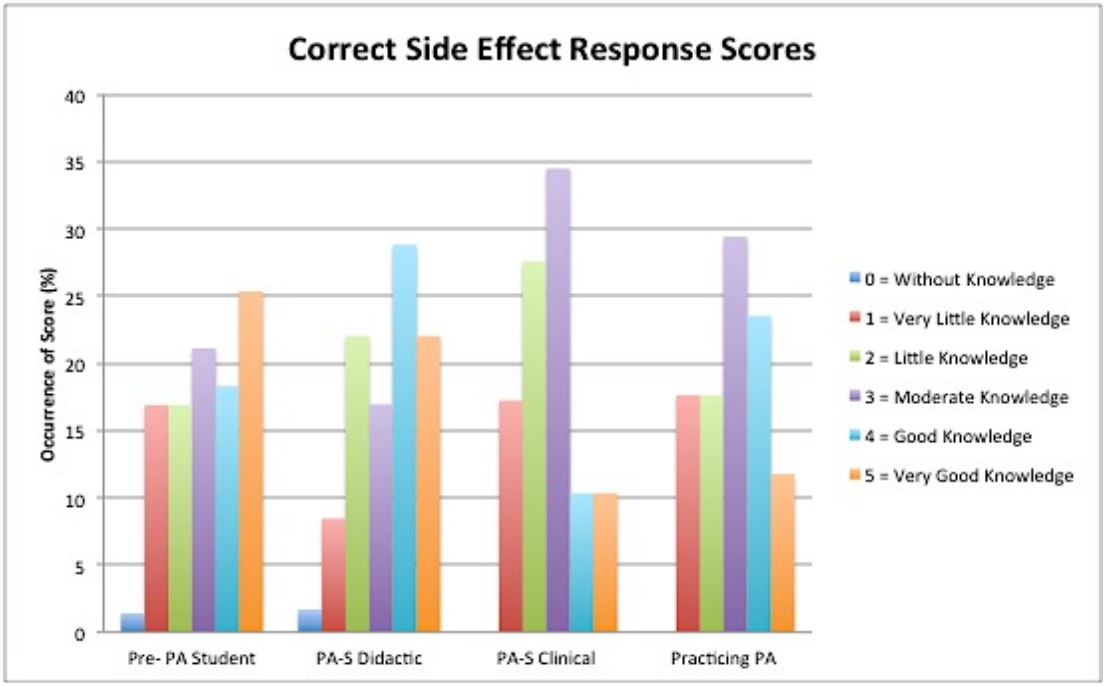

Figure 9. Correct Side Effect Response Scores. This figure depicts the occurrence of the number of correct responses on the side effects of caffeine among all groups. There were no significant differences ($p < 0.05$) between groups.

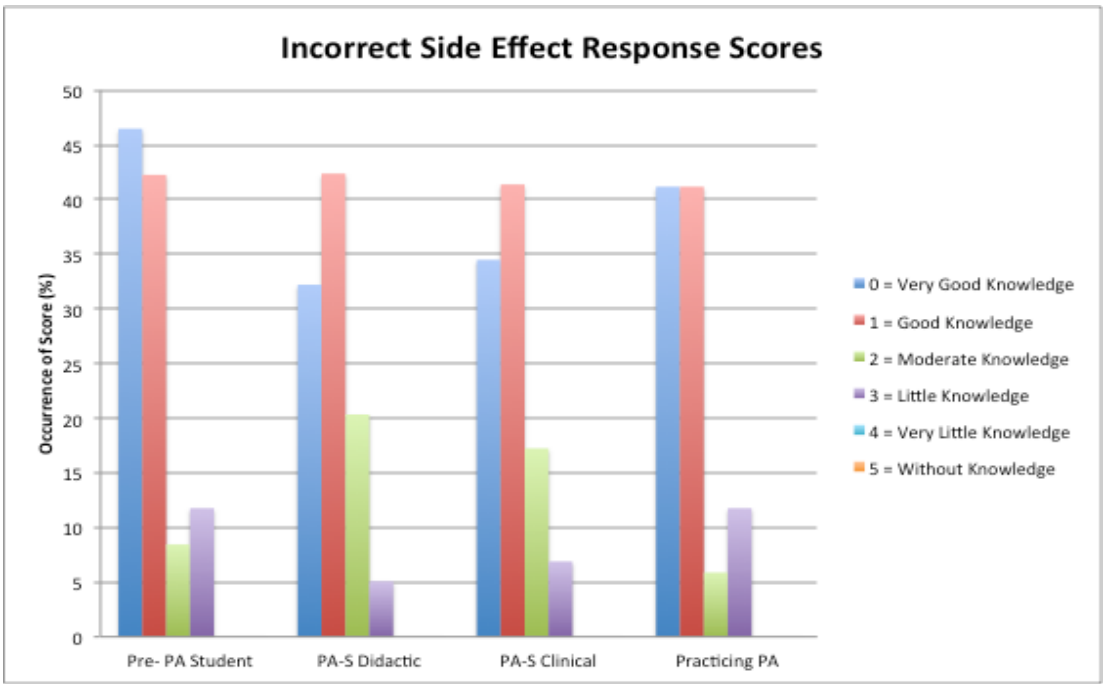

Figure 10. Incorrect Side Effect Response Scores. This figure depicts the occurrence of the number of incorrect responses on the side effects of caffeine among all groups. There were no significant differences ($p < 0.05$) among groups.

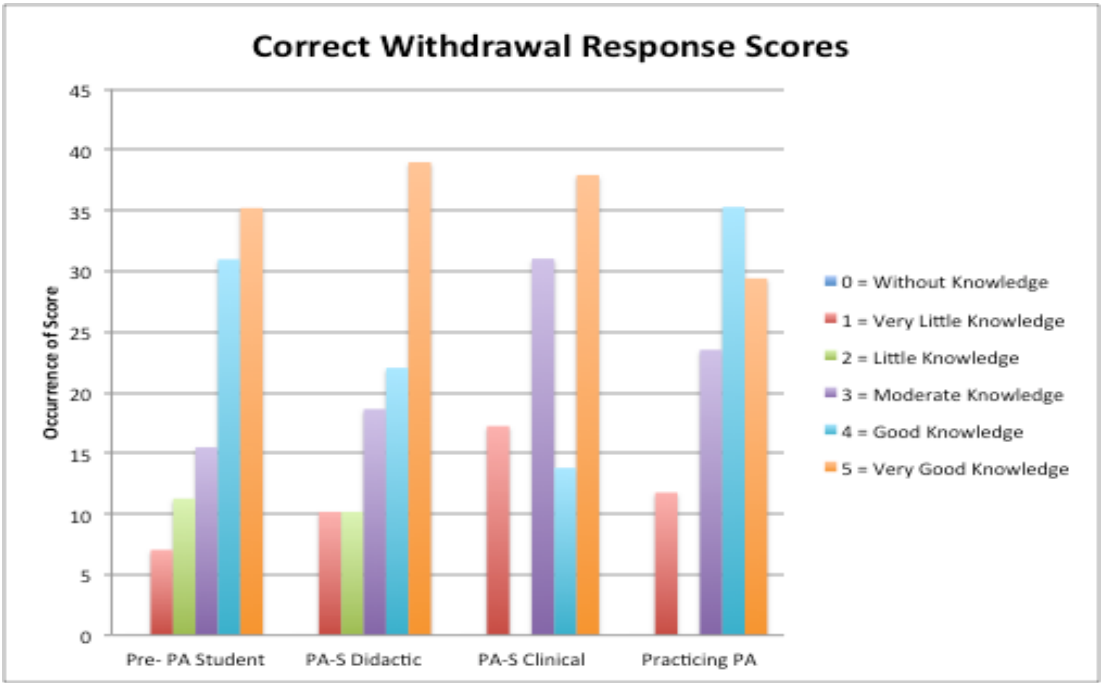

Figure 11. Correct Withdrawal Response Scores. This figure depicts the occurrence of the number of correct responses on the withdrawal symptoms of caffeine among all groups. There were no significant differences ($p < 0.05$) among groups.

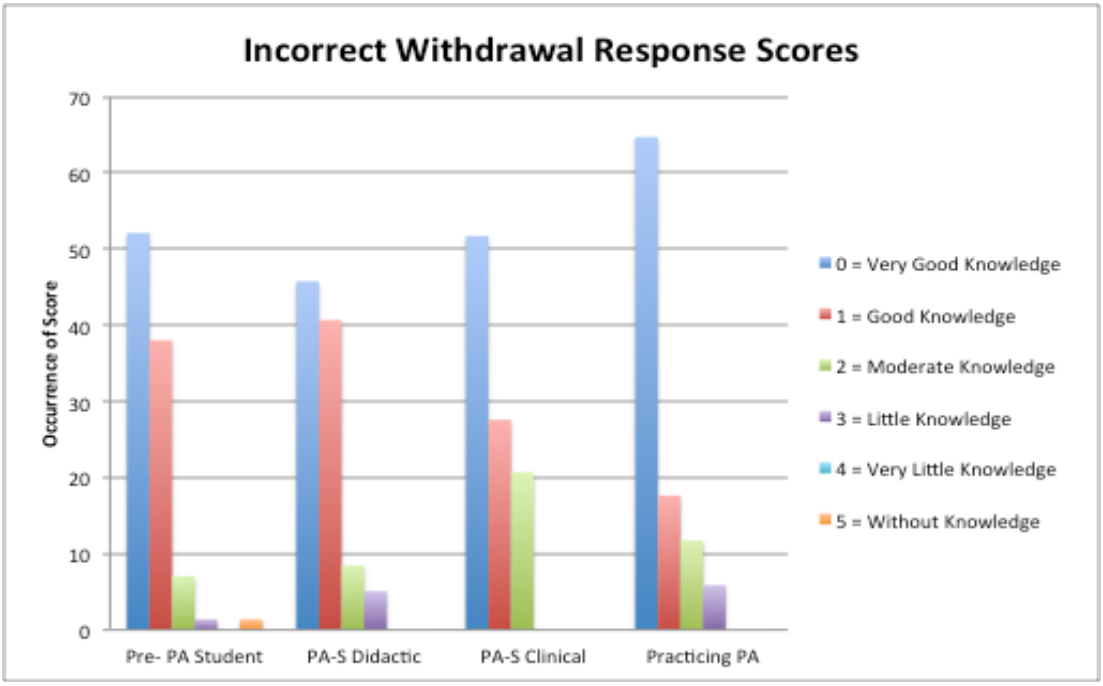

Figure 12. Incorrect Withdrawal Response Scores. This figure depicts the occurrence of the number of incorrect responses on the withdrawal symptoms of caffeine among all groups. There were no significant differences ($p < 0.05$) among groups.