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Health and Academic Achievement in College and University Students

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Health and Academic Achievement in College and University Students

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ABSTRACT

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The purpose of this non-experimental quantitative correlational study was to investigate the relationship between academic achievement and health in a national sample of college students using quantitative data analysis. Specifically, the researcher analyzed the relationship between three health-promoting behaviors (physical activity, strength training, and fruit and vegetable consumption), three negative health behaviors (cigarette, e-cigarette, and opioid use) and obesity with GPA.

Cross-sectional data on student health collected from the American College Health Association's National College Health Assessment II (ACHA-NCHA-II) and completed by 426,650 college students from 650 U.S. colleges during the semesters between 2015 and 2019 formed the foundation for this research. Nine research questions were addressed using a series of chi square tests.

Results showed there was a significant positive relationship between health behaviors and grade average. Students who met the recommendations for fruit and vegetable consumption, moderate activity and vigorous physical activity were more likely to have higher grade averages than those who did not. Students who used cigarettes, opioids, or were obese were more likely to have lower grade averages.

DEDICATION

This dissertation is dedicated to my amazing and supportive family. First, to my father who instilled a love of learning in me from a very young age and set the bar very high. He would have been proud to see me reach this goal. To my mother who taught me to believe I can be and do anything I decide, and who was (and still is) my biggest fan. To my children who inspire me to be a better mother, role model, scholar and citizen. And to my husband, my rock, my equal, and my champion. He has given me strength on many days when I was not sure I could go on.

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Chapter 1. Introduction

Health and education are inextricably connected (Burrows et al., 2017). Healthy people are better learners, and academic achievement endures a lifetime of health benefits (Raspberry et al., 2017). Poor health can also have detrimental physical, mental, and academic effects (Bellavia et al., 2013; Burkhalter & Hillman, 2011). For the purposes of this study, the researcher examined the relationship between positive and negative health behaviors and conditions, and academic achievement.

The global obesity epidemic has sparked many questions about the health of the nation and the developed world. Researchers warn that if current trends continue, the life expectancy gains of the 20th century may be reversed (Biswas et al., 2015; Mann, 2005). The positive relationship between education and health could also be affected (Kantomaa et al., 2013). Kantomaa et al. suggested that obesity may have detrimental repercussions on young people's cognitive function and thus negatively impact academic achievement. Bellavia et al. (2013) found that daily consumption of fruits and vegetables was associated with a substantially longer survival and lower rate of overall mortality, regardless of body weight. Burkhalter and Hillman (2011) reported a negative relationship between obesity and academic achievement due to decay of brain structure and function throughout the lifespan. Consequently, understanding the relationship between academic achievement and health behaviors might help mitigate the health status of students, as well as be instrumental in providing a method to intervene and improve success in higher education. Although there is consistency in findings that healthy behaviors are associated with greater academic outcomes, most of the research has been conducted in younger student populations (Kantomaa et al., 2013; Mann, 2005; Shaw et al., 2015).

Many behaviors promote good health. However, for the purposes of this research, three were examined: fruit and vegetable consumption, physical activity, and strength training. These behaviors were chosen because they are commonly accepted as being essential to good health and are fundamental to decreased morbidity and mortality (Bellavaria et al., 2013; Miller et al., 2017, Wang et al., 2014). In developed countries, nutrition and lack of physical activity is related to five of the ten leading risk factors as causes of disease burden measured in Disability Adjusted Life Years (DALY) (World Health Organization [WHO], 2019). Risk factors include high blood pressure, high cholesterol, obesity, and iron deficiency ("Health effects of dietary risks," 2019). The effects of poor nutrition and obesity also impact the ability to learn resulting from lack of nutrients found primarily in fruits and vegetables (Belot & James, 2011).

Many behaviors contribute to poor health. For the purposes of this research, three were examined: cigarette, e-cigarette, and opioid use. These negative health behaviors were chosen for this research because of their continued or mounting incidence in college student populations. Considerable progress has been made in reducing cigarette smoking among adults in the United States: an estimated 14% of U.S. adults (34.3 million) were current cigarette smokers in 2017, representing a 67% decline since 1965 (Wang et al., 2018). However, in 2017, nearly 9 in 10 (41.1 million) adult tobacco product users in the U.S. reported using a combustible tobacco product, with cigarettes being the product most commonly used (Wang et al., 2018).

While smoking prevalence has decreased over the last decade, e-cigarettes have filled the void, particularly among college students (Allem et al., 2013; Loukas et al., 2015; Parascandola, Augustson, & Rose, 2009; White, 2009). Allem et al. (2015) suggested that 45% of undergraduate students have used an e-cigarette at least once within their lifetime, and 12% of these students used e-cigarettes within the past month. In 2011, ever-use was highest among

young adults (college students and those aged 20-28; 4.9%-7.0%), followed by adults (aged ≥18; 0.6%-6.2%) (Allem et al., 2015). Loukas et al. (2015) found the prevalence of e-cigarette use among current smokers was 25% across the 14-month period. The concurrent use of cigarettes with at least one other tobacco product is associated with escalated and prolonged use of cigarettes and with the increased possibility of addiction or prolonged addiction (Parascandola et al., 2009; White, 2009). Loukas et al. (2015) reported that e-cigarette use among non-smokers may lead to nicotine addiction and/or use of other tobacco products. The introduction of e-cigarettes into the marketplace has created a cycle that could bring the next generation back to smoking traditional cigarettes. The addiction remains the same; the method of nicotine delivery has evolved.

Equally as alarming, the epidemic usage of opioids has garnered much attention in recent years. No longer a problem associated only with marginalized populations, opioid use among college students increased by 343% between 1993 and 2005 (Malone, 2017). In 2014, young adults between ages 18 to 25 years had higher rates of non-medical prescription opioid (NMPO) use than any other age group (Center for Disease Control and Prevention [CDC], 2016). Now the nonmedical use of prescription opioids is second only to marijuana as the most common form of drug use among college students in the United States (Malone, 2017).

Statement of the Problem

There is limited empirical evidence on the relationship between health and academic performance in college students. The purpose of this nonexperimental quantitative correlational study was to investigate the relationship between academic achievement and health in a national sample of college students using quantitative data analysis. Specifically, the researcher evaluated

the relationship between three health-promoting behaviors (physical activity, strength training, and fruit and vegetable consumption), three negative health behaviors (cigarette, e-cigarette, and opioid use) and one negative health condition (obesity) with GPA. Data from the American College Health Association's National College Health Assessment II administered in eight semesters between fall 2015 and spring 2019 from a national sample of U.S. colleges were collected and analyzed.

Research Questions

Exploring the complex relationship between health and academic achievement generated the following research questions:

1. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the guidelines?
2. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the guidelines?
3. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet guidelines from the U.S. Department of Health and Human Services for vigorous physical activity (at least 20 minutes of vigorous physical

activity on 3 or more days of the last week) and students who exercise less than the guidelines?

4. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for strength training (performing 8-10 strength-training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the guidelines?
5. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who are obese (BMI greater than 30) and those who are not?
6. Is there a significant difference in GPAs between college students who used cigarettes in the last 30 days and those who did not?
7. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used e-cigarettes in the last 30 days and those who did not?
8. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used opioids in the last 30 days and those who did not?
9. Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used non-medical prescription painkillers not prescribed to them in the last 12 months and those who did not?

Significance of the Study

Foundational to any human endeavor is health. The college years are of particular interest because higher academic performance during these years is highly related to career success (van

Dierendonck & van der Gaas, 2013). Academic performance influences future educational attainment and income, which, in turn, affect health and quality of life (Amis et al., 2014). Therefore, determining factors related to academic grades is important to both universities, their students, and the community at large.

Data on the positive effects of health promoting behaviors on academic performance could be used by public health professionals to tailor interventions that convey the benefits of health promoting behaviors by addressing the academic concerns of college students. The relationship between health and academic performance data could be used to separate students in need of extra academic assistance, as well as inform administrators of ideal health guidelines for peak academic performance. The college years are an important transition period when long-term lifestyle behaviors may be established (Nelson et al., 2008). Encouraging physical activity is important for students' academic performance, which will ultimately serve as a preventive method for non-communicable diseases that could directly impact their health and success in life (Burrows et al., 2017; Chung et al., 2018; Kantomaa et al., 2013).

Limitations

Although this research draws from a large diverse sample, it is not without limitations. The first is the secondary data analysis design. Secondary data changes with age and may make historical comparisons difficult. Data are self-reported and, therefore, subject to biases including unintentional or intentional misrepresentation, user error, or social desirability biases. However, self-reported GPA has been found to be highly positively correlated with actual grades and a reliable indicator of academic achievement (Kuncel et al., 2005; Sticca, 2017). Likewise, Quick et al. (2015) found that BMI calculated from self-report data were 93% accurate, 4%

underestimated, and 2.7% overestimated, supporting the utility of self-report height and weight for survey research in college students.

Another limitation was the basis of GPA on a small range of values. If GPA could have been measured more precisely (i.e., by numerical value rather than letter grade) the results may have been more accurate. Data were collected via anonymous survey, rather than by in-person interviews. The students were selected randomly, but the institutions self-selected to participate. Because of this, the results are not generalizable nationally. Hidden confounding variables may influence the measurement of academic performance. The sample included few two-year institutions making generalizability limited. The response rate was 19%. Although a low response rate is common for online surveys, research has shown that a low response rate is unrelated to bias (Haring, 2009; Wåhlberg & Poom, 2015).

Delimitations

Although there were many health-related variables available using the ACHA-NCHA II survey instrument, the researcher chose three positive health behaviors (fruit and vegetable consumption, aerobic physical activity, and strength training), three negative health behaviors (cigarette, e-cigarette, and opioid use) and an adverse health condition obesity. The positive health variables were chosen because they are fundamental to good health and are historically lacking in the college student population (Bellavaria et al., 2013; Miller et al., 2017; Nelson et al.; Vella-Zarb & Elgar, 2009; 2009; Wang et al., 2014). The negative health behaviors and a detrimental health condition, obesity, were chosen because of their increased prevalence in the sample population and their detrimental effects on morbidity and mortality (Bellavaria et al., 2013; Johnston et al., 2015; Jones et al., 2015; Laska et al., 2011).

For Research Questions 1-4 (fruit and vegetable consumption, moderate and vigorous physical activity, and strength training) the researcher only included those participants who met the U.S Department of Health and Human Services Guidelines. For example, this cut off excludes participants who eat 0, 1-2, or 3-4 servings of fruit and vegetables per day. For the three physical activity questions, only those participants who met the requirements were included. For moderate-intensity cardio or aerobic exercise, only those who indicated they exercised five or more of the past seven days were included. For vigorous-intensity cardio or aerobic exercise, only those who indicated they exercised three or more of the past seven days were included. For strength training, only those who indicated they performed strength-training exercises on two or more of the past seven days were included. For Research Question 5 (obesity), only those who had a calculated BMI of greater than 30 were included. For Research Questions 6-8, only those participants who indicated they used any number of cigarettes (RQ6), e-cigarettes (RQ7), or any amount of opioids (RQ8) on any number of days during the last 30 days were included. This would exclude the following categories: "never used" and "have used, but not in the last 30 days." For Research Question 9 (prescription painkillers not prescribed to you), only those participants who answered yes to the question were included.

Definitions of Terms

The following terms are defined and used in this study:

1. *Body mass index (BMI):* BMI is a number calculated from a person's weight and height. BMI provides a reliable indicator of body fat for most people and is used to screen for weight categories that may lead to health problems. To calculate BMI, divide weight in pounds by height in inches squared and then multiply by a conversion factor of 703 (CDC, 2011).

2. *Disability Adjusted Life Years (DALY):* One DALY can be thought of as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability (WHO, 2019).
3. *Electronic Nicotine Delivery Systems (ENDS):* According to the Food and Drug Administration (FDA, 2019), ENDS are noncombustible tobacco products, also known as vapes, vaporizers, vape pens, hookah pens, electronic cigarettes (e-cigarettes or e-cigs), and e-pipes These products use a liquid that may contain nicotine, as well as varying compositions of flavorings, propylene glycol, vegetable glycerin, and other ingredients. The liquid is heated to create an aerosol that the user inhales. ENDS may be manufactured to look like conventional cigarettes, cigars, or pipes. Some resemble pens or USB flash drives.
4. *Fruit and Vegetable Consumption:* Fruit and vegetable consumption is measured as servings per day. The current recommendation for fruit and vegetable consumption is five servings per day for adults. This recommendation can be further broken down to three servings of vegetables and two servings of fruits (U.S. Department of Health and Human Services [USDHHS], 2015).
5. *Life Expectancy:* Life expectancy at birth reflects the overall mortality level of a population. It summarizes the mortality pattern that prevails across all age groups - children and adolescents, adults and the elderly (WHO, 2019).
6. *Metabolic Equivalent (MET):* One MET is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O_2 per kg body weight x minute. The MET concept represents a simple, practical, and easily understood procedure for expressing the energy cost

of physical activities as a multiple of the resting metabolic rate. The energy cost of an activity can be determined by dividing the relative oxygen cost of the activity (ml O_2/kg/min) x by 3.5 (Jetté et al., 1990).

7. *Morbidity:* Morbidity is departure, subjective or objective, from a state of physiological or psychological well-being. In practice, morbidity encompasses disease, injury, and disability (CDC, 2019).
8. *Mortality*: Mortality is the numbers of deaths by place, time, and cause (WHO, 2019).
9. *Moderate Physical Activity:* Moderate physical activity is cardio or aerobic exercise that causes a noticeable increase in heart rate, such as a brisk walk (American College Health Association [AHCA], 2015). Examples include:
    a. 3.0 to 6.0 METs (3.5 to 7 kcal/min)
        i. Walking at a moderate or brisk pace of 3 to 4.5 mph on a level surface inside or outside
        ii. Bicycling 5 to 9 mph, level terrain, or with few hills, stationary bicycling—using moderate effort (U.S. Department of Health and Human Services [USDHHS], 2015)
10. *Non-communicable diseases:* Also known as chronic diseases, non-communicable diseases are conditions that cannot be transmitted from one person to another. They tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behaviors factors (WHO, 2019).
11. *Non-medical use of prescription opioids (NMPO):* NMPO is taking prescribed or diverted prescription drugs (drugs not prescribed to the person using them) not in the way, for the reasons, in the amount, or during the time-period prescribed (CDC, 2019).

12. *Obesity:* Obesity is defined as a body mass index of greater than 30 (CDC, 2011).
13. *Opioids:* Natural, synthetic, or semi-synthetic chemicals that interact with opioid receptors on nerve cells in the body and brain and reduce the intensity of pain signals and feelings of pain. This class of drugs includes the illegal drug heroin, synthetic opioids such as fentanyl, and pain medications available legally by prescription, such as oxycodone, hydrocodone, codeine, morphine, and many others. Prescription opioids are generally safe when taken for a short time and as directed by a doctor, but because they produce euphoria in addition to pain relief, they can be misused and have addiction potential (CDC, 2019).
14. *Prescription Opioids*: Also known as opioid analgesics, they are medications that have been used to treat moderate to severe pain in some patients. Categories of opioids for mortality data include (CDC, 2019):
    a. Natural opioid analgesics, including morphine and codeine;
    b. Semi-synthetic opioid analgesics, including drugs such as oxycodone, hydrocodone, hydromorphone, and oxymorphone;
    c. Methadone**,** a synthetic opioid that can be prescribed for pain reduction or for use in medication assisted treatment (MAT) for opioid use disorder (OUD). For MAT, methadone is used under direct supervision of a healthcare provider; and
    d. Synthetic opioid analgesics other than methadone, including drugs such as tramadol, buprenorphine, and fentanyl.
15. *Socioeconomic Status (SES):* SES is a composite measure that typically incorporates economic, social, and work status. Economic status is measured by income. Social status is measured by education, and work status is measured by occupation (CDC, 2019).

16. *Strength Training Activity:* Strength training includes any activity consisting of 8-10 strength training exercises (such as resistance weight machines) for 8-12 repetitions each (ACHA, 2015).
17. *Vigorous Physical Activity:* Cardio or aerobic exercise that causes large increases in breathing or heart rate, such as jogging, for at least 20 minutes (ACHA, 2015). Examples include:
    a. Greater than 6.0 METs (more than 7 kcal/min) (CDC)
        i. Race-walking and aerobic walking—5 mph or faster, jogging or running
        ii. Walking and climbing briskly up a hill backpacking, mountain climbing, rock climbing, repelling
        iii. Roller skating or in-line skating at a brisk pace (USDHHS, 2018).

Overview of Study

This research study is comprised of five chapters. Chapter 1, Introduction, provides background information as well as an overview of the connection between health and education, and an introduction to the college population. It includes the statement of the problem, research questions, significance of the study, limitations, delimitations, definition of terms, and organization of the dissertation. Chapter 2, Review of Literature, details background information on positive and negative health behaviors and current U.S. department of Health and Human Services guidelines. Chapter 2 reviews the health status of college students, college student demographics, and the relationship between health and academic performance. In Chapter 2, the association between health and academic performance in college students is explored, as well as the implications for health and education leaders. Chapter 3 provides discussion on the

methodology. Chapter 4 describes the results of the data analysis. Chapter 5 presents the summary of findings, implications for practice, conclusions, and recommendations for future research.

Chapter 2. Review of Literature

This review of the literature will include the following: background information on positive (physical activity and fruit and vegetable consumption) and negative (cigarette, e-cigarette, and opioid use) health behaviors and current USDHHS guidelines; studies of the relationship between positive and negative health behaviors, and morbidity and mortality; and studies of the relationship between positive and negative health behaviors, and obesity. The researcher reviewed studies of the relationship between sociodemographic characteristics and health behaviors, and the prevalence of obesity in college students, and college student demographics. Finally, this review encompasses studies pertaining to academic performance in children, adolescents and college students; and discusses implications for health and education leaders.

Background of Health Behaviors and Guidelines

Exploring the relationship between health and academic achievement begins with an understanding of this important transitional period. During the college years, young adults are developing independence and adopting lasting health behavior patterns (Nelson et al., 2009). Although many positive health behaviors may be established from childhood, college brings barriers that can sideline positive influences. Often health behaviors are heavily influenced by food and beverage marketing, financial status, and lack of food preparation resources (Nelson et al., 2009). College is the first time emerging adults live independently and take on more personal responsibilities for their own health behaviors and risks. These behaviors may ultimately form the basis for lifetime patterns (Huang et al., 2007; Irazusta et al., 2007).

Positive health behaviors. The positive health behaviors chosen for this research include fruit and vegetable consumption and physical activity. These behaviors were chosen because they are known to be essential to a healthy life and are historically under consumed by the study population (Bellavaria et al., 2013; Lee et. al., 2018; Wang et al., 2014). Despite the overwhelming perception of being in good health, research has shown that college students engage in behaviors that may lead to negative health outcomes if continued (Calimidas & Crowell, 2018). The college period is a time of adjustment, and students are often exposed to an environment that places their health at risk, although the threat to their health is not necessarily obvious (Kim & Kim, 2018). This period is regarded as one in which students are susceptible to health-related problems. This susceptibility is compounded by the lack of concern of students to improve their health and the ease with which the importance of health is ignored (Kim & Kim, 2018).

In their research on disparities in dietary consumption among young adults, Nelson et al. (2009) found that two-year college students reported less frequent meals and poorer dietary consumption compared with four-year college students, with existing differences remaining even after controlling for sociodemographic factors. Nanney et al. (2015) discovered in their research on weight and weight-related behaviors among two-year college students that almost half were overweight or obese, and young males appeared to engage in more risky health behaviors and had higher levels of overweight or obesity. Price et al. (2016) found that overweight/obese college students had worse health profiles than healthy BMI students and weight status was significantly associated with cardiovascular fitness.

***Fruit and vegetable consumption*.** It is well known that fruit and vegetable consumption is essential to good health (Bellavaria et al., 2013; Wang et al., 2014). The current recommendation for fruit and vegetable consumption is five servings per day for adults. This

recommendation can be further broken down to three servings of vegetables and two servings of fruits (USDHHS, 2015; U.S. Department of Agriculture [USDA], 2015). The National Health and Nutrition Examination Survey (NHANES) data reports that Americans continue to fail to meet this minimum requirement. The NHANES I (1971–1975), II (1976–1980), III (1988–1994), and 1999–2002 are cross-sectional nationally representative surveys of the U.S. civilian, noninstitutionalized population (CDC, 2018). Dietary intake information is collected using a complex, stratified, multistage probability cluster sampling design by a trained interviewer using a single 24-hour dietary recall (CDC, 2018).

Not only is fruit and vegetable consumption healthy, but how many servings matters as well. Several studies revealed a dose dependent association between daily fruit and vegetable consumption and mortality (Bellavaria et al., 2013; Miller et al., 2017; Wang et al., 2014). Specifically, Bellavaria et al. (2013) found consuming more fruits and vegetables resulted in substantially longer survival in Swedish men and women, whereas less than five servings per day was associated with progressively shorter survival and higher mortality rates. Likewise, Wang et al. (2014) found that higher intake of fruit and vegetables was significantly associated with a lower risk of all-cause mortality. The average reduction in the risk of cardiovascular disease mortality was 4% (hazard ratio 0.96, 95% confidence interval 0.92 to 0.99; p=0.02) for each additional serving per day of fruit and vegetables combined (Wang et al., 2014). In their large, international prospective cohort study, Miller et al. (2017) found that greater fruit, vegetable, and legume consumption was associated with a lower risk of major cardiovascular disease, myocardial infarction, cardiovascular mortality, non-cardiovascular mortality, and total mortality in the analyses adjusted for age and sex. Fruit and vegetable consumption are key health

behaviors not only in the reduction of morbidity and mortality, but in achievement and success in life (Faught et al., 2017; Martin et al., 2018).

For thousands of years, health behaviors including diet and exercise have been central in progressing cognitive capacity in humans (Gómez-Pinilla, 2017). Research in molecular biology has revealed that food driven signals from the brain influences metabolism and energy as well as synaptic plasticity, in turn effecting cognitive function and advancing civilization (Gómez-Pinilla, 2017). Feeding habits have been intrinsically associated with the development and survival of human civilization due to food choice and geography.

Diet is directly linked to survival and advancement as well as to achievement (Burrows et al., 2017; Miller et al., 2017). Researchers suggest that along with energy, certain dietary components such as micronutrients and essential fatty acids play a vital role in brain development and functioning (Burrows et al., 2017). The connection between higher consumption of nutrient rich foods, such as fruits and vegetables, and lower consumption of nutrient poor foods could then be explained by higher consumption of the aforementioned essential nutrients (Burrows et al., 2017).

***Physical activity*.** Physical activity has been seen as healthy and advantageous at least since the age of Hippocrates, who believed physical activity was essential to health. However, this recommendation changed course in the early 20th century as complete bed rest was prescribed in patients suffering from cardiovascular disease (Lee et al., 2012). This remained popular opinion until 1954 when the work of Jerry Morris, a physician-epidemiologist, whose landmark study conclusively demonstrated that physical activity lowers the risk of heart attack and prolongs good quality of life (Paffenbarger, 2000).

The current recommendation for physical activity is at least 150 to 300 minutes of moderate-intensity aerobic activity per week, and muscle strengthening activities of moderate intensity or greater on two or more days per week (USDHHS, 2018). The following are the key guidelines recommended by the USDHHS:

1. Adults should move more and sit less throughout the day. Some physical activity is better than none. Adults who sit less and do any amount of moderate-to-vigorous physical activity gain some health benefits.
2. For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.
3. Additional health benefits are gained by engaging in physical activity beyond the equivalent of 300 minutes (5 hours) of moderate-intensity physical activity a week.
4. Adults should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on two or more days a week, as these activities provide additional health benefits (p. 8-9).

Physical activity has also been found to be dose dependent. Fishman et al. (2016) discovered that a greater volume of total activity was associated with lower mortality and that replacing minutes of sedentary time with minutes of light activity was associated with lower mortality. Inversely, physical inactivity increases the risk of many adverse health conditions, such as cardiovascular disease, diabetes, and certain cancers, as well as shortens overall life

expectancy (Lee et al., 2012). In their 2012 study of physical activity and mortality, Lee et al. found that physical inactivity caused 6% to 10% of the burden of disease from coronary heart disease, type two diabetes, breast cancer, and colon cancer. Furthermore, inactivity caused almost 10% of premature mortality, or more than 5.3 million of the 57 million deaths that occurred worldwide in 2008.

With the industrial revolution making life easier, physical inactivity now plagues the western world. According to the WHO (2019) lack of physical activity is the fourth leading risk factor for global mortality credited with 6% of deaths globally. In the United States, about half of the adult population (including college students) is not meeting physical activity recommendations (ACHA, 2016). These trends are showing up earlier in life. From 2003 to 2007, the obesity prevalence for youth ages 10–17 years in the United States increased by 10% (Singh et al., 2010). Unfortunately, these conditions in childhood and adolescence are associated with the same in adulthood (Biswas et al., 2015). In the context of increasing risk for chronic disease related to excess weight among youth, experts estimate that current generations of young people may be the first to have shorter life spans than their parents (Biswas et al., 2015; Mann, 2005).

Pandelo and Pandelo (2019) found physical activity could have a significant impact on cognitive and motor functions by increasing cerebral capillary growth and subsequently increasing blood flow and oxygenation. This, along with brain nerve cell growth, has been shown to increase memory and learning. Equally as interesting is the ability of physical activity to stimulate the production of neurotrophins and the development of new cerebral connections, thus showing physiologically how physical activity can have a positive effect on academic performance.

Negative health behaviors and conditions. As with positive health behaviors that increase health status, negative health behaviors and their resulting conditions can decrease health status. For the purposes of this research, three negative health behaviors will be discussed: use of cigarettes, e-cigarettes, and opioids. Obesity will also be examined. These behaviors were chosen because of their prevalence in the study population and their negative impact on lifelong health and academic success.

***Cigarettes and e-cigarettes*.** The negative health effects of cigarette smoking are well documented and include asthma, chronic obstructive pulmonary disease, cancer, diabetes, and gum disease (CDC, 2019). Although declining in recent years, cigarette smoking is still the leading cause of preventable disease and death in the United States, accounting for more than 480,000 deaths every year (Agaku et al., 2014; USDHHS, 2014). An estimated 34.3 million adults in the United States currently smoke cigarettes, of those, 10% are aged 18-24, and 16% are 25-44.

Gilman and Zun (2014) described the deep history tobacco and smoking have in the Americas stretching back to 6,000 BC. The plant today known as tobacco, or Nicotiana tabacum, is a member of the nicotiana genus – a close relative to the poisonous nightshade that could only be found in the Americas. Native Americans had been cultivating and using tobacco for over two millennia for medicinal and religious purposes. Rodrigo de Jerez and Luis de Torres are the first Europeans to observe smoking in Cuba. Jerez took up the habit and ultimately introduced smoking to Spain. In the 15th century, Portuguese sailors began planting enough tobacco for personal use and gifts, and by mid-century Brazil had begun to grow tobacco for trade. By the

end of the 16th century, tobacco could be found in every country in Europe for snuffing or smoking.

Tobacco took hold in the United States around the time of the Revolutionary War and was so valuable it was used for collateral (Randall, 1999). In 1847, Philip Morris was established in the U.K. by selling hand-rolled Turkish cigarettes. R. J. Reynolds Tobacco Company was founded in 1875 and produced chewing tobacco, exclusively. Cigarettes came into popularity after the invention of the cigarette-making machine by James Bonsack in 1881 who went into business with James Duke and the American Tobacco Company (ATC) was born (Gilman & Xun, 2004). The ATC survives today as a part of British American Tobacco, a global company with reported revenues of 13 billion in 2015. Cigarettes came to the height of their popularity during the First and the Second World War because tobacco companies provided cigarettes to millions of soldiers on the front lines, creating hundreds of thousands of faithful and addicted customers.

Gilman and Xun (2004) described the health dangers associated with smoking and tobacco that were discovered early. In the early 17th century, a Chinese philosopher Fang Yizhi discovered the dangers of smoking by noting changes in lung function. Likewise, German doctors warned of lip cancer from pipe smoking in the late 1700's. American doctors started linking tobacco use to lung cancer in the 1930's and the Surgeon General's 1964 report revealed that smoking caused lung cancer in men. Today tobacco products are highly regulated; however, tobacco companies are still multimillion-dollar industries that have evolved to survive. The introduction of the e-cigarette ushered in the new method to market tobacco.

While cigarette use in the United States declined between 2005 and 2012, use of non-cigarette alternative products, such as electronic cigarettes became increasingly prevalent (Agaku et al., 2014; Connolly & Alpert, 2008, King et al., 2013). Although e-cigarettes have been

marketed as smoking cessation aids, there is conflicting scientific evidence on the efficacy of e-cigarettes as a long-term cessation tool (Etter et al., 2011; FDA, 2012; Villanti et al. 2018). E-cigarettes are not included as a recommended smoking cessation method by the U.S. Public Health Service (USPHS, 2008). Additionally, e-cigarette usage has recently been connected with hundreds of cases of severe pulmonary disease and has been reported to CDC by 25 state health departments (Schier et al., 2019). This outbreak of lung disease has prompted the CDC (2019) to issue a warning against using e-cigarettes for any reason, including smoking cessation.

College students are often early adopters of products and have historically been at the forefront of societal changes in substance use that later materialize in the general population (Lee et al., 2017). In a cross-sectional study of college students in North Carolina in 2009, Sutfin et al. (2013) found that college students' lifetime prevalence of e-cigarette use was almost 5% which was higher than were rates of use among other adults at the time, suggesting that college students were early adopters of e-cigarettes (Pearson et al., 2012). Because the college years are a period of transition and stress, the tobacco industry capitalizes on this vulnerable period for tobacco use initiation and transition to addiction, making college students an ideal target market (Ling & Glantz, 2002; Tanner & Arnett, 2013).

Opioids. The opioid epidemic sweeping the nation is certainly present in college students, and at higher rates than other groups. College students report high levels of alcohol and drug use; 63% of U.S. college students report past-month alcohol use, 34% report past-year marijuana use, 21% report past-year illicit drug use other than marijuana, and 13% report past-year non-medical use of prescription drugs (Johnston et al., 2015). Rates of non-medical prescription opioid (NMPO) use among young adults have increased over the past two decades, and use is associated

with high rates of morbidity and mortality (Han et al., 2015). NMPO use is a significant public health concern in part because the increase in NMPO use has coincided with significant growth in heroin use. Among persons 18 to 25 years of age, rates of heroin use have increased 109% from 2002-2013 (Jones et al., 2015). Most heroin users report starting with NMPOs and then transitioning to heroin, which is often more available, less expensive, and more potent (Longo et al., 2016). In an analysis of injection drug users, Al Tayyib et al. (2017) found that more than one-third reported being addicted to prescription opioids prior to initiating injection drug use. Addiction to prescription opioids prior to injection was a significant risk factor for experiencing an overdose (Al Tayyid et al., 2017). The prevalence of prescription opioid use disorder among nonmedical prescription opioid users between 2012 and 2014 increased significantly among 18-to-34-year-olds but stayed relatively stable for 12-to-17-year-olds (Arria & Compton, 2017). Young adult heroin users were nine times more likely to have been former NMPO users.

Nonmedical use of prescription opioids is second only to marijuana as the most common form of drug use among college students in the United States and is associated with lower school performance and increased risky behavior (Malone, 2017). In their analysis of the behavioral responses to opioid use in college students, Meshesha et al. (2017) found that users spend less time on academic activities and that low baseline academic engagement was associated with greater alcohol use at the12-month follow-up. This is consistent with other research suggesting that drug use among college students is associated with lower grades and increased likelihood of dropping out of college or delaying graduation (Arria et al., 2008; Suerken et al., 2016). Meshesha et al. (2017) discovered a significant and increasing negative effect of drug use on academic engagement in the college student population.

Obesity. The high rate of obesity in the United States currently poses a serious threat to the health of college students. Obese students face a greater risk of future chronic conditions, such as type two diabetes mellitus, coronary heart disease, certain types of cancer, long-term disability, and death (U.S. Preventive Services Task Force [USPSTF], 2012). In spring of 2019, the ACHA reported more than 15% of college students surveyed were obese, and almost one quarter were overweight. Not only does excess weight affect long-term health and success but can have negative effects on academic achievement in college.

Research examining the link between body mass index (BMI) and grade point average (GPA) in college students are scarce and inconsistent. Aimé et al. (2017) discovered that although no significant differences were noted for sociodemographic variables, overweight and obese female students reported lower GPA and academic self-efficacy as well as higher depressive symptoms than their normal-weight counterparts did. In their research of a high school population, Rajagopal et al. (2017) discovered that having a higher BMI related to a lower GPA, and lack of exercise and poor weight perception were also associated with a lower GPA. As GPA increased, BMI decreased, suggesting that students who are overweight or obese tend to perform more poorly in school than their normal weight counterparts. Emerging evidence has also linked obesity in children and adolescents to lower brain matter volume in brain regions associated with cognitive control and learning when compared to children and adolescents of healthy weight (Alarcón, 2016; Alosco, 2014; Kennedy, 2016; Maayan, 2011; Ou, 2015; Yau, 2014). This suggests an association between obesity, reduced cognitive and academic abilities, and is consistent with findings from animal models where manipulation of fat mass has been shown to affect cognition (Kennedy, 2016). Martin et al. (2018) discovered that composition of the diet might further affect cognition and achievement by altering neurotrophic and

neuroendocrine factors involved in learning and memory in children and adolescents. However, Alswat et al. (2017) found no correlation between BMI, waist circumference, and school performance except in physics results where obese students performed worse than normal-weight students did.

Because obesity is stigmatizing and socially undesirable, Olivia-Moreno and Gil-Lacruz (2013) found that obesity carries significant psychological and social burdens in addition to the physiological consequences. This addition has an impact on multiple dimensions of quality of life, including academic achievement (Wee et al., 2013). There are age, race, gender, cultural, and economic based differences in the prevalence of obesity (Sullivan et al., 2007). According to the CDC (2018), Hispanics (47.0%) and non-Hispanic blacks (46.8%) had the highest age-adjusted prevalence of obesity, followed by non-Hispanic whites (37.9%) and non-Hispanic Asians (12.7%). The prevalence of obesity was 35.7% among young adults aged 20 to 39 years, 42.8% among middle-aged adults aged 40 to 59 years, and 41.0% among older adults aged 60 and older.

Given the scope of the obesity epidemic, researchers have identified a unique group of obese men and women who exhibit less visceral adiposity and fewer adverse metabolic disturbances and cardiovascular risk factors than would be expected on the basis of their body mass index (BMI). This condition has been termed metabolically healthy obesity (MHO) or uncomplicated obesity. Metabolically healthy obese individuals represent between 10%–45% of the adult obese population, with higher prevalence among younger obese individuals and obese women (Bluher 2010). There is limited research on the cardiometabolic risks and long-term morbidity of these individuals. Caleyachetty et al. (2017) found that individuals who are obese and classified as metabolically healthy are still at an increased risk for CHD, cerebrovascular

disease, and heart failure compared with individuals who are normal weight with no metabolic risk factors. More research is needed in this unique population.

The CDC (2018) reports obesity rates decrease by level of education. Adults without a high school degree or equivalent had the highest self-reported obesity, followed by high school graduates, adults with some college and college graduates (CDC, 2018). Obese individuals are rated as less employable, have lower self-esteem, and face discrimination in school and health care (Grant & Mizzi, 2014). Harrington and Ickes (2016) estimated that the obesity epidemic costs the U.S. $117 billion per year in direct medical expenses and indirect costs, including lost productivity. In sum, many college students may be at significant risk for chronic diseases, emotional trauma, and discrimination due to their overweight or obese status (Harrington & Ickes, 2016).

Body Mass Index (BMI) is an inexpensive, easy-to-perform, and accurate method of screening for weight category as it implies to health. BMI is a person's weight in kilograms divided by the square of height in meters. BMI does not measure body fat directly, but research has shown that BMI is moderately correlated with more direct measures of body fat obtained from skinfold thickness measurements, bioelectrical impedance, densitometry, dual energy x-ray absorptiometry (DXA) and other methods (Freedman et al., 2013; Garrow, 1985). Furthermore, BMI appears to be as strongly correlated with various metabolic and disease outcomes as other direct measures of body fatness (Steinberger et al., 2005).

Health of College Students

College students are not known to be particularly healthy or concerned with health in general (Vella-Zarb & Elgar, 2009). The dietary habits of college students are historically poor

(Nelson et al., 2009). The ACHA (2018) reported that that 5% of college students eat five or more servings per day of fruits and vegetable, and 20% meet daily health recommendations for physical activity. Only 10% of adults in the United States meet the requirement, making college students below the national average intake (Lee-Dwan et al., 2017). In addition, college student eating patterns are typically low in fruits, vegetables, and dietary fiber (Greene et al., 2011) and high in fast food and alcohol (Nelson et al., 2009; Vella-Zarb & Elgar, 2009).

As mentioned earlier, the transition to higher education involves a significant life change that can trigger less healthy behaviors (Deforche et al., 2015). Researchers suggest that because college students are not meeting the national guidelines for physical activity or fruit and vegetable consumption, they are becoming less healthy than previous generations (Keating et al., 2005). Due to not meeting the guidelines, college students experienced weight gain and decreased physical activity (Keating et al., 2005). If the observed weight gain continues across the lifespan, overweight prevalence and associated health risks will also increase (Deforche et al., 2015). According to Levitsky and Young (2004), college students have notably poorer dietary and activity behaviors than their peers who do not attend college.

The AHCA (2012) recognizes the need for effective dietary behavior interventions on college campuses. The Healthy Campus 2020 goals include increasing the number of students who report eating five or more servings of fruits and vegetables per day. Healthy Campus 2020 goals also include increasing the number of students at a healthy weight and reducing the number of students who are obese. Each institution can propose a different strategy to reach these targets as they determine the specific needs of their campus and student population.

Calamidas and Crowell (2018) discovered that unhealthy eating, smoking, and lack of exercise were the most commonly reported negative behaviors. Correspondingly, exercise and

better eating habits were the most common health promoting behaviors students wanted to adopt. Of the 738 participants in a study of health behaviors at the University of Kansas, 21% were overweight and 16% were obese, more than half of the participants reported eating less than the daily recommendation for fruit and vegetables, and two thirds did not meet physical activity requirements (Huang et al., 2002). College students, irrespective of weight status, are failing to meet health-promoting guidelines. In their study of changes in eating and physical activity behavior across seven semesters of college, Small et al. (2013) discovered that, although few college students consumed fruits and vegetables or exercised at optimal levels at the beginning of the study, daily fruit and vegetable consumption and daily physical activity declined significantly throughout the seven semesters. Not only are the health behaviors of many college student's poor, but they are getting worse throughout their college career.

Health behaviors of young adults are subpar, especially the health behaviors of community college students. There is limited research about obesity prevalence and related risk factors among community college students. Previous research on this population has primarily focused on four-year college students (Calamidas & Crowell, 2018; Huang et al., 2003; Small et al., 2013). Laska et al. (2011) found that in community college students, females exhibited less healthy dietary and physical activity patterns than those attending four-year colleges. Although there were less differences, males were less likely to participate in strenuous physical activity and more likely to consume soda and fast food. The differences between two- and four-year students were evident even after controlling for numerous sociodemographic factors (Laska et al., 2011). Nelson et al. (2009) examined differences in dietary factors among young adults by student status and found that two-year college students reported less frequent meals and poorer dietary intake when compared with four-year college students. The differences were still present

when controlled for socioeconomic factors, race, and ethnicity. One assessment of two- and four-year institutions in Minnesota identified that two-year college students were twice as likely to be obese compared with students attending four-year colleges (Laska et al., 2011). Harrington and Ickes (2016) found no significant differences between BMI and health behaviors in college students, reinforcing the idea that college students in general exhibit poor health promoting behaviors.

College Student Demographics

According to the U.S. Department of Education (ED, 2018), fall enrollment in degree-granting postsecondary institutions increased 24% between 1996 and 2006 and was 12% higher in 2016 (19.8 million) than in 2006 (17.8 million). The overall increase between 2006 and 2016 reflects an increase of 18% between 2006 and 2010, followed by a decrease of 6% between 2010 and 2016.

The number of female students rose 10% and fell 14% for males from 2006 to 2016 (ED, 2018). Although male enrollment increased by a larger percentage than female enrollment, the majority (56%) of students in 2016 were female. Male and female enrollments were both higher in 2016 than in 2006, but there were increases during the first part of this period followed by smaller decreases during the most recent part of the period (a decrease of 5% for males from 2010 to 2016 and a decrease of 6% for females).

The racial and ethnic makeup of the college student population has transformed dramatically in the last decade. The Education Department (2018) reports the following demographic changes in the U.S. college student population: The percentage of college students in the U.S. who are Hispanic, Asian/Pacific Islander, and Black increased in the last 40 years

from fall 1976 to fall 2016, the percentage of Hispanic students rose from 4% to 18% of all U.S. residents enrolled in degree-granting postsecondary institutions, and the percentage of Asian/Pacific Islander students rose from 2% to 7%. The percentage of Black students increased from 10% in 1976 to 14% in 2016. The percentage of American Indian/Alaska Native students was higher in 2016 (0.8%) than in 1976 (0.7%). During the same period, the percentage of White students fell from 84% to 57%, and 4% of students in 2016 were of two or more races. Race/ethnicity is not reported for nonresident aliens, who made up 5% of total enrollment in 2016.

Two-year colleges are more racially, ethnically, and economically diverse than four-year institutions. Of the 12 million enrolled, 46% were White, 25% were Hispanic, 13% were Black, and 16% were unreported (American Association of Community Colleges [AACC], 2015; Nelson et al., 2012). The percentage of first-time community college students who identified as Hispanic increased from 13% in 2001 to 26% in 2016 (Nanney et al., 2015).

Health and Sociodemographics

Given the diverse makeup of college populations, understanding the relationship between health and sociodemographics and the resulting disparities is necessary to create a framework for this research. Unfortunately, not all people experience health outcomes equally. There are sweeping health disparities in the United States and around the world. The reduction of health disparities across socioeconomic status (SES) and ethnicity has been the overarching goal of the Healthy People program in the United States since 1990 (Signorello et al., 2014). Healthy People is a federal initiative charged with providing science-based, 10-year national objectives for improving the health of all Americans (Office of Disease Prevention and Health Promotion,

2018) The geographic and temporal trends of health disparities among people with different SES and ethnic backgrounds have persisted and perhaps have worsened over time (USDHHS, 2013).

Laska et al., (2011) discovered differences in weight status, physical activity, dietary intake, and weight control behaviors between two-year vs. four-year college students. Many of the associations between student status and weight behaviors remained significant even after adjusting for socioeconomics, therefore, suggesting that there are other lifestyle factors at work in lives of these adults that are not wholly explained by sociodemographic characteristics.

One study reported observations that mirrored national trends suggesting that on average, Asian students have higher grade point averages than all other races and ethnicities (Perkins, 2004). Cox et al. (2007) reported among Mississippi public school students, white students have higher grade point averages than black students did, even after adjusting for gender, grade level, and substance-use behaviors. Price et al. (2016) found that white students had statistically higher fitness levels, higher self-reported fruit, and vegetable consumption than black students. However, the results should be interpreted within the proper context. A person's racial/ethnic background reveals a collection of cultural, psychological, and sociological factors that may influence academic performance (Cox et al., 2007). Differences in SES, family structure, parental involvement, neighborhood influences, and school-related variables may also account for the perceived differences in academic performance.

In 2011, the CDC identified the following health disparities in the United States that are of interest to this research (p. 2):

- Mortality rates for drug-induced deaths were highest among American Indian/Alaska Natives and non-Hispanic whites.

- Obesity prevalence increased significantly among boys and men, and substantial disparities persisted by race/ethnicity, sex and education.
- Although some progress has been made in reducing cigarette smoking among certain racial/ethnic groups in recent years, little progress has been made in reducing cigarette smoking among persons of low socioeconomic status.
- In 2010, the uninsured rate for adults aged 18-34 years was approximately double the uninsured rate for adults aged 45-65 years.
- Persons living in rural census tracts or living in areas with a higher percentage of senior citizens or with a higher percentage of non-Hispanic whites, more often lacked at least one healthier food retailer (within ½-mile of the tract boundary) compared with persons living in other census tracts.

In sum, those living in poverty have higher rates of smoking and obesity. Certain marginalized populations have higher rates of obesity and smoking, and lack healthy food outlets nearby. These factors must be considered in examination of this research. There are many factors that may affect academic achievement including health inequity, social determinates of health, and health related disparities.

Health and Academic Performance

The medical literature has revealed numerous studies on the relationships among diet and behavior, concentration, cognitive ability, and health outcomes. In their review of the literature, Sorhaindo and Feinstein (2006) reference four channels through which nutrition may affect the ability to learn. The first channel is through physical development. A poor diet can leave children vulnerable to illness, and in turn, more illness can lead to increased absenteeism. The second

channel is through the ability to concentrate and cognition. Deficiencies in certain vitamins and minerals (particularly iron) can influence the development of the central nervous system and cognition throughout the lifespan. The third channel mentioned is behavior. The last channel is through school social life and in particular peer exclusion due to obesity.

Positive health behaviors. A significant body of research has demonstrated the relationship between unhealthy children and poor academic performance (Burkhalter & Hillman, 2011; Larson et al., 2016; Moore et al., 2013; Shaw et al., 2015). The inverse relationship has been studied much less. Burkhalter and Hillman (2011) noted that excess body mass is correlated with poorer academic achievement during development due to greater decay of brain structure and function that lasts through adulthood. The contrary was also found to be true. Increased physical activity participation was associated with increased cognitive health and function throughout the lifespan. Faught et al. (2017) found that Canadian adolescents who participated in daily physical activity and consumed a diet rich in fruits and vegetables exhibited higher levels of academic achievement. Davison and Veugelers (2017) found a positive relationship between physical activity and academic achievement. A study of Korean students (Kim et al., 2016) found similar positive relationships between academic achievement and health promoting behaviors. The positive correlation remained after considering socioeconomic factors.

Fruit and Vegetable Consumption. Public health economists Belot and James (2011) evaluated the effects of diet on educational outcomes through the "Feed Me" campaign. This campaign introduced drastic changes in the meals offered in the schools of one borough in the U.K. that shifted from low-budget processed meals to healthier options. The effects were evaluated in primary schools by comparing educational outcomes before and after the campaign.

The effects were significant. The proportion of children reaching level five or above increased by three percentage points in math, six percentage points in English, and eight percentage points in science. The proportion of children reaching level four or above increased by three percentage points in English and math and by two percentage points in science. They also detected a 14% drop in absences. These effects were particularly noteworthy because they captured direct and short-term effects of improvement in children's diet on educational achievements.

Schools that implemented healthy school meals saw increases in academic achievement among children who were overweight or obese (Martin et al., 2018). Belot and James (2011) investigated a three-year controlled healthy school meal intervention with more than 80,000 children. Their research concluded that healthier school food at lunchtime led to improvement in mathematics, English, and science achievement scores. Golley et al. (2010) and Storey et al., (2011) found that healthier changes in the dining environment and healthier school food over 12 weeks improved classroom on-task behavior in preschool children when compared to control groups.

Rasberry et al. (2017) analyzed results from the 2015 National Youth Risk Behavior Survey (YRBS), a biennial, cross-sectional, school-based survey measuring health-related behaviors among U.S. students in grades 9–12. Analysis assessed relationships between academic achievement and 30 health-related behaviors that contribute to leading causes of morbidity and mortality among adolescents in the United States. Controlling for demographics, Rasberry et al. established that students who earned mostly A's and B's had statistically significantly higher prevalence estimates for health promoting behaviors and significantly lower prevalence estimates for health risk behaviors than did students with mostly D's and F's. These

findings further emphasize the relationship between health promoting behaviors and academic achievement.

Although researchers affirm a positive relationship between positive health behaviors and academic achievement in children and adolescents, the relationship in college students has been studied much less. Burrows et al. (2017) uncovered little research that reported an association between dietary consumption and academic achievement in college students, with only seven studies included in their review. However, the connection between dietary consumption and academic achievement was found to be positive (Burrows et al., 2017).

Physical Activity. Chung et al. (2018) discovered a significant positive relationship between physical activity and grade point average (GPA) in their research of the association between levels of physical activity and academic achievement among medical and health sciences students at Cyberjaya University College of Medical Sciences in Malaysia. Another study of Medical Students at the College of Medicine, King Saud University, Riyadh, Saudi Arabia discovered that medical students who were physically active were also higher achievers with higher GPAs than those that were inactive (Al-Drees et al., 2016). Grade point average decreased from normal weight to obese students in the study population; however, the obese students who had high-GPAs were also physically active (Al-Drees et al., 2016).

Negative health behaviors and conditions. In addition to inactivity being linked with low academic achievement, previous examinations have shown that low academic achievers are more likely to smoke cigarettes, drink alcohol, and use marijuana and other illicit drugs (Sanders et al., 2001).

Cigarettes and E-cigarettes. An international tobacco control four-country survey reported that most e-cigarette users are young, nondaily tobacco smokers who perceive e-cigarettes as less harmful (Adkison et al., 2012). This assumption may be driving the e-cigarette uptake among college students. A national study of 12th graders concluded that students who were regular smokers, or under the influence of marijuana or alcohol, performed significantly lower on standardized tests relative to their peers (Jeynes, 2002). Some tobacco users perceive e-cigarettes as a cessation tool, but many e-cigarette users continue to smoke tobacco (Anand et al., 2015).

Opioids. The study of opioid's effects on the college population is a relatively new phenomenon; however, the consequences can be catastrophic. In their study on university student perceptions about the motives for and consequences of nonmedical use of prescription drugs (NMPOs), Parks et al. (2017) uncovered that students reported physical difficulty recovering from using opioids. They described being extremely tired and emotionally drained and found it harder to regain energy. They also indicated that these drugs were highly addictive and expensive. Several participants told stories of friends or acquaintances that had become addicted and their lives had been ruined. Most participants indicated that they only used these drugs occasionally, when someone had a few available, and were "careful" not to use them regularly. Although not directly related to academic performance, Hoyer and Correia (2019) found that students who misused sedatives were at higher risk of depression than individuals who did not use sedatives or who used sedatives with a valid prescription (Goodwin & Hasin, 2002). Martins et al. (2012) conducted a longitudinal study and found that lifetime nonmedical use of prescription opioids predicted a variety of psychological disorders including major depressive disorder, bipolar disorder, general anxiety disorder, social anxiety disorder, and panic disorder.

These findings suggest that misuse of prescription opioids puts individuals at increased risk of not only overdose and death but also serious mental disorders that are linked to lower quality of life, decreased lifetime success, and suicidal ideation (Furr et al., 2001).

***Obesity*.** Burkhalter and Hill (2011) studied the literature that examined the relationship between energy consumption, storage, and expenditure to cognition and academic achievement and noted that excess body mass is correlated with poorer academic achievement during development due to greater decay of brain structure and function that lasts through adulthood. The researchers also concluded that under- and overconsumption of energy has been linked to deficits in academic achievement and to excess body mass in school age children. Their research established a negative relationship between obesity and learning (Burkhalter & Hill, 2011).

Deliens et al. (2013) measured differences in sociodemographic and health behaviors to identify weight and health behavior related correlates of academic performance in those students who attended course exams. Their results showed lower secondary school grades, higher body mass index (BMI), eating out frequently, and being male predicted lower first year GPAs.

Martin et al. (2018) evaluated lifestyle interventions aimed at improving cognitive function and academic achievement in children and adolescents who are overweight or obese. Overall findings suggested that physical activity interventions did improve cognitive function scores in overweight and obese children and adolescents.

Chapter summary. Health and education are distinctly related. Healthy habits promote a longer lifespan and greater achievement in life (Raspberry et al., 2017). College students represent a significant portion of our emerging adult population. Unhealthy life habits developed in college could have profound negative effects and could ultimately decrease life expectancy for

an entire generation (Mann, 2005; Preston et al., 2018). Though maintaining a healthy weight, eating well, exercising regularly, and avoiding substances may not be easy; the potential benefits are significant, such as living a longer more high-quality life.

Chapter 3. Research Method

Researchers suggest that health-promoting behaviors are associated with greater academic outcomes; however, there is limited empirical evidence on these relationships in college students (Pokhrel et al., 2014). The purpose of this correlational study was to investigate the relationship between academic achievement and health in a national sample of college students using quantitative data analysis. This study analyzed three positive health behaviors (physical activity, strength training, and fruit and vegetable consumption), and three negative health behaviors (cigarette, e-cigarette, and opioid use) and self-reported grade point average (GPA). The relationship between obesity and GPA was also explored. Data were collected from the ACHA-NCHA II, administered between 2015 and 2019 at 650 colleges in the U.S. This chapter consists of a description of the study, research questions, instrumentation, sample, data collection methods, data analysis, and a chapter summary.

Research Questions

The study was designed to investigate the following research questions:

Research Question 1: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the guidelines?

$H_0$1: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the national guidelines.

Research Question 2: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the guidelines?

$H_0$2: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the guidelines.

Research Question 3: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for vigorous physical activity (at least 20 minutes of vigorous physical activity on 3 or more days of the last week) and students who exercise less than the guidelines?

$H_0$3: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines for for vigorous physical activity (at least 20 minutes of vigorous physical activity on 3 or more days of the last week) and students who exercise less than the guidelines.

Research Question 4: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet guidelines from the U.S. Department of Health and Human Services for strength training (performing 8-10 strength-

training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the guidelines?

$H_0$4: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet guidelines from the U.S. Department of Health and Human Services for strength training (performing 8-10 strength-training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the guidelines.

Research Question 5: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who are obese (BMI greater than 30) and those who are not?

$H_0$5: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who are obese (BMI greater than 30) and those who are not.

Research Question 6: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used cigarettes in the last 30 days and those who did not?

$H_0$6: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used cigarettes in the last 30 days and those who did not.

Research Question 7: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used e-cigarettes in the last 30 days and those who did not?

$H_0$7: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used e-cigarettes in the last 30 days and those who did not.

Research Question 8: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used opioids in the last 30 days and those who did not?

$H_0$8: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used opioids in the last 30 days and those who did not.

Research Question 9: Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used non-medical prescription painkillers not prescribed to them in the last 12 months and those who did not?

$H_0$9: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used non-medical prescription painkillers not prescribed to them in the last 12 months and those who did not.

Instrumentation

Developed by an interdisciplinary team of college health professionals, the ACHA-NCHA was pilot tested in 1998-1999 and systematically evaluated with reliability and validity analyses comparing common survey items with national studies such as the National College Health Risk Behavior Survey (CDC). Reliability and validity analysis included comparing relevant percentages with nationally representative databases, performing item reliability analyses comparing overlapping items with a nationally representative database, conducting

construct validity analyses comparing ACHA-NCHA results with a nationally representative database, and conducting measurement validity comparing results of the ACHA-NCHA with a nationally representative database.

The data sets used for evaluation of reliability and validity were:

- National College Health Risk Behavior Survey CDC 1995
- Harvard School of Public Health 1999 College Alcohol Study (CAS)
- United States Department of Justice: The National College Women Sexual Victimization Study 2000 (NCWSV)
- ACHA-National College Health Assessment 1998, Spring 1999 and Fall 1999 Pilots, ACHA-NCHA Spring 2000

The above series of comparisons and statistical analyses used triangulation with information from various independent resources to demonstrate the reliability and validity of the ACHA-NCHA, and its ability to represent the population of students (American College Health Association, 2013). The analyses used different national databases, covered different approaches, and utilized different statistical procedures to accomplish the evaluation.

The ACHA reference group data were subjected to additional analyses including Principal Components Factor Analysis and Reliability Analyses using SPSS, version 25. The purpose of the Principal Components Analysis was to determine groups of items that are related and to provide a structure to conduct Reliability Analysis.

The first Principal Components Analysis was conducted with the Alcohol, Tobacco and Drugs section. The first component of interest to this research was named “Infrequently Used Drugs” which included opioids, and the second component was labeled “Moderately Used Drugs” (which included cigarettes). The first component had an Eigenvalue of 6.40 accounted

for 37.66% of the variance; the second component had an Eigenvalue of 2.13 and accounted for 12.52% of the variance. The Reliability Analysis resulted in an average inter-item correlation of .41 for the first component, .33 for the second component and .30 for the third component. For "Rarely Used Drugs," the Standardized Alpha was .89 for spring 2009 and .91 for spring 2010. For "Moderately Used Drugs," the Standardized Alpha was .74 for spring 2009 and .74 for spring 2010.

The next Principal Components Analysis was conducted with Taking prescription drugs not prescribed. The component was named "Taken un-prescribed drugs" and included opioid painkillers. The component had an Eigenvalue of 2.38 and accounted for 47.5% of the variance. The Reliability Analysis resulted in an average inter-item correlation of .34. The Standardized Alpha was .72 for both spring 2009 and spring 2010.

Principal Component Analyses was not conducted with the Exercise Guidelines, as there were only four variables. The average inter-item correlation was .60 for spring 2009 and .61 for spring 2010. The Standardized Alpha was .86 for spring 2009 and .86 for spring 2010.

Reliability analyses demonstrated moderate to strong results in the evaluation of grouped or scaled items. Repeated reliability analyses demonstrated strong consistency over the two survey periods. Although there are no strict rules as to what is considered an acceptable Standardized Alphas, over .8 is generally considered strong (American College Health Association, 2013). Regarding the average inter-item correlation, coefficients of .4 or larger show that there are fairly strong relationships between the group of items and that the group of items could be used in hypotheses testing.

The primary purpose of the analyses was to demonstrate how reliable various survey items of the ACHA-NCHA II are and to provide confirmation that individual researchers using

the ACHA NCHA II will obtain similar results when using the instrument surveying students at their individual colleges/universities. Overall testing results showed the ACHA-NCHA appears to be both reliable and valid and of empirical value for representing the nation's students (American College Health Association, 2013).

The following variable categories were included for analysis in this study: (1) sociodemographics, (2) negative health related variables, (3) positive health related variables, and (4) grade average. Sociodemographic variables included race/ethnicity, sex, and gender. Negative health related variables included cigarette, e-cigarette, opioid use, and obesity. Positive health related variables included fruit and vegetable consumption, moderate and vigorous physical activity, and strength training. Grade point average included self-reported GPA.

Fruit and vegetable consumption were measured with one question: “How many servings of fruits and vegetables do you usually have per day (1 medium piece of fruit; ½ cup fresh, frozen, or canned fruits/vegetables; ¾ cup fruit/vegetable juice; 1 cup salad greens; or ¼ cup dried fruit)?” Responses were reported on a scale as “I don't eat any” to “5 or more.” Participants who reported five or more servings per day were classified as meeting the U.S. dietary guidelines (USDHHS, 2015).

Physical activity was measured with three questions. The first asked about moderate physical activity participation: "On how many of the past 7 days did you do moderate-intensity cardio or aerobic exercise (caused a noticeable increase in heart rate such as a brisk walk) for at least 30 minutes?" The second asked about vigorous physical activity: "On how many of the past 7 days did you do vigorous-intensity exercise (caused large increases in breathing or heart rate such as jogging) for at least 20 minutes?" The third question asked about strength training: "On how many days of the past 7 days did you do 8-10 strength training exercises (such as resistance

weight machines) for 8-12 repetitions each?" Responses were continuous and ranged from 0 to 7 days. Students who reported participation in moderate exercise for at least 30 min on 5 or more of the last 7 days were classified as meeting the moderate physical activity guidelines; those who reported participation in vigorous exercise for at least 20 min on 3 more of the past 7 days were classified as meeting vigorous activity guidelines; and those who reported doing 8-10 strength training exercises, such as using resistance weight machines, for 8-12 repetitions each on 2 or more of the past 7 days were classified as meeting strength training guidelines.

Obesity was calculated by using Body Mass Index (BMI). The calculation for BMI uses height and weight, which was captured in three questions: “What is your height in feet,” “and inches” and “What is your weight in pounds?” Body Mass Index was calculated by dividing weight in kilograms by height in meters squared. Converting from English measurements, pounds were divided by inches squared and then be multiplied by 703 to convert from lbs. /inches^2 to kg/m^2. Students who registered a BMI as 30 or above were categorized as obese.

Cigarette usage was measured with one question: “Within the last 30 days, on how many days did you use cigarettes?” Responses were continuous, ranged from 0 to 7 days, and were reported on a scale as “never used” to “used daily. Students who reported any cigarette use in the last 30 days were categorized as having used cigarettes.

E-cigarette usage was measured with one question: “Within the last 30 days, on how many days did you use e-cigarettes?” Responses were continuous, ranged from 0 to 7 days, and were reported on a scale as “never used” to “used daily. Students who reported any e-cigarette use in the last 30 days were categorized as having used e-cigarettes.

Opioid use was measured with one question: “Within the last 30 days, on how many days did you use opiates?” Responses were reported on a scale as “never used” to any usage

(including “have used, but not in last 30 days”). Students who reported any opioid use in the last 30 days were categorized as having used opioids.

NMPO use was measured with one question: “In the last 12 months, have you taken any of the following prescriptions drugs that were not prescribed to you?” Responses were reported as “No” or “Yes.” Only responses to “Painkillers (e.g., OxyContin, Vicodin, and Codeine)” were included.

Academic performance was measured with a single question on approximate cumulative GPA: "What is your approximate cumulative grade point average?" Responses were letter grades (i.e., A, B, C, D/F, or N/A) and were coded in the data set as 4-1, respectively. Participants who responded N/A were not included in further analyses that used this variable. Research has shown that GPA obtained from university records correlates very highly with self-reported GPA (r = .89) (Gray & Watson, 2002; Noftle & Robins, 2007).

Sample

The sample for this study consisted of 426,425 undergraduate college students enrolled in 650 colleges in the United States that participated in the ACHA-NCHA-II survey during the eight semesters between fall 2015 and spring 2019. Three hundred and ninety-six colleges were public, 254 were private, 40 were two-year and 610 were four-year or above. The campuses were scattered across the United States with 132 in the Northeast (CT, ME, MA, NH, NJ, NY, PA, RI, VT), 132 in the Midwest (IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SK, WI), 175 in the South (AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV), and 211 in the West (AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, WY). The campus size varied as well. One hundred fifty-one had less than 2,500 students, 56 had between 2,500 - 4,999

students, 109 had 5,000 - 9,999 students, 122 had 10,000- 19,999, and 175 had more than 20,000 students. The campus settings also varied. One hundred sixteen were located in a very large city (population over 500,000), 64 were in a large city (population 250,000 - 499,999), 232 were in a small city (population 50,000 - 249,999), 163 were in a large town (population 10,000 - 49,999), 56 were in a small town (population 2,500 - 9,999), and 19 were in a rural community (population under 2,500). The Carnegie classification for the participating colleges were as follows: 39 were Associates Colleges, 121 were Baccalaureate Colleges, 27 were Baccalaureate/Associates College, 195 were Master's Colleges and Universities, 259 were Doctoral Universities, 9 were Special Focus Institutions, and zero were Miscellaneous/ Not Classified. In the sample, 537 colleges had no religious affiliation, and 113 did have a religious affiliation. Of those, 58 were catholic, and 55 were protestant or other Christian. The majority of the participating institutions administered the survey instrument via the Web (625 institutions and 111,319 students), and 26 institutions (3,040) administered a paper survey. The mean response was 19% and the median response was 14%. Gender categories were female, male, or transgender. Race/ethnicity categories were white; black; Hispanic or Latino/a; Asian or Pacific Islander; American Indian, Alaskan Native, or Native Hawaiian; Biracial or Multiracial; and other.

Data Collection

The researcher formally requested specific data relating to the research questions from the ACHA. After approval from the ACHA, the researcher received the requested data via an SPSS file from the American College Health Association (Appendix A). The opinions, findings, and conclusions presented/reported in this article/presentation are those of the author(s), and are

in no way meant to represent the corporate opinions, views, or policies of the American College Health Association (ACHA). ACHA does not warrant nor assume any liability or responsibility for the accuracy, completeness, or usefulness of any information presented in this article/presentation.

Six hundred and fifty postsecondary institutions self-selected to participate in the ACHA National College Health Assessment between 2105 and 2019, and 426,425 surveys were completed by students on these campuses. All students who participated signed a consent form, and each participating institution obtained institutional review board approval. The data file was emailed to the researcher from the American College Health Association for the parameters described.

The ACHA-NCHA is a nationally recognized research survey that provides precise data about students' health habits, behaviors, and perceptions. Before analyzing and reporting the data, the researcher received approval from the East Tennessee State University Institutional Review Board.

Data Analysis

The following statistical analyses were performed to address the research questions using version 25 of IBM-SPSS software. The .05 level of significance was used for statistical analyses. Descriptive statistics were reported for all variables and include frequencies and percentages for categorical variables. Means, standard deviations, variance, and ranges were calculated for continuous variables. BMI was computed based on self-reported weight and height in the data file, according to the following formula: weight in kilograms/ (height in meters)^2.

The researcher used a series of chi square tests to compare the following:

1. Letter grades of students who met the U.S. Department of Health and Human Services guidelines for fruit and vegetable consumption with those who did not (Research Question 1).
2. Letter grades of college students who meet the U.S. Department of Health and Human Services guidelines for moderate physical activity, vigorous physical activity, and strength training with those who did not (Research Questions 2, 3, and 4).
3. Letter grades of college students who are obese (BMI greater than 30) with those who are not (Research Question 5).
4. Letter grades of college students who use cigarettes, e-cigarettes, opioids, and NMPOs with those who did not (Research Questions 6, 7, 8 and 9).

Chapter Summary

This study was performed using a non-experimental quantitative correlational design to investigate the relationship between academic achievement and health in a national sample of college students using quantitative data analysis. Specifically, the researcher evaluated the relationship between three health-promoting behaviors (physical activity, strength training, and fruit and vegetable consumption), three negative health behaviors (cigarette, e-cigarette, and opioid use) with GPA. The association between obesity and GPA was also examined. Chapter 3 described the research design and methodology for conducting this study. Chapter 4 includes a description of the findings from the data analysis. Chapter 5 provides a summary of the findings, final conclusions, and recommendations for practice.

Chapter 4. Results

The researcher examined the relationship between certain positive and negative health behaviors with grade average in a national sample of college students in the United States. Data was collected by American College Health Association (ACHA) survey administered between fall 2015 and spring 2019. Six hundred fifty postsecondary institutions self-selected to participate in the ACHA National College Health Assessment, and 426,425 surveys were completed by students on these campuses.

Characteristics of the sample included 68% (N = 288,525) female and 32% (N = 132,505) male. The mean age was 23 (N = 417,950). Sixty-six percent (N = 280,179) of the sample were Caucasian, 15% (N = 62,477) were Asian/ Pacific Islander, 14% (N = 61,150) were Hispanic/Latino(a), six percent (N = 24,246) were Black, five percent (N = 19,663) were Biracial or Multiracial, two percent were American Indian, Alaskan Native, or Native Hawaiian (N = 8,103), and three percent (N = 11,376) were other as shown in Table 1.

Table 1.

Sociodemographic and BMI Characteristics of Respondents (N = 421,030)

Characteristic	N	%
Gender		
Female	288,525	68
Male	132,505	32
Race		
White, non-Hispanic	280,178	66
Black, non-Hispanic	24,246	6
Asian or Pacific Islander	61,150	14
Hispanic or Latina	24,246	6
American Indian, Alaskan, or Native Hawaiian	8,103	2
Biracial or Multiracial	19,663	5
Other	11,376	3
Body mass index category		
Underweight (<18.5)	19,470	5.0
Desired (18.5-24.9)	239,774	57.9
Overweight (25.0-29.9)	95,282	22.3
Class 1 obesity (30.0-34.9)	35,877	8.0
Class 2 obesity (35.0-39.9)	14,149	3.0
Class 3 obesity (>40.0)	9,773	2.0

The median grade average was B (1.71, SD =.831). Forty-four percent reported an A (N = 191,388), 42% reported a B (N = 179,991), 9% reported a C (N = 36,870), and less than one percent (0.5%, N = 2,330) reported D/F as shown in Table 2.

Table 2.

Grade Average Frequencies (N = 420,271)

Grade Average	N	%
A	191,388	44.9
B	179,991	42.8
C	36,870	8.6
D/F	9,692	2.3

The majority (61%, N = 259,710) of respondents reported eating 1-2 servings of fruits and vegetables per day, 25% percent (N = 108,449) reported eating 3-4 servings per day, eight percent (N = 33,972) reported eating zero servings per day, and five percent (N = 20,481) reported eating five or more servings per day. The majority of the sample (22%, N = 173,766) reported zero days of moderate-intensity cardio, 41% (N = 173,766) reported zero days of vigorous-intensity cardio, and 50% (N = 214,872) reported zero days of strength training in the past seven days.

Table 3.

Moderate and Vigorous Intensity Cardio and Strength Training of Past 7 Days (N = 426,425)

Days	Moderate- Intensity		Vigorous- Intensity		Strength Training	
	N	%	*N*	%	*N*	%
0 days	93,233	21.9	173,766	40.7	214,872	50.4
1 day	59,279	13.9	70,204	16.5	50,157	11.8
2 days	73,651	17.3	59,840	14.0	48,615	11.4
3 days	68,029	16.0	46,688	10.9	43,305	10.2
4 days	40,522	9.5	25,609	6.0	24,634	5.8
5 days	42,214	9.9	22,633	5.3	21,277	5.0
6 days	19,351	4.5	12,993	3.0	10,157	2.4
7 days	24,165	5.7	8,087	1.9	6,517	1.5

Table 2 shows the frequencies of moderate and vigorous intensity cardio exercise, and strength training for study participants. Exercise frequency decreased as the days increased. The same was true for fruit and vegetable consumption.

The majority (57.9%, N = 239,774) of the sample were classified as desired weight (BMI between 18.5 and 24.9). Less than one third (22.3%, N = 95,282) were classified as overweight (BMI 25-29.9) and eight percent (N = 35,877) were classified as Class I obese (BMI 30- 34.9). Five percent (N = 19,470) were classified as underweight (BMI < 18.5) and three percent (N = 14,149) were classified as Class II obese (35-39.9). Two percent (N = 9,773) were classified as Class III obese with a BMI greater than 40 (Table 1).

Most of the sample had never used cigarettes (77.4%, N = 330,100), or e-cigarettes (81.4%, N = 343,303). Less than 25% had used cigarettes (13.4%, N = 57,113) and e-cigarettes (10.2%, N = 43,483) in the past but not in the last 30 days. Cigarette and e-cigarette use continued to decline as the days increased with the exception of daily use. More students used cigarettes (1.8%, N = 7,809) and e-cigarettes (1.8%, N = 7,845) daily than the categories of 3-5 days, 6-9 days 10-19 days or 20-29 days. Table 4 displays the frequencies of cigarette and e-cigarette use in the sample.

The majority of the sample (97.4%, N = 415,545) had never used opioids, and only one percent (N = 5,538) had ever used opioids, but not in the last 30 days. Similarly, the majority of the sample had not used opioids in the last 12 months (94.5%, N = 403,017). Table 3 shows the frequencies of opioid use in the last 30 days.

Table 4.

Cigarette, E-cigarette, and Opioid Use of Past 7 Days (N = 426,425)

Days	Cigarettes		E-cigarettes		Opioid	
	N	%	*N*	%	*N*	%
Never used	330,100	77.4	343,303	81.4	415,545	97.4
Have used, but not in the last 30 days	57,113	13.4	43,483	10.2	5,538	1.3
1-2 days	14,195	3.3	10,820	2.5	481	.1
3-5 days	5,321	1.2	4,272	1.0	307	.1
6-9 days	3,211	.8	2,905	.7	203	.0
10-19 days	3,221	.8	3,150	.7	135	.0
20-29 days	1,932	.5	1,973	1.8	71	.0
Used daily	7,809	1.8	7,845	1.8	230	.1

Research Question 1

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the guidelines?

$H_0$1: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the national guidelines.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on meeting the servings guidelines for fruit and vegetables. The two variables were final course grade (A, B, C, or D/F) and meeting the guidelines (Yes or No). Student success and meeting the guidelines were found to be significantly different, Pearson χ^2 (3, N = 409802) = 2138.96, p < .001. Cramer's V = .07. Therefore, the null hypothesis was rejected. Students meeting the HHS guidelines for consumption of fruits and vegetables tended to have higher GPAs than students who did not meet the guidelines. Table 5 indicates the percentage of students earning each final course letter grade by those meeting the guidelines (Yes) and those not meeting the guidelines (No). Figure 1 shows the count of the number of students earning each final course letter grade by guideline success.

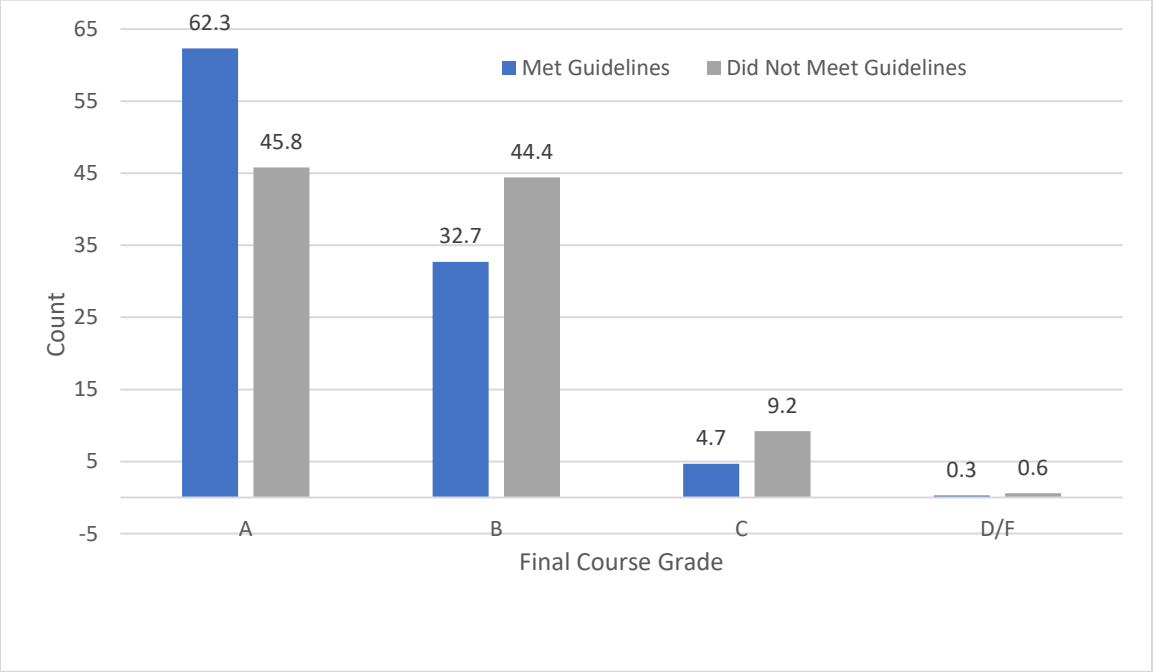
Table 5

Percentage of Students Earning Each Final Course Letter Grade by Meeting Fruit and Vegetables Guidelines

Met Guideline	Total				
	A	B	C	D/F	
Yes	62.3	32.7	4.7	0.3	100.0
No	45.8	44.4	9.2	0.6	100.0

Figure 1.

Percentage of Students Earning Each Final Course Letter Grade by Meeting Fruit and Vegetables Guidelines



Research Question 2

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the guidelines?

$H_0$2: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the guidelines.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on meeting the guidelines for moderate physical activity. The two variables were final course grade (A, B, C, or D/F) and meeting the guidelines (Yes or No). Student success and meeting the guidelines were found to be significantly different, Pearson χ^2 (3, N = 407960) = 320.89, $p < .001$. Cramer's $V = .03$. Therefore, the null hypothesis was rejected. Students meeting the HHS guidelines for moderate physical activity tended to have higher GPAs than students who did not meet the guidelines. Table 6 indicates the percentage of students earning each final course letter grade by those meeting the guidelines (Yes) and those not meeting the guidelines (No). Figure 2 shows the count of the number of students earning each final course letter grade by guideline success.

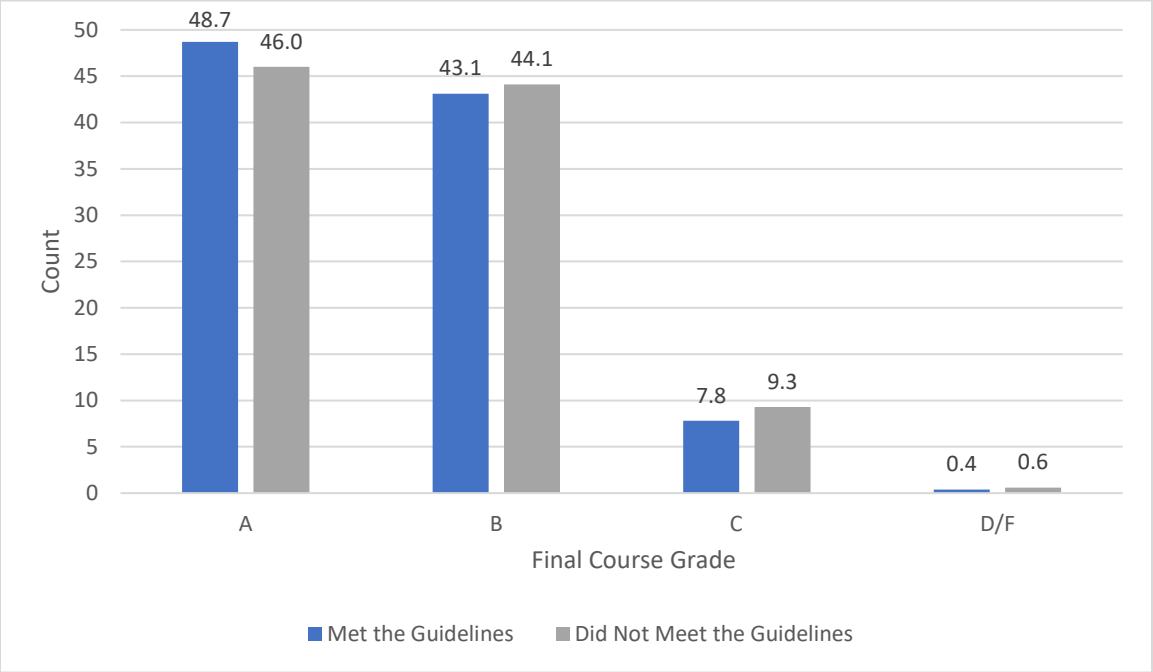
Table 6.

Percentage of Students Earning Each Final Course Letter Grade by Meeting Moderate Exercise Guidelines

Met Guideline	Total				
	A	B	C	D/F	
Yes	48.7	43.1	7.8	0.6	100.0
No	46.0	44.1	9.3	0.4	100.0

Figure 2.

Percentage of Students Earning Each Final Course Letter Grade by Moderate Exercise Guidelines



Research Question 3

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for vigorous physical activity (at least 20 minutes of vigorous physical activity on 3 or more days of the last week) and students who exercise less than the guidelines?

$H_0$3: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines for vigorous physical activity (at least 20 minutes of vigorous physical activity on 3 or more days of the last week) and students who exercise less than the guidelines.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on meeting the guidelines for vigorous physical activity. The two variables were final course grade (A, B, C, or D/F) and meeting the guidelines (Yes or No). Student success and meeting the guidelines were found to be significantly different, Pearson χ^2 (3, N = 407367) = 412.76, $p < .001$. Cramer's $V = .03$. Therefore, the null hypothesis was rejected. Students meeting the HHS guidelines for vigorous physical activity tended to have higher GPAs than students who did not meet the guidelines. Table 7 indicates the percentage of students earning each final course letter grade by those meeting the guidelines (Yes) and those not meeting the guidelines (No). Figure 3 shows the count of the number of students earning each final course letter grade by guideline success.

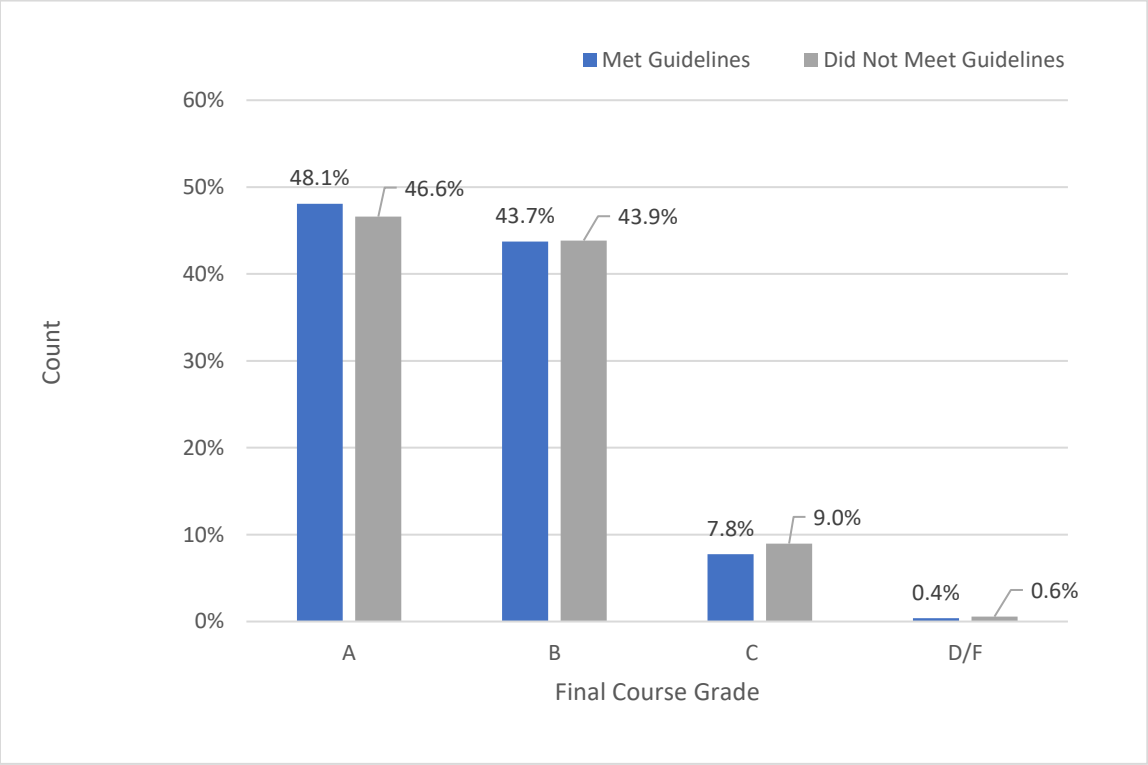
Table 7.

Percentage of Students Earning Each Final Course Letter Grade by Meeting Vigorous Exercise Guidelines

Met Guideline	Total				
	A	B	C	D/F	
Yes	48.1	43.7	7.8	0.4	100.0
No	46.6	43.9	9.0	0.6	100.0

Figure 3.

Percentage of Students Earning Each Final Course Letter Grade by Vigorous Exercise Guidelines



Research Question 4

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the guidelines from the U.S. Department of Health and Human Services for strength training (performing 8-10 strength training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the national guidelines?

$H_0$4: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who meet the U.S. Department of Health and Human Services guidelines for strength training (performing 8-10 strength training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the guidelines.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on meeting the guidelines for strength training. The two variables were final course grade (A, B, C, or D/F) and meeting the guidelines (Yes or No). Student success and meeting the guidelines were found to be significantly different, Pearson χ^2 (3, N = 406904) = 412.76, $p < .001$. Cramer's $V = .03$. Therefore, the null hypothesis was rejected. Students meeting the HHS guidelines for strength training tended to have higher GPAs than students who did not meet the guidelines Table 8 indicates the percentage of students earning each final course letter grade by those meeting the guidelines (Yes) and those not meeting the guidelines (No). Figure 4 shows the count of the number of students earning each final course letter grade by guideline success.

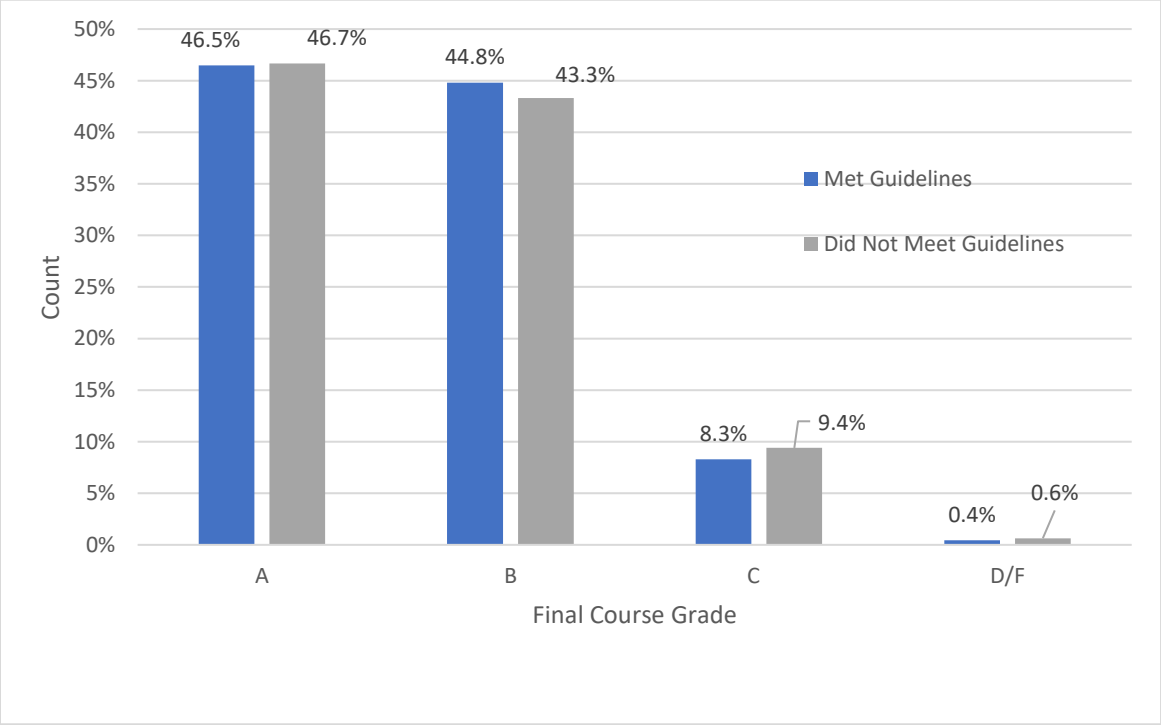
Table 8.

Percentage of Students Earning Each Final Course Letter Grade by Meeting Strength Training Guidelines

Met Guideline	Total				
	A	B	C	D/F	
Yes	46.5	44.8	8.3	.04	100.0
No	46.7	43.3	9.4	0.6	100.0

Figure 4.

Percentage of Students Earning Each Final Course Letter Grade by Strength Training Guidelines



Research Question 5

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who are obese (BMI greater than 30) and those who are not?

$H_0$5: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who are obese (BMI greater than 30) and those who are not.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on obesity. The two variables were final course grade (A, B, C, or D/F) and being obese (having a BMI greater than 30). Student success and obesity were found to be significantly different, Pearson χ^2 (3, N = 424444) = 7007.15, p < .001. Cramer's V = .13. Therefore, the null hypothesis was rejected. Students who were not obese tended to have higher GPAs than students who were not obese. Table 9 indicates the percentage of students earning each final course letter grade by those who are obese (Yes) and those who are not obese (No). Figure 5 shows the count of the number of students earning each final course letter grade by obesity status.

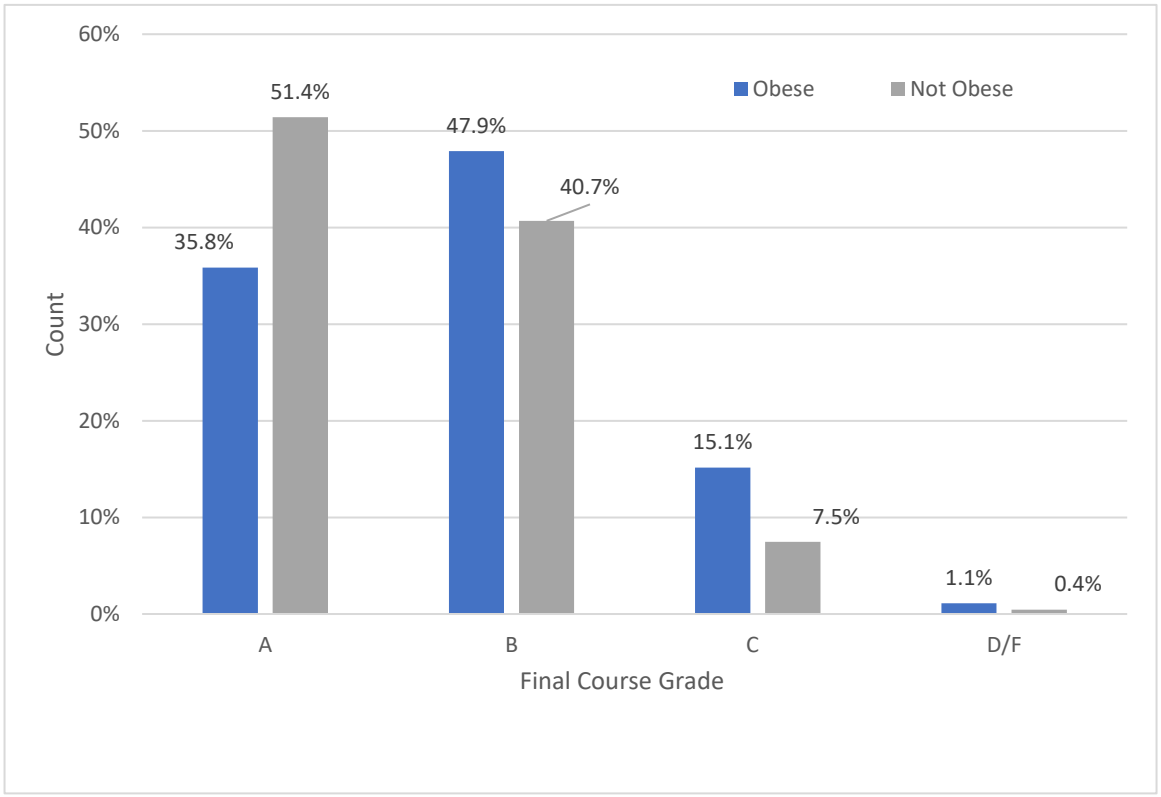
Table 9.

Percentage of Students Earning Each Final Course Letter Grade by Obesity Status

Obese	Total				
	A	B	C	D/F	
Yes	35.8	47.9	15.1	1.1	100.0
No	51.4	40.7	7.5	0.4	100.0

Figure 5.

Percentage of Students Earning Each Final Course Letter Grade by Obesity Status



Research Question 6

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used cigarettes in the last 30 days and those who did not?

$H_0$6: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used cigarettes in the last 30 days and those who did not.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on cigarette usage in the last 30 days. The two variables were final course grade (A, B, C, or D/F) and using cigarettes in the last 30 days. Student success and cigarette usage were found to be significantly different, Pearson χ^2 (3, N = 408968) = 1605.48, $p < .001$. Cramer's $V = .06$. Therefore, the null hypothesis was rejected. Students who did not use cigarettes in the last 30 days tended to have higher GPAs than students who did. Table 10 indicates the percentage of students earning each final course letter grade by those who used cigarettes in the last 30 days (Yes) and those who did not (No). Figure 6 shows the count of the number of students earning each final course letter grade by cigarette usage.

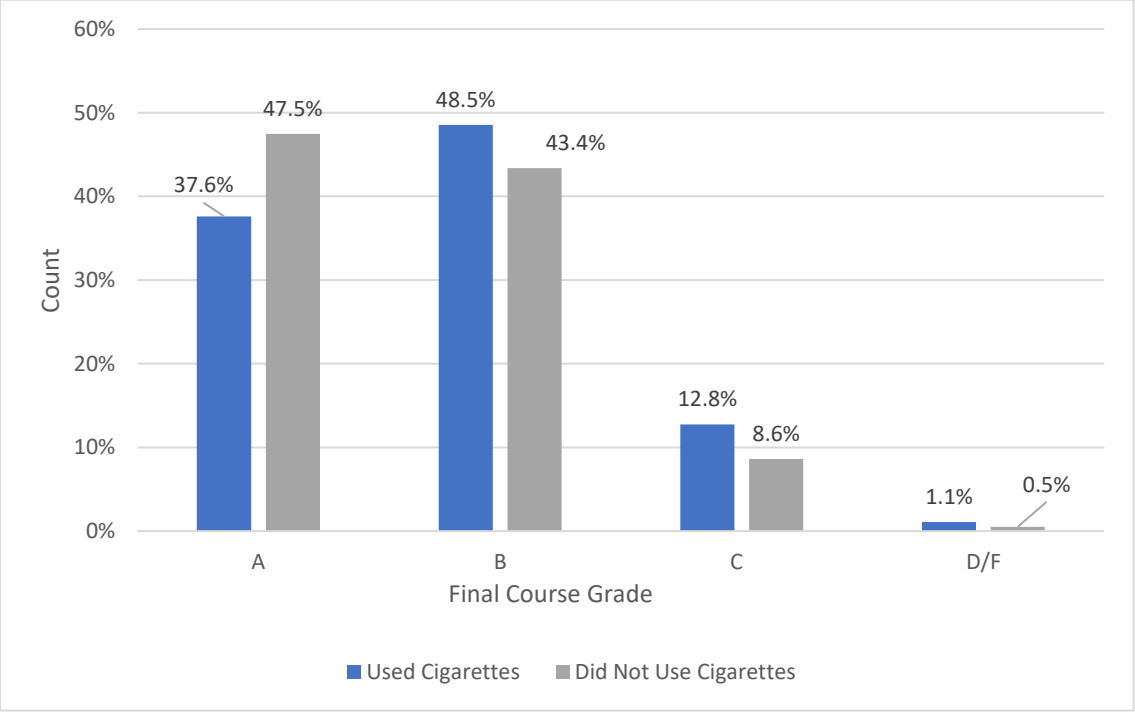
Table 10.

Percentage of Students Earning Each Final Course Letter Grade by Cigarette Usage in the Last 30 Days

Used Cigarettes	Total				
	A	B	C	D/F	
Yes	37.7	48.5	12.8	1.1	100.0
No	47.5	43.4	8.6	0.5	100.0

Figure 6.

Percentage of Students Earning Each Final Course Letter Grade by Cigarette Usage in the Last 30 Days



Research Question 7

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used e-cigarettes in the last 30 days and those who did not?

$H_0$7: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used e-cigarettes in the last 30 days and those who did not.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on e-cigarette usage in the last 30 days. The two variables were final course grade (A, B, C, or D/F) and e-cigarette usage in the last 30 days. Student success and e-cigarette usage were found to be significantly different, Pearson χ^2 (3, N = 408928) = 1622.57, $p < .001$. Cramer's $V = .06$. Therefore, the null hypothesis was rejected. Students who did not use e-cigarettes in the last 30 days tended to have higher GPAs than students who did not. Table 11 indicates the percentage of students earning each final course letter grade by those who used e-cigarettes in the last 30 days (Yes) and those who did not (No). Figure 7 shows the count of the number of students earning each final course letter grade by e-cigarette usage.

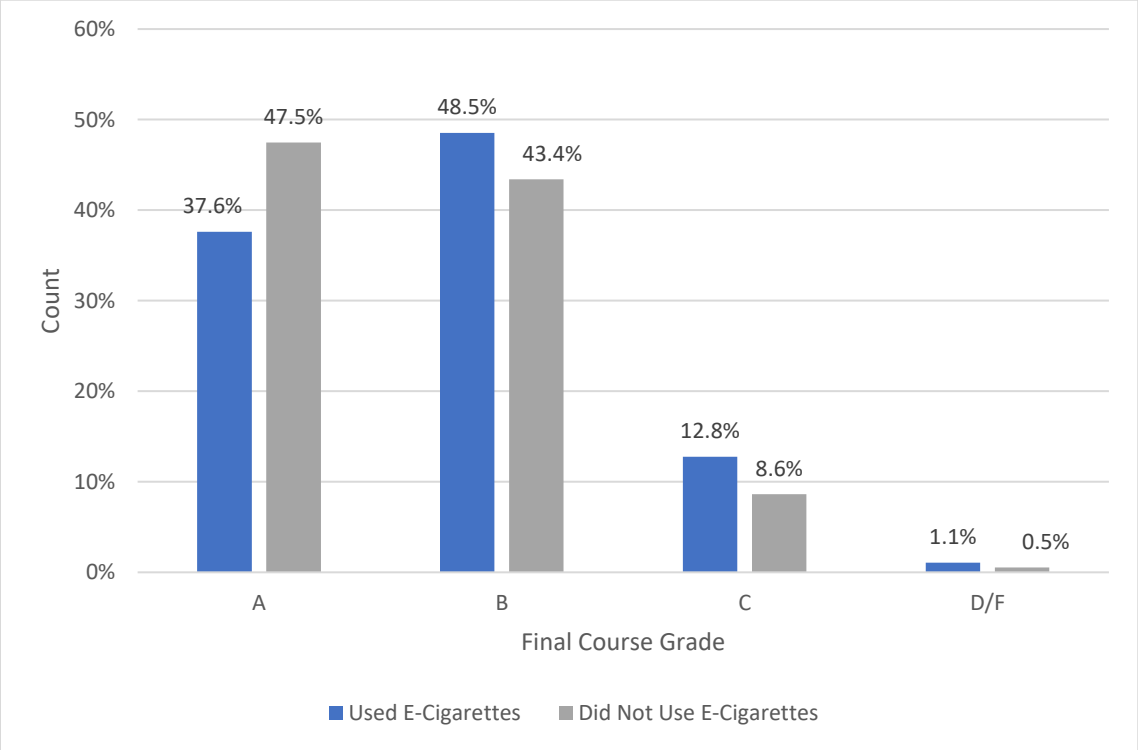
Table 11.

Percentage of Students Earning Each Final Course Letter Grade by E-cigarette Usage in the Last 30 Days

Used E-cigarettes	Total				
	A	B	C	D/F	
Yes	37.6	48.5	12.8	1.1	100.0
No	47.5	43.4	8.6	0.5	100.0

Figure 7.

Percentage of Students Earning Each Final Course Letter Grade by E-cigarette Usage in the Last 30 Days



Research Question 8

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used opioids in the last 30 days and those who did not?

$H_0$8: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used opioids in the last 30 days and those who did not.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending on opioid usage in the last 30 days. The two variables were final course grade (A, B, C, or D/F) and opioid usage in the last 30 days. Student success and opioid usage were found to be significantly different, Pearson χ^2 (3, N = 408612) = 365.37, $p < .001$. Cramer's $V = .03$. Therefore, the null hypothesis was rejected. Students who did not use opioids in the last 30 days tended to have higher GPAs than students who did not. Table 12 indicates the percentage of students earning each final course letter grade by those who used opioids in the last 30 days (Yes) and those who did not (No). Figure 8 shows the count of the number of students earning each final course letter grade by opioid usage.

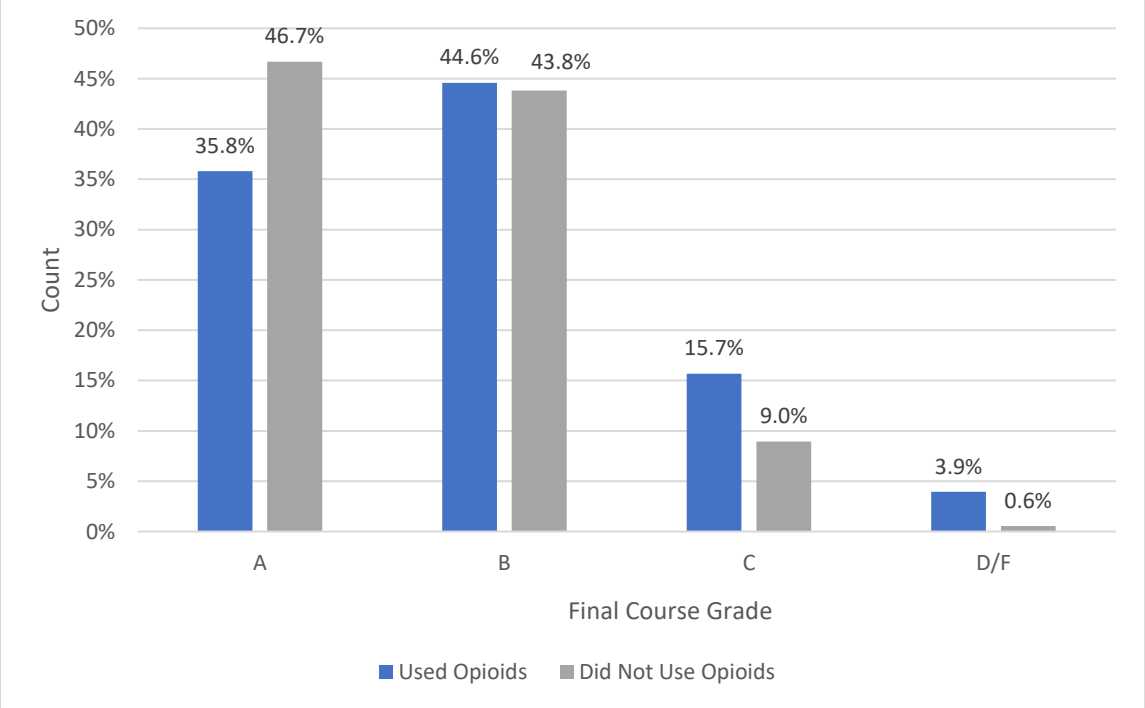
Table 12.

Percentage of Students Earning Each Final Course Letter Grade by Opioid Usage in the Last 30 Days

Used Opioids	Total				
	A	B	C	D/F	
Yes	35.8	44.6	15.7	3.9	100.0
No	46.7	43.8	9.0	0.6	100.0

Figure 8.

Percentage of Students Earning Each Final Course Letter Grade by Opioid Usage in the Last 30 Days



Research Question 9

Is there a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used non-medical prescription painkillers not prescribed to them (NMPO) in the last 12 months and those who did not?

$H_0$9: There is not a significant difference in the proportion of students that earn a letter grade of "A," "B," "C," or "D/F" by students who used non-medical prescription painkillers not prescribed to them in the last 12 months and those who did not.

A two-way contingency table analysis was conducted to evaluate whether student success, as measured by the proportion of students making a letter grade of "A," "B," "C," "D/F," on final course grades, varied depending onNMPO usage in the last 12 months. The two variables were final course grade (A, B, C, or D/F) and NMPOs in the last 12 months. Student success and NMPO usage were found to be significantly different, Pearson χ^2 (3, N = 409151) = 1581.25, $p < .001$. Cramer's $V = .06$. Therefore, the null hypothesis was rejected. Students who did not use NMPOs in the last 30 days tended to have higher GPAs than students who did not. Table 13 indicates the percentage of students earning each final course letter grade by those who used NMPOs in the last 12 months (Yes) and those who did not (No). Figure 9 shows the count of the number of students earning each final course letter grade by NMPO usage.

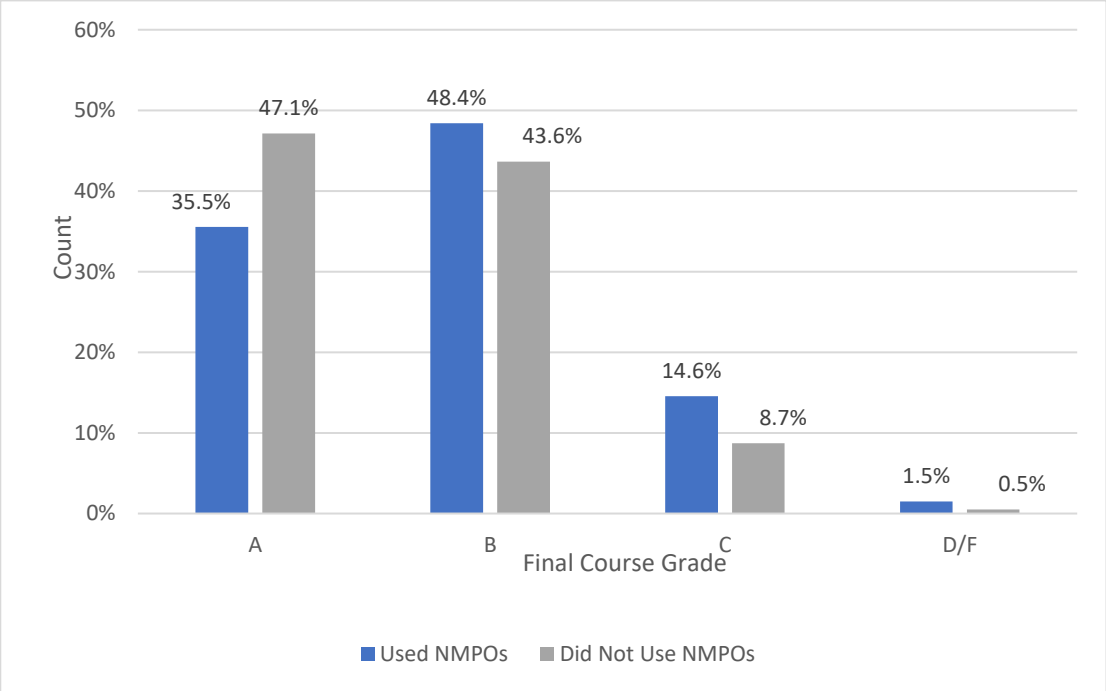
Table 13.

Percentage of Students Earning Each Final Course Letter Grade by NMPO Usage in the Last 12 Months

Used NMPOs	Total				
	A	B	C	D/F	
Yes	35.5	48.4	14.6	1.5	100.0
No	47.1	43.6	8.7	0.5	100.0

Figure 9.

Percentage of Students Earning Each Final Course Letter Grade by NMPO Usage in the last 12 Months



Chapter 5. Summary, Conclusions, and Recommendations

The researcher evaluated the relationship between certain positive and negative health behaviors with self-reported GPAs in a national sample of 426,425 college students in the United States. This analysis examined the relationship between fruit and vegetable consumption, physical activity, obesity, cigarette and e-cigarette and opioid use with self-reported GPAs. The goal of this study was to add to the body of research related to health and achievement and to address the gap in an understudied age group that may be at risk of possible future health consequences at a critical transitory life stage.

Discussion and Conclusions

Largely the results confirmed that the overall health behaviors of college students are poor. Of the 426,425 college students surveyed, more than half did not strength train any days of the last week, 40.7% did not exercise moderately any days of the last week and 21.9% did not exercise vigorously any days of the last week. These findings support Huang et al. (2002) who reported that more than half of college students did not meet physical activity guidelines. Alternately, the findings in this research are slightly less than Nelson's et al. (2009) findings that two thirds of college students did not meet physical activity requirements.

Of the 426,425 students who participated in this research, results showed that there was a significant relationship between health and academic achievement. Research Questions 1-4 examined the relationship between four positive health behaviors (fruit and vegetable consumption, moderate, vigorous, and strength training exercise) and grade average. Not surprisingly, college students consumed less than the national guidelines of fruits and vegetables

per day. The majority of the study population reported consuming 1-2 servings of fruits and vegetables per day.

Students who consumed five or more servings per day had significantly more As and fewer Bs and Cs than those who ate fewer servings per day. The proportion of student earning As were lower, and the proportion of students earning Bs and Cs were higher. This result endorses previous research suggesting that fruit and vegetable consumption has a positive impact on academic achievement (Burrows et al., 2017; Miller et al., 2017).

Students who met the guidelines for moderate and vigorous exercise had significantly more As and significantly fewer Bs, Cs or D/Fs than those who did not meet the guidelines. These results are analogous with prior research that shows similar relationships (Biswas et al., 2015; Singh et al., 2010).

Research Question 4 examined the relationship between strength training and grade average. This relationship was also significant in that there were more Bs than As, Cs, or D/Fs than expected. Little research has been conducted on the effects of strength training independent of cardiorespiratory fitness and academic achievement. Wald et al. (2013) revealed a negative relationship between strength training and academic achievement. Also, García-Hermoso et al. (2017) found a negative association between obesity and academic achievement but only if BMI was used instead of muscular composition.

Research Question 5 examined the relationship between obesity and academic achievement. This relationship was also significant in that obese students received fewer As, and more Bs and Cs than students who are not obese. This result is somewhat consistent with the literature that suggests a negative association between obesity and grade average (Rajagopal et al., 2017).

Research Questions 6-9 examined the relationship between the negative health behaviors and grade average. Results suggest a significant relationship. Students who used cigarettes, e-cigarettes, and/or opioids in the last 30 days had significantly fewer As, and more Bs, Cs, and D/Fs than expected. As with obesity, cigarette, and e-cigarette use, the results were significant. Although students who were obese, used cigarettes, e-cigarettes, opioids, and NMPO's had fewer A's than students who were not obese or use substances, these students tended to pass or earn above average grades despite negative behaviors or factors.

These findings add to the body of research that suggests a relationship between academic achievement and student health. This study presented this relationship as a representation of intellectual health in a large national sample of college students and shows the potential benefits of lifestyle modifications in college that may have immediate effects on grade average. Furthermore this study links physical and intellectual health in a compelling way that may help mitigate preventable health conditions later in life and lead to immediate positive outcomes for the student and society.

Recommendations for Practice

This research revealed a significant relationship between health behaviors and grade average. Based on these results, the effects of health promoting behaviors has traditionally been undervalued in this population. Students who met the guidelines for diet and exercise were significantly more likely to have higher grades. Likewise, the detriment of poor health habits has been overreported as well. The poor health behaviors revealed less As, Cs or D/Fs; the results also showed more Bs. Many colleges already have the information needed to promote student health, academic success, and subsequently improve quality of life post-graduation (Dooris &

Doherty, 2010). Numerous institutions of higher education collect health data; however, few are using it to assess the health of the population as it pertains to variance in academic achievement (Larson et al., 2016). Based on this research, the following recommendations are suggested:

1. Institutions should promote healthy behaviors in ways that are meaningful to students.
2. More value should be placed on promoting healthy habits than the traditional approach of minimizing poor habits in this population.
3. Healthy foods should be prioritized on campus.
4. Unhealthy foods should be eliminated or minimized on campus.
5. The academic benefits of positive health behaviors should be highlighted.
6. The academic detriment of negative health behaviors should be addressed.
7. Health data should be used to proactively to address student health in an effort to prevent or avert health related dropouts.

Recommendations for Further Research

Because of these findings, further research exploring the is indicated:

1. What are the effects of prioritizing positive health behaviors in student populations?
2. Why do students who engage in unhealthy and risky behaviors earn lower GPAs than students who meet the guidelines?
3. What sociodeomographic factors influenced the results of this research?

Together with further examination of the interrelationship between positive and negative behaviors and an examination of dose dependence could provide valuable insight to this study, and add to this important body of research.

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APPENDICES

Appendix A: Data Use Request

Data Use Request Form

Date submitted: 9/ 12/2019

Date needed*: 10/15/2019

**Must allow at least 4-6 weeks for processing*

ACHA-NCHA data is only available to Individual (Regular or Student) ACHA members.

- The PI (Principal Investigator) must be an ACHA individual member to obtain ACHA-NCHA data, and is expected to be the lead author on any publications or presentations connected to this request.
- If the request is for a dissertation/thesis, the student should be listed as the PI and have an ACHA membership.
- Membership is not required if you are an ACHA-NCHA participating school making a request to compare your local data to the reference group data.
- It is advised that you submit your data use request for approval prior to or in conjunction with your membership application. Approval of a data use request is not guaranteed and a membership refund is not authorized if your request is denied.
- For more information and to apply for an ACHA membership, please visit https://www.acha.org/ACHA/Membership/Become_Member/ACHA/Membership/Becoming_a_Member.aspx

Section 1. **Requestor (Principal Investigator) Information:**

Name/Degree: Amber N. Beane, MA, Ed.D Candidate

Title: Student

Institution: East Tennessee State University

[redacted]

[redacted]

[redacted]

E-mail Address: beanea@etsu.edu

ACHA Membership: Individual Member #____

Section 2. **Co-Principal Investigator(s) Information:**

Name/Degree: _____

Title: _____

Institution: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax: _____

E-mail Address: _____

ACHA Membership: *Individual* ____ *Institutional* ____ *Non-Member* ____ *Unsure* ____

Section 3. **Other individual(s) who will be assisting in this research:**
(*please append additional sheets if necessary*)

Section 4. **Research Project Information**

Project title: The Relationship between Health and Academic Achievement in College Students

Project purpose:

The purpose of this nonexperimental quantitative correlational study is to investigate the relationship between academic achievement and health in a national sample of college students using quantitative data analysis. Specifically, I will evaluate the relationship between three positive health behaviors (physical activity, strength training, and fruit and vegetable consumption), three negative health behaviors (cigarette and e-cigarette usage, and opioid usage) with GPA. The association between obesity and GPA will also be examined.

Hypotheses to be tested (if applicable):

Research Question 1: Is there a significant difference in GPAs between college students who meet U.S Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the national guidelines?

$H_0$1: There is no significant difference in GPAs between college students who meet U.S Department of Health and Human Services guidelines to consume five or more servings of fruit and vegetables per day and students who consume less than the national guidelines.

Research Question 2: Is there a significant difference in GPAs between college students who meet national guidelines from the U.S. Department of Health and Human Services for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the national guidelines?

$H_0$2: There is not significant difference in GPAs between college students who meet national guidelines from the U.S. Department of Health and Human Services for moderate physical activity (at least 30 minutes of moderate physical activity on 5 or more days of the last week) and students who exercise less than the national guidelines.

Research Question 3: Is there a significant difference in GPAs between college students who meet national guidelines from the U.S. Department of Health and Human Services for vigorous physical activity (at least 20 minutes of vigorous physical activity on 3 or more days of the last week) and students who exercise less than the national guidelines?

$H_0$3: There is no significant difference in GPAs between college students who meet national guidelines from the U.S. Department of Health and Human Services for vigorous physical activity (at least 20 minutes of vigorous physical activity on 3 or more days of the last week) and students who exercise less than the national guidelines.

Research Question 4: Is there a significant difference in GPAs between college students who meet national guidelines from the U.S. Department of Health and Human Services for strength training (performing 8-10 strength training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the national guidelines?

$H_0$4: There is no significant difference in GPAs between college students who meet national guidelines from the U.S. Department of Health and Human Services for strength training (performing 8-10 strength training exercises for 8-12 repetitions each on two or more days of the last week) and students who exercise less than the national guidelines.

Research Question 5: Is there a significant difference in GPAs between college students who are obese (BMI greater than 30) and those who are not?

$H_0$5: There is no significant difference in GPAs between college students who are obese (BMI greater than 30) and those who are not.

Research Question 6: Is there a significant difference in GPAs between college students who used cigarettes in the last 30 days and those who did not?

$H_0$6: There is no significant difference in GPAs between college students who used cigarettes in the last 30 days and those who did not.

Research Question 7: Is there a significant difference in GPAs between college students who used e-cigarettes in the last 30 days and those who did not?

$H_0$7: There is no significant difference in GPAs between college students who used e-cigarettes in the last 30 days and those who did not.

Research Question 8: Is there a significant difference in GPAs between college students who used opioids in the last 30 days and those who did not?

Ho8: There is no significant difference in GPAs between college students who used opioids in the last 30 days and those who did not.

Research Question 9: Is there a significant difference in GPAs between college students who used non-medical prescription pain killers not prescribed to them in the last 12 months and those who did not?

$H_0$9: There is no significant difference in GPAs between college students who used non-medical prescription pain killers not prescribed to them in the last 12 months and those who did not.

***Section 5 (continued).* Data Requested and Proposed Analyses**

ACHA-NCHA II-C survey time period(s) requested:

Survey period (study number)	Sample size		Survey period (study number)	Sample size	
	Schools	Students		Schools	Students
Spring 2015 (see previous page)			____ Fall 2015 (32)	40	19,861
____ Spring 2016 (33)	137	95,761	____ Fall 2016 (34)	51	33,512
____ Spring 2017 (35)	92	63,497	____ Fall 2017 (36)	52	31,463
X Spring 2018 (37)	140	88,178	X Fall 2018 (38)	40	27,864

Survey item(s) requested (Q1-Q65). *Check all that apply.**
A copy of the survey can be found at: https://www.acha.org/documents/ncha/ACHA-NCHA_IIc_Web_Survey_2011_SAMPLE.pdf

NQ1		NQ18	X	NQ35		NQ51	
NQ2		NQ19		NQ36		NQ52	X
NQ3		RNQ20**		NQ37		NQ53	
NQ4		NQ21		NQ38		NQ54	X
NQ5		NQ22		NQ39		NQ55	
NQ6		NQ23		NQ40		NQ56	
NQ7		NQ24		NQ41		NQ57	
NQ8	X	NQ25		NQ42		NQ58	
NQ9		NQ26		NQ43		NQ59	
NQ10		NQ27		NQ44		NQ60	
NQ11		NQ28	X	NQ45		NQ61	
NQ12		NQ29	X	NQ46	X	NQ62	
NQ13		NQ30		RNQ47**	X	NQ63	X
NQ14		NQ31		RNQ48**		NQ64	
NQ15		NQ32		NQ49	X	NQ65	
NQ16		NQ33		NQ50	X	NQ66	
NQ17		NQ34					

**Complete datasets will not be provided*
***These items were changed or added to this version of the ACHA-NCHA II and should not be compared with previous versions of the same questions.*

Analyses Plans:

Descriptive statistics will be performed on all study variables to include frequencies and percentages for categorical variables. Means, standard deviations and ranges will be calculated for continuous variables. BMI will be computed on the basis of self-reported weight and height. A series of t-tests will be used to determine if there is a significant difference in GPA between two-year college students and the study variables.

Section 6. **Intended Dissemination of Results**

How will the results of this research be used/disseminated? (check all that apply)

____ Journal Article(s)
List journal(s) _____

____ Book Chapter(s)
List book(s) _____

____ Professional organization presentation(s)
List organization(s) _____

__X__ Thesis/Dissertation
Name of primary advisor Dr. Jill Channing

____ Fact Sheet/Brochure

____ Policy Development

____ Educational Programming Development/Implementation

____ Comparison to individual institution's results

____ Other
Please List _____

Section 7. **Data Use Guidelines**

The ACHA-NCHA data contain information about high-risk behaviors, and all data are confidential. ACHA will not release data on any institution, nor will it release data sets where it is possible to identify any participating schools. Individuals who are granted access to any ACHA-NCHA data must adhere to ACHA's data use guidelines, which are provided in Section 8. Failure to sign or to adhere to the attached agreement will result in immediate termination of data use privileges.

The accuracy of the users' statistical analyses and the findings they report are not the responsibility of the American College Health Association. ACHA shall not be held liable for improper or incorrect use of the data.

Section 8. **Data Use Agreement**

Signing this agreement does not guarantee your request will be approved; however, this section must be complete for your application to be considered.

By signing below, I agree to the following:

- I acknowledge that the ACHA-NCHA data is the exclusive property of ACHA. The data is confidential and proprietary, and I will take all reasonable precautions to prevent unauthorized disclosure or access, including through necessary communications with, and oversight of, the persons named herein. I will use the data solely for the purposes stated, and I shall not transfer the data to, or share the data with, any person not identified in this Request Form. Upon completion of my use of the data, or at any time if so directed by ACHA, I shall return the data to ACHA, without retaining a copy, and shall purge such data from any print or electronic records.
- I acknowledge, as the person making the data request, that I am the PI for the project listed above, and expect to be the lead author on any publications or presentations resulting from this request.
- I will reference the American College Health Association when reporting any data obtained from the ACHA-NCHA utilizing the following standard format (items in Arial font are specific to the data you receive and must be completed appropriately):

  American College Health Association. American College Health Association-National College Health Assessment, Survey Period(s) [computer file]. Silver Spring, MD: American College Health Association [producer and distributor]; (YYYY-MM-DD of distribution).
- I will include the following disclaimer language in any published article or presentation:

  The opinions, findings, and conclusions presented/reported in this article/presentation are those of the author(s), and are in no way meant to represent the corporate opinions, views, or policies of the American College Health Association (ACHA). ACHA does not warrant nor assume any liability or responsibility for the accuracy, completeness, or usefulness of any information presented in this article/presentation.
- I will grant access to ACHA-NCHA data to only those individuals specified in this *Data Use Request Form*. Should the need to grant access to additional individuals arise, I will contact the ACHA Research Director immediately.
- If my institution requires, I will obtain all necessary Institutional Review Board (IRB) approval for secondary data analysis prior to beginning my research, and I will provide ACHA with appropriate documentation of IRB approval.
- I will provide ACHA with any final products produced using ACHA-NCHA data, which include but are not limited to: professional journal manuscripts, professional conference presentations, student theses/dissertations, book chapters, policy documents, fact sheets, and brochures.

Amber Beane

Signature of Principal Investigator Date 9/18/2019

_____ _____

Signature of Co-Principal Investigator(s) Date

When all sections are complete, please email or fax this form to:

Mary Hoban, PhD, CHES
mhoban@acha.org
410.859.1510 (fax)

Appendix B: Data Use Approval

October 2, 2019

Amber M. Beane, MA, Ed.D Candidate
East Tennessee State University
47 Wayward Path
Candler, NC 28715

Dear Amber,

Thank you for submitting a request to use ACHA-NCHA data in your project, "The relationship between Health and Academic Achievement in College Students." Your request has been approved and enclosed you will find the ACHA-NCHA Reference Group Datasets you requested and the corresponding survey codebook. Both institutional and student identifiers have been removed from the files.

I have enclosed a copy of our data use guidelines and agreement for your information. Your signed copy is on file in my office. Please note that additional studies using the ACHA-NCHA data acquired through this request require submission of a new data use request to the ACHA-NCHA Program Office.

As stated in the agreement, we would appreciate a copy of any final products that result from your research. We also ask that you add the following disclaimer to any article or presentation you make using the ACHA-NCHA data:

> *The opinions, findings, and conclusions presented/reported in this article/presentation are those of the author(s), and are in no way meant to represent the corporate opinions, views, or policies of the American College Health Association (ACHA). ACHA does not warrant nor assume any liability or responsibility for the accuracy, completeness, or usefulness of any information presented in this article/presentation.*

Please don't hesitate to contact me if you have any questions.
Best of luck with your research,

Mary Hoban, PhD, MCHES
Director, ACHA-NCHA Program Office

Enclosure: ACHA-NCHA Data Use Guidelines and Agreement

8455 Colesville Road, Suite 740, Silver Spring, MD 20910 • P: (410) 859-1500 • F: (410) 859-1510 • www.acha.org

VITA

AMBER NOELLE BEANE

Education:	Doctor of Education, Educational Leadership, East Tennessee State University, Johnson City, Tennessee, 2020
	M. A. Health Education, East Carolina University, Greenville, North Carolina, 2016
	B.S. Public Health, The University of North Carolina at Greensboro, 2011
Professional Experience:	Mountain Health Education Center, Department of Continuing Professional Development, Project CARA, Opioid Education Team, 2020
	Helpmate, Community Engagement Specialist, Healthcare, 2019
	Asheville Buncombe Community Technical College, Adjunct instructor, Health, 2016-2018
	Evergreen Community Charter School, Director of Health Education, 2015-2017
	Iron Girls, Executive Director, 2014-2016
Honors and Awards:	Graduated Summa Cum Laude, 2011
Affiliations:	American College Health Association (ACHA), 2019-Present
	MAHEC Substance Use Disorder Task Force, 2019-Present