DISSERTATION

THE PREVALENENCE AND CLUSTERING OF CARDIOVASCULAR RISK FACTORS IN COLLEGE STUDENTS

Submitted by

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ABSTRACT

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THE PREVALENCE AND CLUSTERING OF CARDIOVASCULAR RISK FACTORS IN COLLEGE STUDENTS

Cardiovascular disease (CVD) has been the leading cause of death in the United States for adult men and women for the last 80 years and is a major cause of disability. Additionally, CVD is the second leading cause of death in young adults ages 18 to 29. This chronic disease is typically associated with adults; however, recently CVD has been identified in the younger population as well.

The literature on CVD risk factors and college students is very limited. College campuses serve as an ideal setting to examine risk factors for CVD among young adults.
College life can lead to multiple changes in lifestyle including changes in activity patterns, dietary intake, sleep patterns, weight fluctuations, alcohol consumption, tobacco use, and drug use. Collectively, the impact of these behaviors sets the stage for the development of multiple risk factors associated with CVD. Therefore, the purpose of this investigation was to identify the prevalence and clustering of CVD risk factors with undergraduate students' age 18 – 25 years old enrolled at Colorado State University (CSU), during the spring semester, 2017.

A non-experimental, cross-sectional research design was used to identify the prevalence and clustering of CVD risk factors in the sample. Multiple screenings were centrally located on campus for student convenience. The screening included informed consent, health history questionnaire, resting blood pressure, lipid analysis, and health and wellness questionnaire.

A total of 180 students were recruited for the study. The average age was 21.40 years with a range of 18 – 25 year. Over half, 62.18 percent were female, 53.75 percent were seniors, and 81.88 percent were White. Although the study was open to the entire university, 78.62 percent were from the department of Health and Exercise Science. Students from 23 different academic departments were represented in the sample.

A total of 706 CVD risk factors were identified including; 208 for nicotine use, 238 with family history of CVD, 42 for high LDLs, 32 for elevated SBP, 24 for elevated DBP, 22 for inactivity, 21 for elevated triglycerides, 20 for elevated total cholesterol, 20 for elevated blood glucose, 19 for low HDLs in males, 15 for low HDLs in females, 39 for BMI $\geq$ 25 kg/m^2), 4 for increase in waist circumference for females, and 2 for an elevated waist circumference in males. The range of CVD risk factors per student was from zero to six. The significance in totality of CVD risk factors in this apparently healthy undergraduate student sample is startling and warrants further examination.

Male students showed statistically significant higher glucose, TCHOL/HDL, SBP, and DBP, and were more likely to use cigarettes e-cigarettes, cigars, and smokeless tobacco, anabolic steroids and beer than females. Female students had a statistically significant higher total cholesterol level, HDL, and wine consumption than males. White students had a higher prevalence of hookah and smokeless tobacco, wine, liquor, drinking up to five drinks in one setting, driving after drinking alcohol, and consuming marijuana edibles. Freshmen had a statistically significant lower SBP than sophomores, and seniors. A statistically significant difference was found with seniors consuming more beer than freshman and sophomores. Seniors were also more likely to drive after drinking alcohol than freshman, sophomores, and juniors. Lastly, juniors had a statistically significant higher consumption of marijuana edibles than sophomores did.

CSU undergraduate students are more likely to rank their general health as “very good” or “excellent”, less likely to have a history of elevated blood pressure, more likely to use hookah, and less likely be obese when compared to undergraduate college students across the nation. Multiple correlations were identified and followed up with simultaneous multiple regressions were completed to investigate the best predictors of tobacco use, hookah use, elevated SBP, elevated DBP, BMI, and elevated total cholesterol. K-means cluster analysis provided a visual display of various groupings for family history of CVD, blood lipids and general health, blood pressure, tobacco and marijuana use, alcohol use, and general health tobacco and alcohol use combined, and drug use. Data were standardized to Z-scores for comparison. The Z-scores greater than three included cigarettes, e-cigarettes, hookah, cigars, smokeless tobacco, cocaine, methamphetamines, and other illegal drugs.

Collectively, these results indicate a significant prevalence of CVD risk factors and high alcohol and drug use among the CSU student sample. It is apparent that this undergraduate college student sample may be more at risk for developing subsequent CVD than previously thought and should be screened for CVD beginning at age 20 as recommended by health and medical experts.

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As an adult learner and a fulltime faculty member, this Ph.D. could not have been possible without the support and encouragement I have received from my colleagues, friends and family. Additionally, I was extremely fortunate to have a doctoral committee that was fully invested and supported me throughout this Ph.D. journey.

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Dr. Gene Gloeckner also served as a co-advisor for my committee. Thank you. Thank you. Thank you. You have taught me more about statistics than I ever thought possible. Your teaching style and confidence in my ability to complete this project was more than I could have asked for. Thank you for your mentorship, editorial comments, and guidance.

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DEDICATION

This dissertation is dedicated to my parents and my children. My father passed away two years ago after a brave battle with pancreatic cancer. He was always an inspiration to me, even in his final days. My mother's love and support during this entire doctoral program has been extraordinary and I am more than thankful. To my daughters Erin and Lauren, I encourage you to continue learning, growing, and developing. Chase your dreams, regardless of age.

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DEFINITION OF TERMS

The following terms are defined to assist in the understanding of this research:

1. Anthropometric: the science of measuring the human body as to height, weight, and size of component parts, including skinfolds, to study and compare the relative proportions under normal and abnormal conditions (J. A. Anderson, 2008)
2. Atherosclerosis: disease of the heart where plaque builds up inside the arteries. Atherosclerosis can lead to a heart attack, stroke, peripheral artery disease, or death (Burt et al., 1995; Gibbons, Shurin, Mensah, & Lauer, 2013)
3. Blood Pressure: the pressure exerted by the circulating volume of blood on the walls of the arteries and veins and on the chambers of the heart. Blood pressure is regulated by the homeostatic mechanisms of the body by the volume of the blood, the lumen of the arteries and arterioles, and the force of cardiac contraction. In the aorta and large arteries of a healthy young adult, average blood pressure is approximately 120 mmHg in systole and 80 mmHg during diastole (Goff et al., 2014).
4. Binge Drinking: consuming five or more standard size alcoholic drinks (12 ounces of beer, 5 ounces or wine, 1.5 ounces of 80 proof spirits, or 8-9 ounces of malt liquor) in a two-hour period for males and four or more standard size alcoholic drinks in a two-hour period for females (Wechsler & Nelson, 2008).
5. Body Mass Index (BMI): A ratio of weight (kg) by the square of height (m^2) (kg/m^2). Criteria from the World Health Organization includes a low BMI is

considered <18.5 kg/m^2, normal ≥ 18.5 to < 25.0 kg/m^2, overweight 25.0 to 29.9 kg.m^2, and obese ≥ 30 kg/m^2 (McArdle, Katch, & Katch, 2010).

6. Cardiovascular disease: any abnormal condition characterized by dysfunction of the heart and blood vessels. In the United States cardiovascular disease is the leading cause of death. Various forms of cardiovascular disease include atherosclerosis, cardiomyopathy, rheumatic heart disease, syphilitic endocarditis, and systemic venous hypertension (K. Anderson, Anderson, & Glanze, 1998).
7. Cholesterol: a waxy lipid soluble compound found in animal tissues. A member of a group of compounds called sterols; it is an integral component of every cell in the body. It facilitates the absorption and transport of fatty acids. Cholesterol is continuously synthesized in the body, primarily in the liver. Increased levels of low-density lipoprotein (LDL) cholesterol may be associated with the pathogenesis of atherosclerosis, where higher levels of high-density lipoprotein (HDL) cholesterol appear to lower the risk for heart disease. Normal adult levels of blood cholesterol are 150 to 200 mg/dl, or 3.9 to 5.2 mmol/L (SI units) (K. Anderson et al., 1998).
8. Chronic disease: a disease that persists over a long period as compared with the course of acute disease. The symptoms of chronic disease are sometimes less severe, often result in complete or partial disability, and may lead to death. Examples of chronic disease include arthritis, cardiovascular disease, diabetes mellitus, and emphysema (K. Anderson et al., 1998).

9. Cluster Analysis: the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters) (Kaufman & Rousseeuw, 2009).
10. Coronary artery disease: an abnormal condition that may affect the heart's arteries and produce various pathological effects, especially the reduced flow of oxygen and nutrients to the myocardium. The most common kind of coronary artery disease is coronary atherosclerosis (K. Anderson et al., 1998).
11. Diabetes Mellitus: a complex disorder of carbohydrate, fat, and protein metabolism that is primarily the result of a deficiency or complete lack of insulin secretions by the beta cells of the pancreas or resistance to insulin (K. Anderson et al., 1998).
12. Dyslipidemia: abnormality in, or abnormal amounts of lipids and lipoproteins in the blood (K. Anderson et al., 1998).
13. Emerging adulthood: proposed as a new conception of development for the period from the late teens through the twenties, with a focus on ages 18–25 (Arnett, 2014).
14. Essential Hypertension: elevated blood pressure with no single identifiable cause, but risk for the disorder is increased by obesity, a high serum sodium level, hypercholesterolemia, and a family history of high blood pressure (K. Anderson et al., 1998).
15. Exercise: the performance of any physical activity for the purpose of conditioning the body, improving health, or maintaining fitness or as a means

of therapy for correcting a deformity or restoring the organs and body functions to a state of health (K. Anderson et al., 1998).

16. High Density Lipoprotein (HDL): lipoproteins produced by the liver and small intestines contain the highest percentage of protein (50%), and the least lipid (20%) and cholesterol (20%). HDL protect against heart disease as these lipoproteins act like scavengers in the reverse transport of cholesterol by removing it from the arterial wall and delivering it to the liver for incorporation into bile and subsequent excretion via the intestinal tract (McArdle et al., 2010).
17. Hypertension: the medical term for high blood pressure. In adults, the disorder characterized by elevated blood pressure persistently exceeding 140/90 mmHg. The incidence of hypertension is higher in men than in women and is twice as great in African-Americans as in Caucasians (K. Anderson et al., 1998).
18. Low Density Lipoprotein (LDL): a plasma protein provided from very low-density lipoproteins or by the liver, containing relatively more cholesterol and triglycerides than protein. It is derived in part, if not completely, from the intravascular breakdown of the very low-density lipoproteins (VLDL) and delivers lipids and cholesterol to the body tissues. The high cholesterol content may account for its greater the atherogenic potential as compared with the VLDLs.
19. Metabolic syndrome: a multifaceted grouping of coronary artery disease risks including obesity, insulin resistance, glucose intolerance, dyslipidemia, and hypertension (McArdle et al., 2010).

20. Myocardial infarction: necrosis of a portion of cardiac muscle caused by an obstruction in a coronary artery through atherosclerosis, a thrombus or a spasm. Also called a heart attack (K. Anderson et al., 1998).
21. Obesity: an abnormal increase in the proportion of fatty cells, mainly in the viscera and subcutaneous tissues of the body (K. Anderson et al., 1998).
22. Overweight: more than normal in body weight after adjustment for height, body build, and age, or 10% to 20% above the person's desirable body weight (Anderson et al.,1998).
23. Physical activity: body movement produced by muscle action that increases energy expenditure (McArdle et al., 2010).
24. Risk Factor: a factor that causes a person or a group of people to be particularly susceptible to an unwanted, unpleasant, or unhealthy event, such as cigarette smoking, which increases the potential for developing respiratory or cardiovascular disease (K. Anderson et al., 1998).
25. Secondary hypertension: elevated blood pressure associate with any of several primary diseases, such as renal, pulmonary, endocrine, and vascular diseases (K. Anderson et al., 1998).
26. Stress: any emotional, physical, social, economic, or other factor that requires a response or change. Ongoing chronic stress can result in physical illness (K. Anderson et al., 1998).
27. Triglycerides: a simple fat compound consisting of three molecules of fatty acid and glycerol. Triglycerides make up most animal and vegetable fats and are the principal lipid in the blood, where they circulate within lipoproteins.

The total amount of triglycerides and the amount, proportion, and kinds of lipoproteins are important in the diagnosis and treatment of many diseases and conditions, including diabetes, hypertension, and heart disease (K. Anderson et al., 1998)

CHAPTER 1: INTRODUCTION

Cardiovascular disease (CVD) has been the leading cause of death in the United States for adult men and women for the last 80 years and is identified as a major cause of disability (Miniño, Heron, Murphy, & Kochanek, 2007; Mozaffarian et al., 2016). Additionally, CVD is the second leading cause of death in young adults ages 18 to 29 (Fernandes & Lofgren, 2011; Miniño et al., 2007). Currently, CVD causes one in three (approximately 800,000) deaths each year in the United States (CDC, 2015). The chronic disease process of CVD is typically associated with adults; however, recently CVD has been identified in the younger population as well (Akosah, Schaper, Cogbill, & Schoenfeld, 2003; Al-Asadi, Habib, & Al-Naama, 2006; Anding, Suminski, & Boss, 2001; Arts, Fernandez, & Lofgren, 2014; Aryal, 2014). As clinical consequences of CVD increase, so does the significance of prevention.

Cardiovascular disease (CVD) is a grouping of diseases that involves the heart and blood vessels of the body. This chronic disease involves an atherosclerotic process that begins early in life and continues to develop over many decades. Atherosclerosis is a medical condition that develops when a substance identified as plaque accumulates in and within the walls of the arteries. As plaque accumulates over time, it becomes hardened and narrows the arterial diameters making it difficult for blood to flow through the vasculature with ease, and creates a greater risk for a heart attack or stroke. The process of atherosclerosis has the potential to lead to serious medical complications including hypertension, heart attack, stroke, or even death (McArdle et al., 2010).

For many young adults, entering college is a critical time of transition. This period of transition can lead to adverse lifestyle patterns and risky behaviors that may progress into risk factors for chronic diseases such as hypertension, obesity, diabetes mellitus, and cardiovascular diseases (Das, 2014). Researchers are discovering that many CVD risk factors are prevalent among healthy young college students (Das & Evans, 2014). As the number of cardiovascular risk factors increases, so does the severity of asymptomatic coronary aortic atherosclerosis in young people (Berenson, 1998). Therefore, college students may be more at risk from developing subsequent CVD than previously expected.

Emerging Adulthood

Graduating from high school marks a transition into early adulthood for many students. For many of these young adults, this period is typically followed by the beginning of college that is another key transitional period. Appropriately, 41 percent of the 17-24-year-old population is enrolled in college in the United States (Das, 2014). Considered as the first major transition in a young adult's life, it represents a complex period in which youth who have been dependent on parental support begin to take definitive steps toward independence. Jeffrey Arnett from the University of Maryland College Park focuses his research on the late teens through the twenties and has identified this period in life as emerging adulthood (2000). This period is neither adolescence nor adulthood, but the period between. Arnett defines emerging adulthood as a new developmental period from the late teens through the twenties, with a focus on ages 18-25 (2014).

Unstable years filled with profound change. For most people, the late teens through the mid-twenties are the most unstable years of life (Arnett, 2000). These years are filled with profound change and importance. Typically, these years are a time of identity development, exploring possibilities with love, career choices, lifestyle behaviors, and worldviews. Emerging adulthood exists in cultures that allow young people a period of exploration and independence during the late teens and twenties (Arnett, 2000). Emerging adulthood is a time when many different directions remain possible, and little about the future has been decided. According to Arnett, most refer to this period as a time of instability, more so than any other period in life (2000). Although a relative short period in one's life, the emerging adulthood is a critically important time in life and deserves attention. It is during this developmental phase that many young people obtain the level of education and training that will begin or provide the foundation for income and occupational achievements for the remainder of their working life (Arnett, 2000). By the end of the late twenties, most individuals have made life choices that will have enduring ramifications. When adults later consider the most important events in their lives, they most often name events that occurred during college years (Arnett, 2000).

The traditional college years are a time of transition from adolescence to adulthood. As many young adults leave the parental home to begin college they become challenged with the stress involved in establishing independence, adapting to physical environment changes, balancing work hours with academic demands, social networks, and acknowledging new financial responsibilities (Das, 2014). During this transition, pronounced changes in health behaviors often result as a response to both different social environments and newly acquired responsibilities.

Gaining control. During this period, young adults strive to achieve greater control over their lifestyles and may engage in a variety of both protective (e.g., regular exercise, daily consumption of fruits and vegetables) and risky (e.g., binge drinking, smoking) behaviors that have the potential to affect their current and future health status. An emphasis on the transition to adulthood is important because children and youth are widely regarded as the most physically active segments of the population, yet this advantage quickly disappears with the transition to college (Kwan, 2014). It is during this time of increased individual responsibility and independence that students establish behaviors and habits that may last a lifetime (Dinger, 2014) therefore this is an opportune time to develop health lifestyle behaviors that can be maintained in the future. Clearly, the transition into early adulthood marks a critical life passage.

Predictable changes during transition. Studies have shown many consistent trends as young adult's transition to college (Li, 2016). Common tendencies included decreases in physical activity coupled with increases in inactivity, unconventional schedules, stress, binge drinking, smoking, unhealthy dietary habits, ignoring preventive safety habits such as wearing helmets, seat belts and or condoms, and engaging in long-term sun exposure (Raynor & Levine, 2009). These trends are apparent as inhibitions weaken following high school due to reductions in adult influence, and the perception that these health-risk behaviors are socially acceptable or normative among peer groups and new group allegiance.

As young adults outgrow binge drinking and smoking, physical activity participation continues to decrease. Given the public health implication, intentional efforts to reduce or prevent the occurrence of all these health risk behaviors is suggested with greater focus on reducing the decline in physical activity during this transition to early adulthood is warranted. Educational programs and preventive screenings for students during this transitional period are highly recommended (Kwan, 2012). University and college campuses are ideal settings to screen young adults and identify current risk factors for CVD. Individual health beliefs and lifestyles are evolving during this period in student lives. Consequently, it is important to screen and educate young adults while lifestyle behaviors are established that will likely influence their adult health and well-being.

Statement of the Research Problem

Although CVD is the second leading cause of death in young adults ages 18 to 29 (Fernandes & Lofgren, 2011; Miniño et al., 2007), little is known about the prevalence and clustering of cardiovascular risk factors among college students between 18 – 25 years old. Young adults entering college are transitioning into a critical point in their lives. While establishing personal independence, college students are also making lifestyle choices such as exercise or activity patterns, dietary choices, tobacco use, alcohol consumption, sleep patterns, time management, stress management, and self-responsibility that can have either positive or negative consequences on current and future health. This transition into adulthood is an ideal time to develop healthy behaviors and lifestyle habits for lifelong adherence.

College campuses serve as a distinct setting for examining risk factors for CVD among young adults. Although numerous CVD risk factors begin early in life, the college student population is not often studied for risk factors. It appears that these young adults are a model group to screen for risk factors associated with CVD. As a faculty member in an institute of higher education, I have seen first-hand the value of preventive screening with college students. Although genetics cannot be altered, behavioral habits have immense consequences on current and future health and well-being. The earlier risk factors and adverse behaviors can be identified, the great the possible resolution.

Statement of Purpose

The purpose of this investigation was to identify the prevalence and clustering of risk factors associated with cardiovascular disease (CVD) with undergraduate students' age 18 – 25 years old enrolled at Colorado State University (CSU), during the spring semester, 2017.

This investigation should contribute and further the comprehension of the prevalence and clustering of CVD risk factors with college students. This study will be grounded in a solid theoretical foundation, include a lipid analysis, anthropometric measurements, and use a questionnaire with questions derived from national and international college student health questionnaires with previously established validity and reliability.

Research Questions

The research questions addressed in this study are as follows:

1. What is the prevalence of each CVD risk factor (family history, gender, tobacco use, elevated blood pressure, elevated cholesterol levels, low HDLs, elevated LDLs, elevated triglycerides, elevated fasting glucose, inactivity, and excess weight (BMI $\geq$ 30))?
2. For each CVD risk factor, what differences are seen in prevalence between genders, ethnic groups, and class year?
3. What are the differences in CVD risk factors found with the CSU students data compared to data from the National College Health Assessment (NCHA)?
4. What are the correlations among the 12 CVD risk factors?
5. What clusters of risk factors are found in the sample? How many clusters emerge and what combinations of risk factors make each cluster unique?

Assumptions

1. It is assumed that participants will be honest and truthful to the extent of their knowledge about their current health status, family history, and lifestyle habits while completing the health and lifestyle survey.
2. It is assumed that after regular calibration, all equipment will function properly to produce valid results.
3. It is assumed that the Principal Investigator (PI) and Registered Nurses (RNs) followed appropriate protocols while taking assessments.

Delimitations

The study was based on blood lipid analysis, anthropometric measurements, and survey data completed from a convenience sample of CSU undergraduate students, with an age range of 18-25 years old. Students were recruited campus wide. Every participant was informed on the study protocol and offered their consent prior to the beginning of assessments. The sample size was 120 students enrolled at CSU during the spring semester of 2017.

Limitations of the Study

There are certain limitations that may have restricted the scope of the study or influenced the outcomes. For example, a potential limitation of this study was self-reported data. According to Stevens (2002), participant error exists with self-reporting data collection due to participants' intentionally or unintentionally misreported information or misunderstanding of the questions being asked. Incompleteness also existed due to lack of information regarding family health history. Additionally, participants within this age range of 18-25 years old may not have yet established a routine of preventive care and therefore, may not have been fully aware of their own health history and current health status.

The generalizability of the study may be limited to the study sample (Gliner, Morgan, Harmon, & Harmon, 2000). It is possible that study participants may have had a heightened motivation for participation due to their personal lifestyle or interest in activity and general health. Therefore, it is unknown if this specific sample is representative of the theoretical student population enrolled at CSU during the spring semester of 2017.

Researcher's Perspective

Currently, I am the Director of Health Promotion and a Senior Instructor for the department of Health and Exercise Science at Colorado State University (CSU). My Bachelor and Master of Science degrees are in Kinesiology and Exercise Physiology, respectfully. Throughout my education and career cardiovascular health, risk factors associated with the disease process, and healthy lifestyles targeted at disease prevention have been my focus. Cardiovascular disease remains the leading cause of mortality and morbidity in the United States. An abundance of research exists on cardiovascular disease and treatment with adults and the progression of disease with the nation's youth, yet the research on this topic is scarce with the college student population. Therefore, I find it interesting and vitally important to research the prevalence and clustering of cardiovascular risk factors with the college student population. I look forward to working with this understudied population regarding their heart health while their adult lifestyle habits are being established during their college years.

As an exercise physiologist employed at the Heart Center of the Rockies and a senior instructor employed at CSU, I have gained over 28 years of experience in diagnostic assessments. I am very capable of measuring the following assessments that will be part of this study; height, weight, and waist circumference measurements. I have partnered with Register Nurses from the Health District of Northern Colorado to perform the blood pressures and blood analysis. I have developed the health and wellness survey used in this study with questions derived from the National College Health Assessment (NCHA), the Student Stress Survey (SSS), and the International Physical Activity Questionnaire (IPAQ) all with previously documented reliability and validity.

CHAPTER 2: LITERATURE REVIEW

For many young adults, entering college is a time of critical transition. The college years are typically filled with excitement as students begin to gain independence and establish new adult behaviors. These years of early adulthood can lead to multiple changes in one's lifestyle including changes in activity patterns, dietary intake, sleep patterns, weight fluctuations, alcohol consumption, tobacco use, and drug use. Collectively, the impact of these behaviors sets the stage for the development of multiple risk factors associated with cardiovascular disease (CVD).

CVD is the number one cause of death in the United States (US) and a significant public health concern (Kurian & Cardarelli, 2007). Despite recent declines in CVD, it remains the leading cause of death and is identified as a major cause of disability (Yach, 2014). Currently, CVD is responsible for approximately 800,000 or one in three deaths annually in the United States (Das & Evans, 2014).

Cardiovascular disease (CVD) risk factors.

Risk factors for CVD were first identified from the initial findings from the Framingham Heart Study (FHS) in the early 1960s. A risk factor is defined as a measurable characteristic that is causally associated with increased disease frequency and that is a significant independent predictor of an increased risk of disease development (O'Donnell & Elosua, 2008). Identifying CVD risk factors at a young age may allow for better preventive strategies and ultimately less CVD diagnoses and deaths in the future (T. L. Nelson, Puccetti, & Luckasen, 2015).

Two classifications for CVD risk factors. Risk factors associated with CVD are easily quantifiable and divide into two separate but equally important categories: non-modifiable and modifiable. Non-modifiable risk factors include family history, age, and gender. Modifiable risk factors consist of nicotine use, dyslipidemia, elevated systolic and diastolic blood pressures, diabetes, inactivity, and obesity (Dawber, 1980; Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004). Additionally, in 2014 the American College of Sports Medicine (ACSM) stated that a high-density lipoprotein (HDL) cholesterol greater than or equal to 60 mg/dl is considered a negative risk factor; consequently, one positive risk factor is subtracted from the total number of risk factors identified.

The risk of CVD in young adults aged 18–24 is underestimated despite the high prevalence of risk factors and early signs of atherosclerosis in this group (Arts et al., 2014; Caleyachetty et al., 2015; Gharaibeh et al., 2012; Hlaing, Nath, & Huffman, 2007). Research shows that the prevalence of CVD in young adults between the ages of 20 and 39 years is 14.2 percent for males and 9.7 percent for females (Marma, Berry, Ning, Persell, & Lloyd-Jones, 2010). According to Arts et al. (2014), more than 50 percent of young adults aged 18–24 years have at least one risk factor for CVD, and nearly 25 percent have advanced atherosclerotic lesions. Therefore, college students may be more at risk for developing subsequent CVD than previously expected. Despite this, the Center for Disease Control (CDC) (2002), reported that 63.7 percent of young adults (18 to 44 years) are screened for elevated cholesterol while 88.8 percent of middle-aged adults (45 to 64) are screened regularly.

Prevalence of cardiovascular disease risk factors. The extent of atherosclerosis is directly correlated with the number of risk factors present (Al-Asadi et al., 2006). Risk factor profiles in young adults strongly predict long-term CVD disease (Arts et al., 2014). According to the National Heart, Lung, and Blood Institute (NHLBI), one risk factor doubles the risk for CVD, two risk factors increases the risk for CVD fourfold, and three or more risk factors increases the risk for CVD more than tenfold (Gibbons et al., 2013). Therefore, an exponential relationship exists between the number of cardiovascular risk factors and the probability of developing CVD in both young and old individuals.

Screening and treatment programs. Historically, research and treatment for CVD has mainly focused on the adult population. By comparison, comprehensive investigational programs that evaluate the prevalence of CVD risk factors in college students are minimal. However, perhaps for the first time, college students are away from home for extended periods of time and making lifestyle choices that may have serious long-term consequences on their adult health status.

Since several risk factors begin at a young age and continue to adulthood the American Heart Association (AHA) and the NHLBI emphasize preventive measures beginning in young children and adolescents (Lloyd-Jones et al., 2010). The earlier a risk can be identified and modified, the greater likelihood of inhibiting or delaying the onset of CVD (Romero, McMahan, & Cathorall, 2005a). Therefore, it is important to understand and monitor the impact college life can have on development of CVD risk factors with the student population.

Non-Modifiable Risk Factors

Specific risk factors have been identified that are associated with the development of CVD. A large number of risk factors are modifiable and can be controlled or reduced with lifestyle habits or treated medically by a health care provider. Non-modifiable risk factors for CVD have also been identified and include family history, age, and gender. Although these factors cannot be altered, it is important to understand the significance of each.

Family History. A family history of CVD represents the net effect of shared genetic, biochemical, behavioral, and environmental components (Colditz et al., 1991). According to Dr. William Kraus (2004), preventive cardiologist at Duke University, both the risk factors for heart disease and risk of developing heart disease are strongly linked to family history, health history, or patterns and habits The World Heart Federation (2013), the National Heart Lung and Blood Institute (NHLBI), (2013), and American College of Sports Medicine (ACSM), (2013), all state that one's risk of heart attack increases if a first-degree male relative suffered a heart attack prior to the age of 55, or if a first-degree female relative suffered a heart attack prior to the age of 65. If both parents have suffered from heart disease before the age of 55, an individual's risk of developing heart disease can rise to 50 percent compared to the general population. The same relationship exists for developing a stroke. In addition, studies have shown a genetic relationship with hypertension, abnormal blood lipids, and type-2 diabetes, which are all risk factors for CVD. The presence of a positive parental history increases the risk of CVD in men by 50 percent and 70 percent for women (Imes & Lewis, 2014; Lloyd-Jones et al., 2004).

The evidence from vascular studies has demonstrated subclinical abnormalities in individuals with a family history of CVD. In young subjects, relative luminal narrowing in both the right and left coronary arteries at post mortem is evident in those having a family history of CVD compared to those without such a history. In addition, two generations of the Framingham Heart Study were evaluated for the presence of coronary artery and abdominal aortic calcification. This calcification was associated with those with a history of premature parental CVD (55 for men and 65 for women) and or coronary artery disease ((Gibbons et al., 2013).

It is recommended that those with a family history of CVD have blood cholesterol checked by the age of 18, or earlier, and regularly thereafter (Gharaibeh et al., 2012; Goff et al., 2014; Panel, 2002). The presence of both structural and functional abnormalities of arterial function, coupled with a large body of epidemiological data, supports the fact that a family history of CVD is an important risk factor for accelerated atherosclerosis. This parental association with a family history of CVD has been confirmed in men, women, siblings, and for different racial and ethnic groups (Leander, Hallqvist, Reuterwall, Ahlbom, & de Faire, 2001; Myers, Kiely, Cupples, & Kannel, 1990; Sesso et al., 2001).

Prevalence. Although a family history is a non-modifiable risk factor, it is indeed an important risk factor and warrants identification so preventive measures can begin early in life. At least 30.5 percent of college freshman had at least one parent that had a history of CVD (Khoddam & Doran, 2013). These students were found to weigh more and to smoke. This group was also less likely to exercise, adhere to a low-fat dietary intake, seek health educational information, have knowledge regarding family health history, and have a blood cholesterol test done prior to starting college (Imes & Lewis, 2014). Family history has also been associated with hypertension, abnormal blood lipids, and type 2 diabetes, which are further risk factors for the development of CVD (Sowers, Epstein, & Frohlich, 2001). Although a family history of CVD does indicate a greater likelihood of disease development, it does not have to be imminent. Healthy lifestyle habits and adhering to prescription medication to treat associated risk factors can often lessen the genetic influences associated with CVD.

Age

A significant determinant of cardiovascular health is age. Aging is an inevitable part of life and unfortunately poses the largest risk factor for CVD (North & Sinclair, 2012). Age is not considered to be a modifiable risk factor but, unfortunately, it outranks all those that are (e.g., lipids, blood pressure, and smoking) as a predictor of clinical events (Sniderman & Furberg, 2008). Unfortunately, many epidemiological studies have shown that cardiovascular risk factors tend to increase with age (Tuomilehto, 2004), making age an important risk factor for CVD (North & Sinclair, 2012). CVD is multifactorial and can develop at any age; however, generally the risk increases with age due to the progressive decline in several physiological processes coupled with a slow buildup of plaque within the coronary arteries. This progressive development begins during childhood and continues into adulthood.

Changes with advancing age are considered gender specific. Men's risk begins to increase at age 45, when 10 of 1,000 men develop signs of CVD. By age 55 the risk doubles to 21 of 1,000 men, and by age 85 approximately 74 of 1,000 men have CVD. Women's risk for developing CVD increases with age, but the trend begins about 10 years later (55 years), and becomes more apparent with the onset of menopause (Berry et al., 2012; Burt et al., 1995).

Younger individuals can develop CVD. Disease development in the younger population is seen with an accelerated accumulation of plague in the coronary vessels, obesity, and diabetes. Obese children and adolescents are more likely to have additional CVD risk factors such as hypertension and dyslipidemia (Franklin et al., 2001; Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Gall, Jose, Smith, Dwyer, & Venn, 2009). Since arteries can be occluded with plaque over time, it is imperative to take advantage of time and intervene early.

As one advances in years, the heart ages and undergoes subtle physiological changes, even in the absence of disease. The heart is a muscle and with age tends to relax less completely between beats, resulting in chamber stiffness and cardiac inefficiency. When a cardiac disease is present, the age-related changes compound problem and treatment options (Luepker et al., 2003).

Gender

Both men and women are at risk for developing CVD, however, significant differences exist between the two genders. Although CVD is often referred to as a man's disease, women also suffer from CVD. In the United States, CVD is the number one cause of death for both men and women (Antelmi et al., 2004). However, unlike heart disease, both men and women are at an equal risk for developing a stroke (Beal, 2010).

Middle aged men suffer from CVD 2 to 5 times more than women (Go et al., 2014), especially prior to menopause. Exposure to endogenous estrogens during the fertile period of life delays the manifestation of CVD in women by improving blood lipid concentrations. This chemical adaptation protects pre-menopausal women from CVD, expect in smokers (Towfighi, Zheng, & Ovbiagele, 2009). Research has shown total cholesterol, LDL-C, and triglycerides to be higher in males when compared to females and multiple risk factors accelerated the CVD process (Kuklina, Yoon, & Keenan, 2010).

Gender differences for CVD diminish with age. A rise in coronary heart disease following menopause was noted in a cohort of 2,873 Framingham women who were followed for 24 years. No premenopausal woman developed a myocardial infarction or died of coronary heart disease, however, cardiac events were common in postmenopausal women. The incident rate of CVD was more than double for postmenopausal women compared to premenopausal women, whether menopause was natural or surgical (Jousilahti, Vartiainen, Tuomilehto, & Puska, 1999).

Although menopause does not typically occur until the fifth decade of life, gender differences are still important for college student. Lifestyle habits established as young adults tend to become adult behaviors (M. C. Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008; Nguyen-Michel, Unger, Hamilton, & Spruijt-Metz, 2006; Woods, Mutrie, & Scott, 2002)

Modifiable Risk Factors

While age, gender and family history are non-modifiable risk factors for CVD, several risk factors are modifiable and can be controlled or modified with lifestyle habits or medical treatment and monitoring. Nicotine use, blood lipids, hypertension, diabetes, inactivity, and obesity have been recognized as modifiable risk factors for CVD in 52 countries (Yusuf et al., 2004).

Nicotine use. The effects of tobacco use have well researched and documented. In the 1940s smoking was identified as a major risk factor for heart disease, stroke, and several cancers (Gerald S Berenson et al., 1998; CDC, 1999; Huang, Shimel, Lee, Delancey, & Strother, 2007; Rigotti, Lee, & Wechsler, 2000). In 1964 the Surgeon General first reported on the health effects of cigarette smoking. Despite warnings, people continue to smoke and initiate smoking. Smoking has been identified as a major risk factor for heart disease, stroke, and several cancers since the 1940s (Gerald S Berenson et al., 1998; CDC, 1999; Huang et al., 2007; Rigotti et al., 2000).

The tobacco epidemic is one of the biggest public health threats today with more than 1 billion smokers (Mendis, Puska, & Norrving, 2011). Cigarette smoking is the leading cause of preventable disease and death in the United States, accounting for more than 480,000 deaths every year, or 1 of every 5 deaths (Jamal et al., 2015; Woods et al., 2002). It is estimated that smoking causes 10 percent of all CVD. Additionally, smoking is the second leading cause of CVD, following high blood pressure (Smith et al., 2011). Tobacco is associated with approximately 6 million deaths per year with more than 5 million deaths resulting from direct tobacco use and 600,000 resulting from exposure to second-hand smoke (Go et al., 2013), accounting for 6 percent of females and 12 percent of male deaths worldwide (Bonaca et al., 2012). Smokers have a three times higher mortality rate compared to non-smokers (Jha et al., 2013). It is estimated that by the year 2030, tobacco related deaths are projected to increase to more than 8 million deaths per year (Organization, 2013).

Smoking harms every organ in the body, including the heart, blood vessels, lungs, eyes, mouth, reproductive organs, bones, bladder, and digestive organs. Additionally, nicotine, whether smoked or chewed, damages endothelium cells and blood vessels, increases fatty deposits in the arteries, increases clotting, raises low-density lipoproteins, reduces high-density lipoproteins, promotes coronary artery spasms, temporarily raises blood pressure, and lowers exercise tolerance (Mendis et al., 2011).

Additionally, carbon monoxide from smoking tobacco has a high affinity to the oxygen receptors on red blood cells. When present, carbon monoxide adheres to the red blood cell and prevents oxygen from being carried by this important oxygen transport molecule. Therefore, nicotine use decreases the quantity of oxygen that the blood can transport resulting in a limited exercise capacity and energy to perform daily living tasks. Additionally, nicotine increases the tendency for blood clot formation. Blood clots can travel throughout the body and become lodged in the arterial system causing a range of complications that ultimately may result in a stroke, heart attack, or sudden death. Clearly, there is much dangerous potential harm associate with nicotine use.

Prevalence. Recently, smoking prevalence among U.S. adults and college students has decreased by 50 percent and 30 percent respectively (Mozaffarian et al., 2015). However, smoking is still the number one preventable cause of death and illness in the U.S., with approximately 1 billion smokers in the world (Heydari et al., 2012). In 2013, 27.1 percent of young adults 18 to 20 years of age were current smokers compared with 5.6 percent of adolescents aged 12 to 17 years (Rigotti et al., 2000). Nonsmokers and occasional smokers in high school are more likely to become more frequent and heavier smokers once in college (Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004), This age group is the youngest legal target of tobacco industry marketing (Aryal, 2014).

The prevalence of nicotine use among college students is surprisingly high, but not as high as the same age individuals not enrolled in college (Wetter et al., 2004). For the majority of young adults, the transition to college represents progression into adulthood and the freedom to make self-initiated choices, including the decision whether to smoke. Many college students who have never tried smoking before may experiment with cigarettes, and students who were occasional smokers in high school are more likely to become more frequent, heavier smokers once in college (Patterson, 2004). Research has revealed that those who start smoking while young are at much higher risk of cardiovascular disease than those who start as an adult.

Social smoking, or smoking while partying or socializing is a newly identified phenomenon in the young adult population that is poorly understood. Walters (2010) surveyed 351 college smokers (18-27 years of age) enrolled in a large Midwestern university and found that 70 percent reported social smoking. The sample consisted primarily of freshmen (68.01%), living in on-campus housing (67.6%), white (93.4%), and male (52.9%). In addition, those reported that more social smokers (30.89%) than other smokers (6.8%) were members of a fraternity or sorority.

Demographics. In the United States, college men between the ages of 18-25 are more likely to smoke than females, and ethnic distributions have been shown to be 36.1% White, 15.9% African American, 25.6% Hispanic, and 23.0% Asian (Rigotti et al., 2000). This higher occurrence of tobacco use among white students, compared to other groups has been replicated in additional research (Li et al., 2003; Meier, Tackett, Miller, Grant, & Wagener, 2015; Mendis et al., 2011; Moran, Wechsler, & Rigotti, 2004). Patterson (2004) discovered that African American students are the fastest growing subpopulation of college student smokers, and Rigotti (2000) found this subpopulation also have the highest prevalence of cigar smoking.

Patterns of Tobacco Use. Young smokers commonly identify themselves as "social smokers." Social smoking is a distinct pattern of tobacco use that is common among college students and may represent a stage in the uptake of smoking (Moran, 2004). Students who smoke mainly with others rather than alone are defined as social smokers. Moran, found that social smoking was independently associated with a lower frequency and intensity of tobacco use, less nicotine dependence, less intention to quit, and fewer recent quit attempts (2004).

Intense tobacco marketing strategies targeting the young adult population also influence the smoking practices of college students. College students are the youngest target the tobacco industry can legally market, which most likely plays a role with students experimenting with various tobacco products. Due to the addictive nature of nicotine, experimentation may lead to lifelong dependency for these students, which has the potential to reverse the decline in smoking rates among American adults seen over the past 50 years (Patterson, 2004).

In the United States, cigar smoking is typically associated with older men. However, in the early 1990s, younger men and women started smoking cigars and currently is a common practice with college students. Rigotti, et al., (2005) found cigar use more common with freshman and sophomores than juniors and seniors, suggesting that cigar smoking is a new phenomenon entering the college population.

Evidence based research. Numerous studies have documented the use of nicotine among college students. Results from the Monitoring the Future Study (MTFS) for the year 2000 provides a comprehensive account of smoking rates among American college students. The MTFS is a longitudinal study in which specific subpopulations (8^{th}, 10^{th}, 12^{th} graders; college students and young adults) are presented with the same survey questions across time so the trends can be observed. In 2000, of the 1,350 college students responding to the survey, 41.3% had smoked in the past year (annual prevalence rate), daily use of cigarettes in the past 30 days was reported by 17.8% of students, where 10.1% of students stated they had smoked at least half a pack of cigarettes in the past 30 days (Patterson et al., 2004).

The 2001 Harvard College Alcohol Study (CAS) also revealed important information regarding nicotine use among college students. This large research project was a repeated measure, longitudinal study that used a randomly selected cross-section of students from 120 nationally represented 4-year colleges in the United States. Data from the 1999 sample indicated a 32% increase in smoking prevalence among US college students since 1993. However, these rates have remained stable from 1999 to 2004 (Rigotti, Moran, & Wechsler, 2005). Additional data from CAS indicates that smoking rates are very similar between the sexes; however, total tobacco use was higher in males than females due to men's increased use of cigars and smokeless tobacco (Rigotti et al., 2000).

Lifestyle patterns and tobacco use. Lifestyle patterns such as activity, athletics, and socioenvironmental influences are also correlated to a reduced smoking prevalence among college students. In a survey of more than 17,000 college students from 140 American colleges, male students who were more involved in varsity and intramural athletics were less likely to have smoked in the last 30 days than male students who did not participate (Rigotti et al., 2000). Smoking rates were not significant among female students, however, the data still showed female athletes smoking prevalence at 20% compared with 23% for those not involved in athletics (S. E. Jones, Oeltmann, Wilson, Brener, & Hill, 2001; Rigotti et al., 2000). In addition, students living in restricted housing, such as at home or in a residence hall showed lower smoking rates than those living in apartments or Greek housing options. Therefore, participation in physical activity, athletics, and living in restricted living environments appear to have protective effects on smoking.

Specific variables, such as living in Greek housing and drug use have been shown to increase smoking prevalence with college students. Data indicated that membership in a fraternity or sorority was positively associated with smoking status. Specifically, male students were almost 30% more likely to smoke and female students were almost 50% more likely to smoke if they belonged to a Greek organization (Emmons, Wechsler, Dowdall, & Abraham, 1998). Research has shown cigarette smoking rates are higher with those using multiple substances. Smokers were more than 6.5 times more likely to currently use marijuana, and almost 5 times more likely to engage in binge drinking compared to nonsmokers (Emmons et al., 1998).

Nicotine is used as a coping mechanism for those managing depression or stress. Naquin et al., (1996) found a significant increase in the number of cigarettes smoked per day, one month before examinations, compared with the day before (12.9 vs 17.9). Similar increases were observed in smoking for stimulation and exam anxiety. Smokers report higher levels of perceived stress, higher levels of emotional-focused coping skills, and higher levels of avoidance-coping skills than nonsmokers and former smokers (Naquin & Gilbert, 1996). The most significant increase in smoking behavior (54% increase) was reported among females with exam-stress and low levels of social support, while smoking behaviors remained stable among all male and female students with higher levels of social support (Steptoe, Wardle, Pollard, Canaan, & Davies, 1996). In addition, smokers were more likely to have higher levels of perceived stress, higher levels of emotional-focused coping skills, and higher levels of avoidance-coping skills than nonsmokers and former smokers (Naquin & Gilbert, 1996). Finally, according to

Emmons (1998), those with low life satisfaction, internal locus of control, and self-efficacy are more likely to smoke cigarettes.

Finally, student's attitudes and beliefs about smoking are also important. Male smokers stated that smoking made them feel more masculine compared to nonsmokers. Also, smokers reported feeling less anxious, and 56 percent of female responses felt that smoking helped them control their weight. Mines (1998), found that regular smokers of all ages were more likely than occasional smokers to report more colds and other illnesses. Interestingly, approximately 55% of regular smokers felt that their smoking habit would likely be their cause of death, compared with 25% of the occasional smokers. Although a large proportion of college students have made an attempt to quit smoking, only a minority actually succeed (Patterson et al., 2004).

Consistent with physical inactivity, smoking and problem drinking are modifiable health-risk behaviors linked to numerous chronic diseases and premature mortality. The prevalence of smoking and binge drinking markedly changes during the transition to early adulthood. However, unlike inactivity, these are considered critical threats to public health. The high prevalence of these behaviors has been notable particularly on post-secondary campuses, as the college/university environment tends to foster both smoking and drinking (Kwan, Cairney, Faulkner, & Pullenayegum, 2012).

Lifestyle factors, such as regular activity, varsity athletics, and restrictive housing environments, may be protective variables against the uptake and progression of smoking behaviors, where the use of alcohol, marijuana, and drugs, along with inactivity, and Greek life have been identified as predictors of smoking among U.S. college students (Emmons et al., 1998; Green et al., 2007).

Various forms of nicotine. For decades, college students have experimented with various forms of nicotine. Historically, cigarettes were the primary source of nicotine used by college students until the early 21st century when additional sources of nicotine use emerged. Rigotti (2000) found cigar use to be more common with freshman and sophomores than juniors and seniors suggesting that cigar smoking is a new trend for those entering the college population.

E-cigarettes. In 2003 e-cigarettes were developed in China and introduced in the United States in 2006. Since 2007, the use of e-cigarettes have been on the rise (Saddleson et al., 2015). During the past 10 years, the usage of e-cigarettes on college campuses has exponentially risen with ranges from 4.9 to 29 percent of college students reported as regular users (Littlefield, Gottlieb, Cohen, & Trotter, 2015; Sutfin, McCoy, Morrell, Hoeppner, & Wolfson, 2013). In 2014, e-cigarettes became the most commonly used tobacco product among young adults (Saddleson et al., 2015). Student involved in risky behaviors such as tobacco, marijuana, or alcohol use are associated with using e-cigarettes (Saddleson et al., 2015). Some consider e-cigarettes or vaping as a safer alternative to tobacco cigarettes; however, e-cigarettes still delivers nicotine. Nicotine use among young adults may cause lasting harm to brain development and lead to addiction.

Hookah smoking. During this same time period, Hookah use has also risen among college students. National data indicates nearly 25 percent of college students have smoked from a hookah (Braun, Glassman, Wohlwend, Whewell, & Reindl, 2012). Compared to nonsmokers, cigarette, hookah, and dual users were more likely to be younger, male, White, and use other substances (including alcohol), members of a Greek Life, live in the West, and attend larger institutions of higher education (Jarrett, Blosnich, Tworek, & Horn, 2012). It appears that students engage in smoking hookah for social reasons and underestimate the additive exposure that comes with the deep inhalations and prolonged periods of use associated with this nicotine delivery system. Hookah is becoming the first tobacco product tried by many college students (Meier et al., 2015). Risky behaviors such as additional tobacco use, marijuana, and alcohol use have been associated with using e-cigarettes and hookah (Heinz et al., 2013; Saddleson et al., 2015). Regardless of the source or the trends taking place college campuses, all methods expose the user to nicotine, increase the risk of CVD substantially and should be avoided (Sutfin et al., 2013). See Appendix A for prevalence of nicotine use.

Research as compared the nicotine content of a cigarette to a hookah session. According to Cobb (2010), a hookah session typically involves close to 200 puffs, with an average puff volume exceeding 500 ml. In comparison, a cigarette involves 20-13 puffs with an average volume of 50 ml per puff. Also, a cigarette is typically completed within five minutes while a single hookah session last approximately 60 minutes. Therefore, the typical inhalation from a single cigarette is approximately 500-600 ml of smoke, while the typical inhalation from a hookah session can equate to the inhalation of approximately 90,000-100,000 ml of smoke. See Table 1 for comparative inhalation data for hookah smoking compared to cigarette smoking.

Table 1

Mean Puff Topography for Hookah Users and Cigarette Smokers

Topography Variable	Hookah N = 20[24]	Hookah N = 52[22]	Cigarette N = 30[25]	Cigarette N = 56[26]
Puff number	178.0	171.0	10.0	12.7
Puff volume (ml)	590.0	530.0	51.0	48.6
Puff duration (s)	2.8	2.6	1.4	1.5
Interpuff interval (s)	15.2	15.5	30.7	21.3

Note. The Mean Puff Topography for Hookah Users and Cigarette Smokers is from the American Journal of Health Behavior (2010).

The damage nicotine produces in the body is significant and varies by specific form. For example, the risk of a non-fatal heart attack increase by 5.6 percent for every cigarette smoked and persists even with only one to two cigarettes per day (Vollset, Tverdal, & Gjessing, 2006). Chewing tobacco more than doubles the risk of a heart attack (Center for Disease Control, 2010). Smoking cigars is a known risk factor for CVD, certain cancers and chronic obstructive pulmonary disease (COPD). Low-tar cigarettes were not developed until the 1960s and 1970s and ultra-light cigarettes are even more recent. However, nicotine is present in all these products and researchers conclude that the evidence on low-tar cigarettes has the same risk as medium-tar cigarettes. Therefore, cigarettes, low-tar and ultra-light cigarettes, chewing tobacco cigars, e-cigarettes or vaping, and hookah all contain nicotine, are addictive, and increase the risk of heart disease substantially, and therefore should be avoided.

Dangers of young adult use. Those who start smoking while young are at much higher risk of cardiovascular disease than those who start as an adult (Halperin, Smith, Heiligenstein, Brown, & Fleming, 2009). For those less than 35 years of age, smoking is one of the main risk factors associated with an acute myocardial infarction (MI) compared to those 65 and older. Berenson et al., (1998), showed that fatty streak lesions in the coronary vessels were higher in young smokers compared to nonsmokers.

A study investigated cigarette smoking and associated health risks among students at five universities. Nearly 25 percent of students had never tried nicotine, 41 percent reported less than one cigarette/day, 80 percent of the daily smokers smoked less than 10 cigarettes per day, and 45 percent of the students smoked more than 10 cigarettes per day and met criteria for tobacco dependence (Halperin et al., 2009). Smoking has been found to be associated with high-risk alcohol use, dangerous driving, relational abuse, depression, lack of exercise, and use of emergency and mental health services (Halperin et al., 2009).

Benefits of Tobacco Cessation. Although smoking causes a great deal of damage to the body, quitting smoking has numerous benefits that can be measured at soon as 20 minutes after quitting. Further benefits are noticeable with additional time of no smoking. Within 15 years of no smoking, one's risk of cardiovascular disease becomes nearly the same as the individual who has never smoked (McArdle et al., 2010). Numerous approaches exist to help people stop smoking. These include nicotine-replacement patches, gum, and prescribed oral medication. Based on these collective research findings, health promotion programs focusing on smoking prevention and cessation for college students are essential.

Hypertension

The public health burden of hypertension is enormous. In the United States, about 77.9 million (1 of every 3) adults have high blood pressure (Bonaca et al., 2012). High blood pressure or hypertension is a major modifiable risk factor for CVD. Hypertension is the leading cause of CVD worldwide (Mendis et al., 2011).

Uncontrolled hypertension can lead to a cascade of more serious cardiovascular conditions such as heart disease, peripheral vascular disease, and stroke. Hypertension has been found in 69 percent of first heart attacks, 77 percent of first stroke, and 74 percent of congestive heart failure (Go et al., 2013). Additionally, high blood pressure is associated with kidney failure and premature mortality and disability. In 2009, high blood pressure was listed on 61,762 American death certificates as the primary cause of death and as a primary or contributing cause of death in about 348,102 cases of the more than 2.4 million U.S. deaths (Bonaca et al., 2012).

Hypertension tends to increase with age and is often referred to as the "silent killer" because the disease typically has no warning signs or symptoms. Unless blood pressure is measured on a regular basis, elevated high blood pressure may go undetected. According to Yoon et al., (2010), an estimated 19.4 percent of adults with hypertension were unaware they had the condition. Untreated hypertension can cause an increase in morbidity and mortality.

Blood pressure is the force of blood pushing against the walls of the arteries as the heart pumps blood. Blood pressure is measured as two numbers, written one over the other and recorded in millimeters of mercury. Blood pressure varies with activity and age, but an average blood pressure is 120/80 mm/Hg. The first number is the systolic pressure and represents the amount of pressure in the arterial system as the heart contracts. The second number is the diastolic pressure or the pressure in the arterial system when the heart is relaxed or between beats. If this pressure rises and remains elevated over time, it can damage the body in many ways.

Associated Risk factors. As with many chronic diseases, risk factors associated with hypertension as identified as obesity, excessive alcohol, smoking, age, high sodium intake, and family history. Hypertension increases the risk of heart disease, heart attack, and stroke. In addition, those who are obese, smoke, or have high blood cholesterol along with high blood pressure, greatly increase the risk of both heart disease and stroke. Additionally, those with hypertension have a greater likelihood of developing type II diabetes and having various complications from both type I and type II diabetes (Sowers et al., 2001). In a large, prospective study that included 12,550 adults, the development of type II diabetes was almost 2.5 times as likely in an individual with hypertension compared with normotensive counterparts (Gress, Nieto, Shahar, Wofford, & Brancati, 2000; Sowers et al., 2001). The increase prevalence of hypertension in diabetics suggests that the two common chronic diseases often coexist. According to Sowers (2001), although each pathophysiological disease is independent of the other, each condition exacerbates the other.

Demographics. Hypertension affects both men and women; however, notable patterns have been revealed. Men tend to have a higher prevalence of high blood pressure until age 45. During middle age 45 to 64, the prevalence of hypertension is similar between men and women. Beyond the age of 65, a higher prevalence of women tend to have high blood pressure (Gerald S. Berenson, 2001; Huang et al., 2003). It is recommended that blood pressure monitoring continue throughout the lifespan for both men and women.

Prevalence. Hypertension is one of the most important causes of premature death worldwide and the prevalence is growing (Mendis et al., 2011). Currently, nearly one billion people have high blood pressure and it is estimated that by 2025, approximately 1.56 billion adults will be living with hypertension (Sowers et al., 2001).

According to the National College Health Assessment (Association, 2013) approximately 3 percent of college students have known hypertension. Atherosclerotic lesions that cause CVD are correlated ($p < .05$) to systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, LDL-C, and triglycerides (Berenson, et al., 1998). According to Pyle, Lalumandier, & Sawyer, (2000), approximately 31 percent of adult Americans had hypertension, 3.4 percent of college students had hypertension, and college males had a greater occurrence than age-matched females. In a 12-year follow-up study, CVD was significantly associated with blood pressure, total cholesterol, LDL cholesterol, and HDL cholesterol (all $p <.001$) (Wilson et al., 1998). Approximately 28 percent of CVD events in men and 29 percent in women were related to blood pressures that exceeded 130/85 mg/dL. Unless blood pressure is measured on a regular basis, elevated high blood pressure may go undetected. Untreated hypertension can cause to an increase in morbidity and mortality.

A single or isolated blood pressure measurement should not be used for evaluation purposes. Numerous variables can alter a blood pressure including stress; fatigue, sleep deprivation, influence of stimulates, and exercises. Therefore, a series of blood pressure assessments should be taken for a comprehensive evaluation regardless of age. Screening of blood pressure elevation, even in younger adult groups not usually associated with hypertensive disease, can identify individuals needing further medical evaluations (Pyle, 2000). Blood pressures as assessments are simple and inexpensive, and should be monitored during the college years. A classification matrix for adult blood pressure values is presented in Table 2.

Table 2

Adult Blood Pressure Values

Blood Pressure Category	Systolic (mm/Hg)	Diastolic (mm/Hg)
Normal	< 120	<80
Prehypertension	120 – 139	80 – 89
High Blood Pressure (Stage 1)	140 – 159	90 – 99
High Blood Pressure (Stage 2)	≥ 160	≥ 100
Hypertension Crisis (Emergency Care Needed)	≥ 180	≥ 110

Note. Adult Blood Pressure Values is from The Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report from the Panel Members Appointed to the Eighth Joint National Committee (JNC 8). (2014).

Screening guidelines. The American Heart Association (AHA), recommends that blood pressure screening begin at age 20 if not before. Follow-ups should be performed once every two years if blood pressure is normal and every 6 months if hypertensive (Go et al., 2014).

Blood Lipids

A significant risk factor for heart disease is elevated blood cholesterol. Cholesterol is a waxy, fat-like substance carried in the blood and found within all cells of the body (Gibbons et al., 2013). It facilitates the absorption and transport of fatty acids, aids in tissue synthesis, and is necessary for the production of steroid hormones including cortisol, cortisone, and aldosterone in the adrenal glands and the sex hormones progesterone, estrogen, and testosterone (Glanze, Anderson, & Anderson, 1990).

Sources of Cholesterol. There are two sources of cholesterol. First, cholesterol is continuously synthesized in the liver and is known as endogenous cholesterol. Second, cholesterol that enters the body when animal products are consumed is exogenous cholesterol.

Animal products tend to be high in both cholesterol and saturated fat and therefore, should be kept to a minimum. Selecting low-fat animal proteins, including dairy products is highly recommended by the AHA.

Low Density Lipoproteins (LDL). Cholesterol is transported in the body by different lipoproteins. Low density lipoproteins (LDLs) are protein molecules produced by the liver and contain a greater percentage of cholesterol and triglycerides than protein. Cholesterol combines with fat, calcium, and other substances in the blood and collectively form a substance referred to as plaque. LDL's transport cholesterol and plaque and deposit these substances on the surface of the endothelium cells in the arteries throughout in the body. As plaque slowly accumulates over time, it hardens the arteries and narrows the vessel diameter obstructing blood flow which increases the risk for a heart attack, stroke, or chronic heart disease. LDL cholesterol is often referred to as the "bad" cholesterol; therefore, it is imperative to keep the LDL values as low as possible.

High Density Lipoproteins (HDL). Cholesterol can also be transported throughout the body by high density lipoproteins (HDLs). HDLs have a greater percentage of lipoprotein along with cholesterol and triglycerides. HDL molecules transport cholesterol and other lipids to the liver for excretion or re-utilization. An increased concentration of HDL particles is strongly associated with decreased accumulation of atherosclerosis within the walls of the arterial system and decrease the risk of a cardiac event. HDLs are sometimes referred to as "good cholesterol" and should be maintained in high concentration in the blood.

Cardiovascular disease (CVD) is a chronic condition in which plaque builds up in the arterial walls and lumen of the coronary arteries. Atherosclerosis is the term used to identify this accumulation of plaque. Individuals with high blood cholesterol have a greater chance of developing CVD. By itself, the condition usually has no signs or symptoms, therefore, many may not be aware of elevated cholesterol levels until symptoms develop and CVD disease is diagnosed.

Normative values. Blood lipids are measured by a blood analysis known as a complete blood lipoprotein panel. The panel is used to measure total cholesterol, low-density lipoproteins (LDL- cholesterol), high-density lipoproteins (HDL-cholesterol), triglycerides (a type of fat found in the blood), and fasting glucose (a screening for diabetes). All levels are measured in milligrams (mg) per deciliter (dL) of blood (Lorenzo, Williams, Hunt, & Haffner, 2007; Panel, 2002). See Table 3 for recommended lipid and glucose levels.

Table 3

Recommended Blood Lipids and Glucose Levels (mg/dL)

Variable	Optimal	Intermediate	High
Total Cholesterol	< 200	200 – 239	≥ 240
LDL Cholesterol	< 130	130 – 159	≥ 160
HDL Cholesterol	≥ 40 in men	30 – 39	< 30
	≥ 50 in women	40 – 49	< 40
Triglycerides	≤ 150	151 – 199	≥ 200
Glucose	< 100	100 – 126	≥ 127

Note. LDL = Low Density Lipoprotein, HDL = High Density Lipoprotein

Association of dyslipidemia and cardiovascular disease (CVD). The association between dyslipidemia and CVD was first established from the Framingham Study in 1960 (Kannel, Castelli, Gordon, & McNamara, 1971). Additional epidemiological studies have since established dyslipidemia as a major independent risk factor for CVD (Downs et al., 1998; Kannel et al., 1971; Kannel, McGee, & Gordon, 1976; Lloyd-Jones et al., 2010; Murguía-Romero et al., 2013). Additionally, a study of patients with metabolic syndrome (a clustering of risk factors) demonstrated that dyslipidemia was the most significant contributor to CVD risk (Tuomilehto, 2004).

Screening guidelines. The American Academy of Pediatrics (AAP) (2008), recommends that all children have their cholesterol levels tested between the ages of 9 and 11, and again between the ages of 17 and 21 even if they do not have a family history of heart disease. Additional guidelines come from the National Heart Lung Blood Institute (NHLBI) and are titled The National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III). These guidelines were developed after an extensive review of the literature and recent clinical trials. The NCEP ATP III (2002) recommends that routine screening for blood lipids begin at age 20 and every five years after, which is consistent with the United States Preventive Service Task Force (USPSTF) (Lorenzo et al., 2007) and the AAP. The college years appear to be the ideal time to begin a lipid panel screening. College students should be aware of their blood lipids and become educated on lifestyle behaviors that promote heart health throughout their adult life.

Dyslipidemia or high blood fats directly relate to pathological changes, functional abnormalities, and strongly predict CVD in adulthood (Cohn, Quyyumi, Hollenberg, & Jamerson, 2004). Approximately 24.3 percent of children and 53.4 percent of adults have elevated blood cholesterol levels (Go et al., 2014; Mozaffarian et al., 2016). The prevalence of ideal cholesterol levels in children have lowered over the past decade, but remain unchanged in adults. According to the 2009 to 2012 data, more than 100 million US adults have a total cholesterol level ≥ to 200 mg/dL; almost 31 million exceed 240 mg/dL (Mozaffarian et al., 2015). From 2003 to 2012, the percentage of adults using cholesterol-lowering medications increased from 20 to 28 percent.

Key findings with children. The Muscatine Heart Study began in 1970 and is one of the longest running studies of cardiovascular risk factors in children in the United States. Between 1970 and 1981, 11,377 students from Muscatine, Iowa participated in the initial research project and were followed up 12 years later at ages 20 to 38 years. Children with elevated cholesterol, blood pressure, and BMI had similar findings as an adult, as well as a cardiovascular related cause of death (Lauer, Lee, & Clarke, 1988).

Key finding with college students. Research has shown that as high as 27 percent of college students have an elevated total cholesterol level, which was the most prevalent risk factor measured (Burke, Reilly, Morrell, & Lofgren, 2009). Morrell et al., (2012) found slightly over 25 percent of her college sample had elevated total cholesterol levels. According to the CDC (2013), 9.5 percent of men and 10.3 percent of women aged 20 to 34 have high cholesterol. Snow and Beavers (1999) studied 1,088 college students and reported 11.1 percent had elevated cholesterol levels. Within the subset, 9.1 percent were considered borderline high and 2 percent were in the high risk category. In addition to elevated total cholesterol levels, Fernandes et al., (2011) and Huang et al., (2007) found 10 percent and 23.9 percent had low HDLs receptively.

Reduction benefits. The risk of a heart attack decreases by 2 percent for every 1 percent decrease in blood cholesterol. Additionally, decreasing LDLs and increasing HDLs minimizes plaque deposits within the coronary arteries leading to disease reduction.

Diabetes

Over the past two decades, the prevalence of diabetes has increased substantially (Selvin, Parrinello, Sacks, & Coresh, 2014). Between 2001 and 2009, type II diabetes increased by 30.5 percent in children and adolescents and now accounts for approximately 50 percent of all childhood diabetes. In 2008, 10 percent of the world's population was diagnosed with diabetes, which ultimately was responsible for 1.3 million deaths globally. Currently, diabetes affects 1 in 10 adults, with 90 to 95% of cases being type II diabetes (Mozaffarian et al., 2015). Diabetes and associated complications decreased longevity in both men and women by an average of 7.5 to 8.2 years (Mozaffarian et al., 2015).

Associated risk factors. Those with diabetes and CVD have several characteristics in common including age, obesity, smoking, sedentary lifestyles, android fat distribution patterns, and dyslipidemia characterized by elevated triglycerides, low levels of high density lipoproteins (HDL) cholesterol and small, dense low-density lipoproteins (LDL) particles when compared to nondiabetic counterparts (Pérez, Soto-Salgado, Suárez, Guzmán, & Ortiz, 2015; Resnick & Howard, 2002). Diabetes is not associated with gender, nor does gender appear to influence the progression of glucose disorders (Resnick & Howard, 2002). Diabetes and prediabetes raise the risk of CVD more in women than in men. Prior to menopause circulating estrogen protects women against CVD; however, the protective effect is not evident in diabetic women exposing them to twice the risk of developing CVD (Mendis et al., 2011).

Many ethnic groups show higher rates of CVD and diabetes. Non-Hispanic blacks, Mexican-Americans, American Indians, and Alaska Natives have a higher prevalence of diabetes than Non-Hispanic White adults (Go et al., 2013; Winston, Barr, Carrasquillo, Bertoni, & Shea, 2009). Likewise, the data have shown African Americans and Hispanic women have a less favorable profile than non-Hispanic White women (Winston et al., 2009).

Association with cardiovascular disease (CVD). Diabetes is a powerful, independent risk factor for CVD. Additionally, CVD is the most common and costly vascular complication of diabetes (Lorenzo et al., 2007). The close association between diabetes and CVD suggests that the significant increase in the prevalence of type 2 diabetes foreshadows an equally daunting rise in the incidence of CVD. The importance of diabetes is often underestimated. Data suggest that diabetes increases the risk of CVD two- to-threefold in men and four-to-six fold in women and a two-fold increase in the risk of stroke (Howard & Magee, 2000). Diabetes accounts for up to 80 percent of deaths in those with CVD (Sowers et al., 2001). Diabetics also have a poorer prognosis after a cardiovascular event compared to those without diabetes. For those with diabetes, 60 percent of mortality is associated with CVD (ADA, 1997). In addition, a large number of longitudinal cohort studies indicate that diabetes increases the risk of CVD two- to-threefold in men and four-to-six fold in women (Howard & Magee, 2000). Diabetics also have a two-fold increase in the risk of stroke (ADA, 1997).

Patients with diabetes have a poorer prognosis after cardiovascular events compared to those without diabetes. In 2008, 10 percent of the world's population was diagnosed with diabetes, which ultimately is responsible for 1.3 million deaths globally. Diabetes and prediabetes raises the risk of CHD more in women than in men. Prior to menopause circulating estrogen protects women against CVD. However, in women with diabetes, the disease inhibits the protective effects of estrogen and exposes the female to double the risk of developing CVD (Mendis, 2011).

A meta-analysis of 37 studies estimated the relative risk of fatal CVD associated with diabetes in both men and women. The rate of fatal CVD was higher in patients with diabetes than in those without (5.4 vs. 1.6%). In addition, the relative risk for fatal CVD in diabetics compared to non-diabetes was significantly greater among women when compared to men, 3.5, (95% confidence interval 2.70 to 4.53 vs. 2.06, 1.81 to 2.34). Conclusive results showed the relative risk for fatal CVD associated with diabetes is 50% higher in women than men (Huxley, Barzi, & Woodward, 2006).

Normative values. Diabetes mellitus is a disease defined as a fasting blood glucose value of 126 mg/dL(Mendis et al., 2011; Metzger, Coustan, & Committee, 1998; Organization, 2016). Prediabetes is a condition in which blood glucose levels are higher than normal, but not as high as diabetic levels. A prediabetic blood glucose value is between 100 – 125 mg/dL, and is a risk factor for both diabetes and CVD. By comparison, a normal fasting blood glucose level is <100 mg/dL.

Those with type 2 diabetes commonly have distinct physical and metabolic profiles. Diabetic individuals are considerably heavier than their nondiabetic counterparts are, have an android fat distribution pattern, are less active, have dyslipidemia characterized by elevated triglycerides, low levels of high-density lipoproteins (HDL) cholesterol and small, and dense low-density lipoproteins (LDL) particles. (Resnick, 2002). Additionally, smoking has repeatedly been associated with development of diabetic complications and increased mortality risk. Therefore, it is important for those with diabetes to monitor and control CVD risk factors including not using nicotine, establishing normal blood pressures, lowering LDL cholesterol levels, controlling weight, and participating in regular physical activity (Howard & Magee, 2000).

Physical Activity

It is well established that regular physical activity (PA) is beneficial in improving physiological and psychological health (Association, 2009, 2012; Bacon, Sherwood, Hinderliter, & Blumenthal, 2004; Barry et al., 2014; Blair & Church, 2004; Blair, LaMonte, & Nichaman, 2004; Dinger, Brittain, & Hutchinson, 2014; D. W. Jones & Hall, 2004; Kemmler & von Stengel, 2013; Lowry et al., 2000; Nguyen-Michel et al., 2006; Paffenbarger, Wing, & Hyde, 1978; Sacheck, Kuder, & Economos, 2010; Suminski, Petosa, Utter, & Zhang, 2002). Based on the numerous benefits associated with regular activity, one might assume that habitual activity is the norm among Americans. However, epidemiological research has shown substantial declines in physical activity from high school to college. According to Kilpatrick (2005), 38 percent of college students participate in regular vigorous activity compared to 65 percent of high school students and 20 percent of college students participate in moderate physical activity compared to 26 percent of high school students. Additionally, physical activity patterns in college students are usually insufficient to improve fitness and health. Additionally, almost 50 percent of college students have further decreases in their physical activity post-graduation (Kilpatrick, Hebert, & Bartholomew, 2005).

Healthy Campus 2020 identifies physical inactivity as 1 of 11 priority health objectives for the college population (Association, 2012; Keating, Guan, Piñero, & Bridges, 2005). According to Sparling (2002), the physical activity patterns established in college are likely to be maintained into adulthood and influence long-term adult health status. The importance of lifelong activity patterns were seen in a meta-analysis that revealed normal weight fit individuals had 50 percent less mortality when compared to unfit individuals regardless of BMI (Barry et al., 2014).

Prevalence of physical activity (PA). Physical activity patterns are well researched and documented in all groups. The most significant declines in regular physical activity are during adolescence (Ages 15-18) and young adulthood (ages 18-25) (Wallace, Buckworth, Kirby, & Sherman, 2000). Additionally, data from national health-related surveys show that approximately 67.0 percent of high school students, 37.6 percent of college students and 14.0 percent of adults participate in vigorous physical activity. Documented changes with moderate physical activity across the age groups is more constant, with 21.1 percent of high school students, 19.5 percent of college students, and 19.7 percent of adults engaging in a more moderate form of regular physical activity. By age 21, 42.0 percent of males and 30.0 percent of females' report participating in regular vigorous physical activity (Wallace et al., 2000).

Health benefits associate with physical activity (PA). The association between PA and positive health outcomes are well established. Those who exercise regularly or maintain an active lifestyle have a lower incidence of CVD. Specifically, a strong inverse relationship exists between activity and blood pressure, blood lipid levels, blood glucose levels, and obesity (Lowry et al., 2000; Steffen et al., 2001), healthier food choices (Lowry et al., 2000), blood clotting factors, stress management (Steffen et al., 2001) and the health of blood vessels and inflammation (Alberti et al., 2009), which are all risk factors for either promoting or decreasing CVD.

Transitioning through college can be a very stressful time. A literature search produced 55 studies that examined the influence of stress on physical activity (PA) and the majority (76.4%) indicated that psychological stress predicted less PA and more sedentary behavior (Stults-Kolehmainen & Sinha, 2014).

Prevalence of activity among college students. In the fall 2009 the National College Health Assessment (NCHA) was completed by the American College Health Association (ACHA). The report indicated that 43.6 percent of college students met the recommendations for moderate or vigorous exercise or a combination of both. Males were more active than females, 50.4 percent and 39.9 percent, respectively (Dinger et al., 2014). With respect to exercise intensity, 18.2 percent exercised moderately three to seven days, 55.1 percent exercised moderately one to four days, and 26.7 percent did not exercise at all during the last week. Regarding vigorous-level intensity, 26.3 percent reported exercising vigorously three to seven days, 30.2 percent reported exercising vigorously one to two days, and 43.5 percent of students reported that they did not exercise at all during the last seven days (Dinger et al., 2014). In addition, the assessment found that according to Body Mass Index (BMI), 61.8 percent of students were at a healthy weight (36.2 percent male and 63.8 female), 21.2 percent were considered overweight (26.1 percent male and 18.4 percent female) and 17.0 percent were obese.

Consequences of inactive lifestyles. Inactive individuals are twice as likely to develop CVD as those who are physically active. A lack of physical activity can exacerbate other CVD risk factors, such as high blood cholesterol, triglycerides, high blood pressure, prediabetes, diabetes, overweight and obesity (Gibbons et al., 2013). Regular exercise has been shown to improve health, weight management, mental concentration, and energy levels, while reducing stress and anxiety (Blair et al., 2004).

Overweight/Obesity Indisputable evidence links obesity to multiple health problems. As early as the 1920s, a significant association between body weight and blood pressure was noted in men (Dublin, 1925; Symonds, 1923). Several epidemiological studies have confirmed this association throughout the decades. The Framingham Study found that hypertension is about twice as prevalent in the obese as the non-obese for both genders (Hubert, Feinleib, McNamara, & Castelli, 1983). Data from the Muscatine Heart Study showed that obese children had higher blood pressure levels than lean children (Lauer, Connor, Leaverton, Reiter, & Clarke, 1975). Additionally, the Nurses' Health Study found a 2-to 6-fold greater prevalence of hypertension among obese women (Manson et al., 1995).

Data from the Framingham Study further supported the relationship between overweight and elevated blood pressure. According to Higgins (1998), those with the highest body mass index (BMI) exhibited 16 mmHg higher systolic and 9 mmHg higher diastolic blood pressures than those with lower BMIs. For systolic blood pressure, this translated into an increase of 4 mmHg for each 4.5 kg (10 pounds) of increased weight. In addition to elevated blood pressure, overweight and obesity are correlated with an increased risk of CVD. Young adults with a BMI of 25 kg/m^2 have 1.5 to 2 times greater risk for developing CVD than those maintaining a healthy body weight (Gerald S Berenson et al., 1998; Hubert et al., 1983).

Prevalence of obesity. Obesity has been classified as an epidemic, and is evident among all age groups. Globally, at least 2.8 million people die each year because of being overweight or obese. Worldwide, one in 10 children is estimated to be overweight. In the United States, the number of overweight adolescents has tripled since 1980, and research has shown that 66% of adults are overweight or obese (Ogden et al., 2006). In 2008, 9.8 percent of men and 13.8 percent of women were obese, compared to 4.8 percent for men and 7.9 percent for women in 1980 (Ogden et al., 2006). Young overweight individuals have a greater risk of becoming obese adults and suffering negative health consequences associated with the condition when compared to non-overweight young individuals (Das & Evans, 2014).

Weight gain during the college years is considerably higher than the general population over the same time-period. According to Arts et al., (2014), college students gain weight up to 11 times faster than young adults not in college and typically, the weight is maintained throughout college and into adulthood. Contributing environmental stimuli include "all-you-can-eat dining halls, snacking on high-fat junk foods, and decreases in activity patterns (Levitsky, Halbmaier, & Mrdjenovic, 2004).

Consequences of overweight and obesity. Overweight and obesity can increase the risk of heart disease in several ways including: a ten-fold increase in developing high blood pressure, an increase in diabetes, a decrease in high density lipoproteins (HDL) or "good" cholesterol, an increase the development of noninsulin dependent diabetes (NIDDM) , and a less active activity pattern (Chobanian et al., 2003; Harsha & Bray, 2008). Clearly, these consequences are significant and deserve the attention of the medical community, school administrators, educators, parents and children.

Weight patterns with college student. The National College Health Assessment surveyed over 80,000 college students throughout the country and found 30% of respondents were overweight or obese (Morrell, et al., 2012). It has been shown that from the freshman to senior year females gained from 3.75 to 9.92 pounds and males gained from 9.26 to 14.22 pounds, accounting for a weight increase of 8 percent (Racette, Deusinger, Strube, Highstein, & Deusinger, 2008).

According to Sacheck (2010), 60% of the college student population has body fat percentages above desirable levels. This phenomenon was associated with increased cholesterol and LDL in both men and women, as well as increased triglycerides and decreased HDL in women ($p < 0.05$). When dichotomized into "fit" and "unft" groups, the fit demonstrated more optimal levels of serum glucose and lipids independent of percentage of body fat ($p > 0.05$). Finally, according to Fernandes (2011), obese college students were more likely to have three or more risk factors for metabolic syndrome and males had more risk factors than females.

Student's perception of physical activity. Although college students rank physical activity and nutrition as their top health promotion and education priorities, few interventions target this population (Das & Evans, 2014; Dinger et al., 2014; Poobalan, Aucott, Precious, Crombie, & Smith, 2010). In keeping with the strong message that prevention is important for inhibiting chronic disease, weight management interventions for this young adult population are critical (Das & Evans, 2014). Preventive measures to reduce the incidence of overweight are critical for improving the health of college students and our nation (Racette et al., 2008).

Metabolic Syndrome

Due to the increases in weight, hypertension, and dyslipidemia in young adults, metabolic syndrome is becoming increasingly common (Lakka et al., 2002).

Criteria for metabolic syndrome. Metabolic syndrome is a clustering of interrelated risk factors and has been defined as having dyslipidemia, hypertension, hyperglycemia, and large waist circumference. Metabolic syndrome is considered a precursor for CVD and diabetes (Fernandes & Lofgren, 2011). See table 4 for criteria for diagnosing metabolic syndrome (Alberti et al., 2009).

Table 4

Criteria for Metabolic Syndrome

	Defined Level for Metabolic Syndrome	
Risk Factor	Males	Females
Waist circumference	≥ 90 cm	≥ 80 cm
HDL	≤ 40 mg/dL	≤ 50 mg/dL
Triglycerides	≥ to 150 mg/dL	≥ to 150 mg/dL
SBP	≥ 130 mmHg	≥ 130 mmHg
DBP	≥ 85 mg/Hg	≥ 85 mg/Hg
Glucose	≥ 100 and ≤ 126 mg/dL	≥ 100 and ≤ 126 mg/dL

Note. The Criteria for Metabolic Syndrome is a joint interim statement from the international diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; and international association for the study of obesity. Circulation (2009).

HDL = High Density Lipoproteins, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure

Prevalence of metabolic syndrome. The prevalence of metabolic syndrome increases with age. According to the National Health and Nutrition Examination Survey (NHANES) (2003-2006) data, the prevalence of metabolic syndrome in the U.S. is 34 percent. In the 20 to 39-year group, Ervin (2009) reported metabolic syndrome in 20.3 percent of males and 15.6 percent of females. Although metabolic syndrome affects White women and men equally, it is more common in African American and Mexican American women than in men of the same racial groups (Huang et al., 2007).

College students and metabolic syndrome. Huang (2004) found the following risk factors: 1.8 percent for large waist circumference and for impaired fasting glucose levels, 2.5 percent had high triglycerides, 13.5 percent had low HDL cholesterol, and 1.2 percent had high blood pressure. Additional CVD risk factors included: 11.7 percent had high total cholesterol levels, 5.5 percent had high LDL cholesterol levels, 26 percent smoked, and 27 percent were overweight. In a follow-up study, data showed males were more obese, hypertensive, and had higher triglycerides than females (Huang et al., 2007).

A study of more than 800 college students from the University of New Hampshire showed one third of the participates were overweight or obese, and 66 percent of males and 50 percent of females had at least one risk factor for metabolic syndrome (Sowers et al., 2001).

Association of cardiovascular disease and mortality. According to Fernandes et al., (2011), metabolic syndrome occurs in young adults and should be screened for due to its association with CVD. A systematic review and meta-analysis of longitudinal studies assessed the association between metabolic syndrome and CVD and mortality. Thirty-seven eligible studies with 43 cohorts and 172,573 individuals were reviewed. The overall pooled risk ratio (RR), for cardiovascular events and death for those with metabolic syndrome was 1.78 (95%

confidence interval (CI 1.58 to 2.00) (Gami et al., 2007). Additionally, the risk of cardiovascular events and death were higher for women compared to men (RR 2.63 vs. 1.98, p = 0.09) (Gami et al., 2007). Therefore, available evidence suggests that those with metabolic syndrome are at an increased risk for CVD and death. Identifying metabolic syndrome early in life can be helpful in targeted interventions designed to lower the risk of future development of this disease along with CVD, and diabetes.

Conclusion

Morbidity due to CVD is generally related to the extent of vascular lesions (Berenson, 1998). Therefore, identifying associated risk factors is considered a useful tool in predicting the severity of atherosclerosis. It is well known that the accumulation of fatty streaks and fibrous plaques in the coronary arteries and aorta increase with age. Among the cardiovascular risk factors, body mass index (BMI), systolic and diastolic blood pressure, serum concentrations of total cholesterol, triglycerides, low-density lipoprotein cholesterol, and high density lipoprotein cholesterol, and smoking were associated with the magnitude of lesions in the aorta and coronary arteries (Berenson, 1998). Furthermore, multiple risk factors had a significant impact on the development of atherosclerosis.

Epidemiologic studies have shown cardiovascular risk factors have a tendency to reinforce each other and have an influence on morbidity and mortality (Berenson, 1998). These studies have also shown that risk factors tend to associate and present in combination with other relatable factors. Clustering of risk factors has been identified in childhood and continues into young adulthood (Tamragouri, 1986). Therefore, the presence of multiple risk factors may indicate that the development of atherosclerosis may be accelerated in young individuals as these multiple risk factors have the potential to increase the likelihood of a cardiovascular event.

This literature provides an abundance of evidence indicating that risk factors for CVD begin at a young age, increase during college, and carry forward into adulthood. Although the importance and need for preventive screening is recommended by the AHA, NHLBI, and the AAP, the majority of young adult are not screened (Kuklina et al., 2010). The literature supports the importance of identifying those at risk for CVD so that steps can be taken to manage, alleviate, and prevent future CVD risk factors (Arts et al., 2014).

CHAPTER 3: METHODOLOGY

Using a non-experimental, cross-sectional research design, the investigator identified the prevalence and clustering of risk factors associated with cardiovascular disease (CVD) in undergraduate student ages 18 – 25 years old enrolled at Colorado State University (CSU), during the spring semester, 2017.

In addition to studying risk factors for cardiovascular disease (CVD) with this student sample, the author also was interested in alcohol and drug use among these students. These variables were included in the study due to the high rate of use in the college student population. Additionally the Center of Disease Control has suggested that additional CVD risk factors to consider are gender, poor diet, and excessive alcohol use with this age group (Al-Asadi, 2006).

The research questions addressed in this study were as follows:

1. What is the prevalence of each CVD risk factor (family history, gender, nicotine use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30)) for the CSU student sample?
2. For each CVD risk factor found in the CSU student sample, what differences are seen in prevalence between genders, ethnic groups, and class status?
3. What are the differences in CVD risk factors found with the CSU data compared to data from the National College Health Assessment (NCHA)?
4. What correlations exist among the 11 CVD risk factors identified in the CSU student population?

5. Do CSU students cluster together based on CVD risk factors? If so, how many clusters emerged from the data and what combinations of risk factors make each cluster unique?

Research Design and Sample

A non-experimental, cross-sectional research design was used. The research study explored differences among a variety of subgroups of undergraduate college students. The study was based on the post-positive paradigm. According to Creswell (2002), complicated problems are composed of knowledge and facts that are more comprehendible when broken into smaller parts. Based on the post positive paradigm, absolute truth can never be found; therefore, research questions are tested but do not lead to conclusions about absolute truth (Guba & Lincoln, 1994). A quantitative framework was used to answer the research questions, which is typical with a post positive paradigm (Creswell, 2002; Gliner et al., 2000).

A convenience sample was used to examine the prevalence and clustering of CVD risk factors among undergraduate college students attending Colorado State University (CSU). Study participates were undergraduate students between the ages of 18 and 25, enrolled at CSU during the spring semester of 2017. Students outside the specific age range were not included in the study.

Established in 1870, CSU is a public university in the Rocky Mountain region. It is the state's land-grant institution located in Fort Collins, Colorado. According to the CSU Institutional Research, Planning and Effectiveness website (2017), the total student population enrolled at the main campus at CSU during the spring semester of 2017 was 26,213. Breakdown by academic level includes 21,904 undergraduate students, 3,744 graduate students, and 565 professional veterinary medical students. Of the CSU undergraduate student population, 93%

are between the ages of 18 to 25. The undergraduate student population on the main CSU campus includes White Americans at 80.70 percent (N = 17,677), and minorities at 19.63 percent (N = 4,300). Specific minority breakdown includes Asian at 13.00 percent (N = 2,848), Black Americans at 10.60 percent (N = 2,322), Hawaiian Pacific Islanders at 0.60 percent (N = 131), Hispanic/Latino at 56.9 percent (N = 12,463), Native American at 2.3 percent (N = 504), and multiracial at 16.5 percent (N = 3,614).

Recruitment and Setting

Students were recruited from the CSU campus at large to ensure a complete demographic representation of the student population. Recruiting efforts included announcements made in large lecture classes by the doctoral student, posted flyers in key locations around campus (see Appendix D), word of mouth, and day of the event walk-up interest and inquiries. Appointments were scheduled for students wanting to secure a specific day and time for participation. Confirmation calls were made 24 hours prior to each appointment. Approximately 25 percent of the time slots remained unscheduled to accommodate walk-ins.

On-campus cardiovascular screenings were held in the Lory Student Center on February 22, February 23, and April 25, 2017 from 8:00 am – 11:00 am. The Flea Market area across from the CSU Bookstore was reserved in advance for all screenings (see Appendix E). This location was purposely chosen due to its central location on campus, accessibility, and convenience for students. The doctoral student, four Register Nurses (RNs) from the Health District of Northern Larimer County, and two students from the department of Health and Exercise Science (HES) will be present for both screening days. Four RNs will be available to assist students with scheduled appointments and one RN will be available to accommodate walk-ins or students who became interested after walking by the display.   Figure 1 displays a flowchart for the organizational layout for the screening held at the LSC.

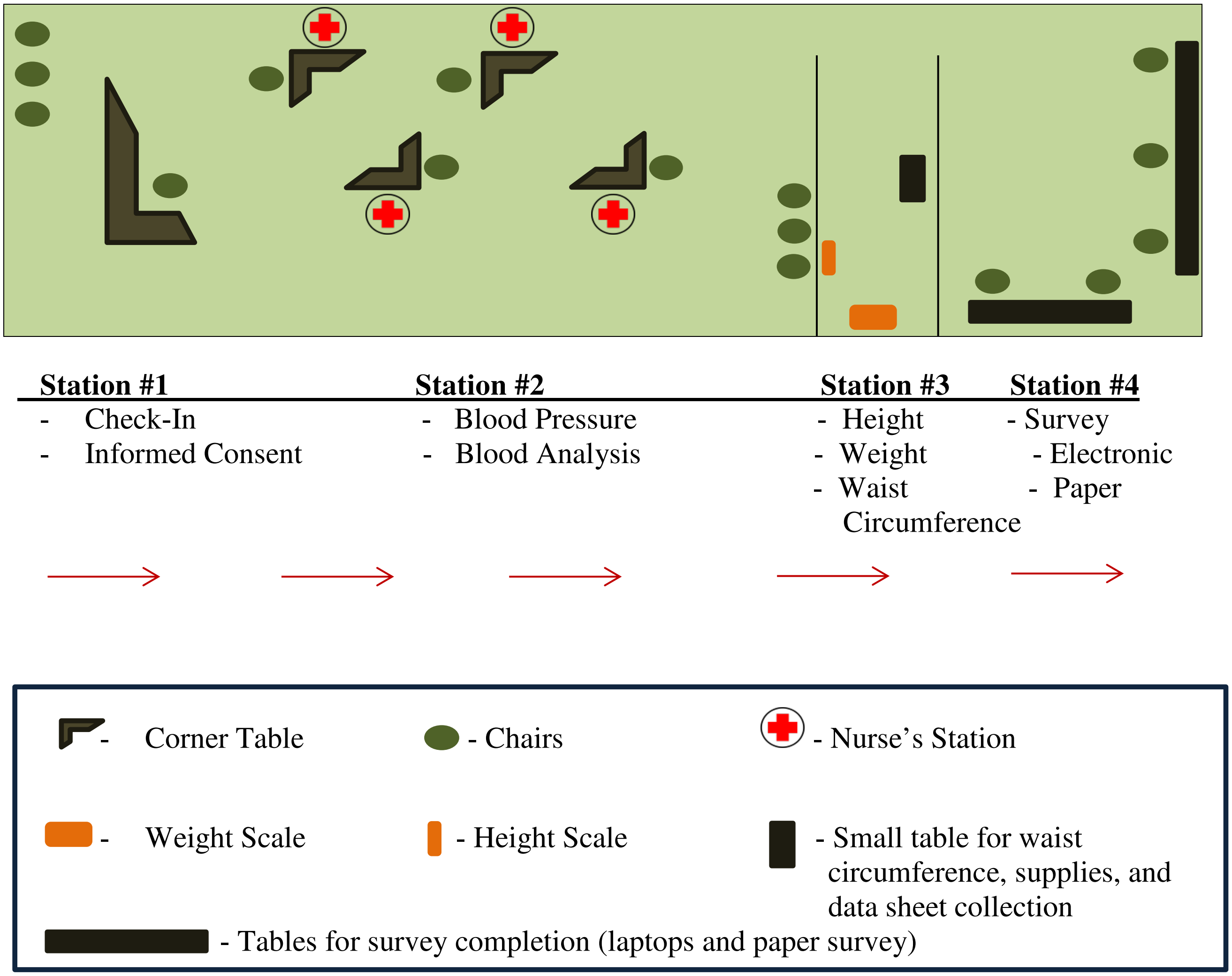

Figure 1. The progression of subject flow during the CVD Risk Factor Screening held at the Lory Student Center at Colorado State University. Students began with station #1, advanced to station #2, station #3, and station #4 in that specific order.

Screening Protocol

Research subjects proceeded through four separate stations during the CVD risk factor screening program. Subjects advanced through the screening in the following order; station one, station two, station three, and station four. Station one was for check-in. Subjects were greeted and a trained HES student reviewed the purpose of the screening, answered questions, and obtained the informed consent (see Appendix G). Once completed, subjects were directed to the restrooms across the hall and asked to wash their hands with warm soapy water.

Once the hand washing was completed, subjects advanced to station two, the nurse's station. Subjects were allowed to sit and rest quietly for five minutes prior to the resting blood pressure assessment. For consistency, all blood pressure measurements were taken on the left arm. The manual auscultatory technique was used with a mechanical aneroid sphygmomanometer. The cuff was inflated to 160-180 mmHg and released at a rate of 2-3 mmHg per second for accuracy (Medicine, 2013). The appropriate Korotkoff sounds were measured and recorded. Standard procedures were applied to all steps.

Following the blood pressure assessment, subjects prepare for the blood analysis. All analyzers were calibrated according to manufacturer protocols. Using powder-free gloves, the RN positioned the participant's hand in an upward position. The hand was massaged as well as the finger to increase blood flow into the area. The middle or ring finger was consistently used with all participants. The finger was scrubbed with an alcohol swap and allowed to air dry. The finger was held in an upward position and lanced with a lancet. The RN applied pressure on the finger allowing blood to be collected for analysis. The first drop of blood was blotted with a gauze pad and immediately discarded in an appropriate biohazard container. The participant's finger was kept in a downward position and gently massaged to maintain blood flow. The capillary tube was held at a 30-degree angle below the collection site until filled. The capillary tube was sealed and placed in the lipid analyzer for analysis. A sterile adhesive bandage was placed over the puncture site and all supplies were discarded appropriately in a biohazards container. All results were recorded on the participant's data sheet and explained and compared with normal values. Each RN was responsible for reviewing the data with each subject tested at their station including; total cholesterol, HDLs, LDLs, triglycerides, total cholesterol/HDL ratio, blood glucose, and systolic and diastolic blood pressure.

Following the blood pressure and blood analysis, participants advanced to the station three for height, weight, and waist circumference measurements. To ensure subject privacy, all measurements were taken behind a screen partition. An inelastic anthropometric tape fixed to a smooth wall was used to measure height. Participants were instructed to position themselves with backs aligned with the tape and remain motionless, hands flat on their thighs, and heads placed in the Frankfurt horizontal plane (Freitas et al., 2013). Measurements were taken without footwear and recorded to the quarter inch and recorded. Subject's weight was measured wearing light clothing, without footwear or outerwear. A digital electronic anthropometric scale for adults was used, with a 200 kg capacity. Measurements were taken to the hundreds place and recorded. All measurements in station three were taken by the PI. Height and weight measurements were taken twice to confirm accuracy. Any differences in measurements were averaged for the final data point(s).

Body mass index (BMI) was later calculated and defined as the ratio of weight (kg) by the square of height (m^2). The following criteria from the World Health Organization (2000), was used to categorize BMI; low BMI <18.5 kg/m^2, normal BMI ≥ 18.5 to < 25.0 kg/m^2, overweight BMI ≥ 25.0 to ≤ 29.9 kg.m^2, and obese BMI is ≥ 30 kg/m^2. The final anthropometric assessment was the waist circumference (WC). Measurements were taken at the midpoint between the last rib and the upper border of the iliac crest at the end of expiration. Subjects were in the upright position and an inelastic tape measure placed on the skin was used for the assessment (Freitas et al., 2013). Measurements were taken to the eighth of an inch and recorded. The doctoral student was responsible for all measurements taken at station three and for collecting each subject's data record.

The fourth and final station involved the completion of a health and lifestyle survey (see Appendix G). Questions were derived from the National College Health Assessment (NCHA), a nationally recognized research survey, the Student Stress Survey (SSS), (Ross, Niebling, & Heckert, 1999), and the International Physical Activity Questionnaire (IPAQ), which has extensive reliability and validity testing in 12 countries. The survey had 65 questions distributed in seven subsections including demographics (questions 1-13), health history (questions 14-28), tobacco and marijuana use (questions 29-33) alcohol use (questions 34-44), drug use (questions 45-55) exercise habits (questions 56-63), and time spent sitting (questions 64-65). To ensure privacy and confidentiality, the survey was completed in a close-by, but separate room. Lap-top computers were available for students who preferred an electronic submission and clipboards with printed surveys, pens, pencils, and erasers were available for subjects who preferred a manual submission. To ensure privacy and confidentiality laptops were spread apart from one another and out of monitor sight range from others also completing the survey (see Appendix J). A trained student from HES was available to assist subjects with questions during the final station.

To ensure confidentiality, name identifiers were not used; rather subjects established an identifier for themselves based on their middle initial followed by the last four digits of their cell phone number. The code identifiers were used to match the physical data measured during the screenings to the responses on the health and lifestyle questionnaire. See Table 5 for a complete listing of variables from the survey by question number, level of measurement, and number of levels.

Table 5

Variables from the Survey by Survey Number, Level of Measurement, and Number of Levels

Variable	Survey Number	Level of Measurement	Number of Levels
Demographics			
Gender	2	Dichotomous	2
Date of Birth	3	Scale	
Age	4	Ordinal	8
Residence	5	Nominal	6
Hispanic or Latino	6	Dichotomous	2
Race	7	Nominal	6
Department	8	Nominal	27
Year in School	9	Ordinal	4
GPA	10	Scale	6
Honor's Student	11	Dichotomous	2
Fraternity/Sorority	12	Dichotomous	2
Hours of work	13	Ordinal	6
Health Information			
General Health	14	Ordinal	6
Personal Health History	15-21	Dichotomous	2
Family Health History	22-28	Nominal	3
Tobacco Use			
Cigarettes	29	Scale	8
E-cigarettes	30	Scale	8
Hookah	31	Scale	8
Cigars	32	Scale	8
Smokeless Tobacco	33	Scale	8
Alcohol Use			
Beer	34	Scale	8
Wine	35	Scale	8
Liquor	36	Scale	8
Vaporized Alcohol	37	Scale	8
4 or more drinks	38	Scale	8
Drive after drinking	39	Scale	8
Drive after 4 or more	40	Scale	8

Drive after marijuana	41	Scale	8
Drive after drug use	42	Scale	8
Number of drinks	43	Scale	12
Hours drinking	44	Scale	11
Drug Use			
Marijuana	45	Scale	8
Cocaine	46	Scale	8
Methamphetamines	47	Scale	8
Adderall	48	Scale	8
Sedatives	49	Scale	8
Hallucinogens	50	Scale	8
Anabolic Steroids	51	Scale	8
Opiates	52	Scale	8
Inhalants	53	Scale	8
MDMA (Ecstasy)	54	Scale	8
Other	55	Scale	8
Exercise and Activity			
Participation	56	Dichotomous	2
Recent participation	57	Scale	8
Walk	58	Scale	8
Moderate activity	59	Scale	8
Vigorous activity	60	Scale	8
Time in leisure	61	Scale	24
Time in moderate	62	Scale	24
Time in vigorous	63	Scale	24
Sitting/weekday	64	Scale	24
Sitting/weekend	65	Scale	24
Behavior Change	69		

An alternative screening option was available for students unable to attend the specific screening dates and times at the LSC. Student appointments for blood analysis and blood pressure readings could be made directly with the Health District of Northern Colorado during a community screening. A variety of days and times were available each month through the spring semester, 2017. Once complete, students brought their data sheet to the doctoral student's office for study inclusion. To ensure subject privacy, subject's height, weight and waist circumference measurements were taken in the Human Performance Clinical Research Laboratory (HPCRL) by the PI. For consistency, all measurement taken followed the exact procedures listed above.

Finally, subjects completed the health and lifestyle questionnaire in a research office in the HPCRL and were given the choice to complete their responses electronically or on paper.

The study included 180 participants. This sample size was sufficient to detect a large effect size with .80 (Cohen's 1988 criteria) and statistical power of .05 was used for significance with correlational, causal-comparative, and experimental research designs (Erdfelder, Faul, & Buchner, 1996; Onwuegbuzie & Leech, 2004).

Data Analysis

The researcher used the Statistical Package for the Social Sciences (SPSS) software (Version 24) for statistical analysis. A combination of descriptive, differential, and associational statistical analyses were used to answer the following five research questions:

1. What is the prevalence of each CVD risk factor (family history, gender, tobacco use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30))?
2. For each CVD risk factor, what differences are seen in prevalence between genders, ethnic groups, and class status?
3. What are the differences in CVD risk factors found with the CSU data compared to data from the National College Health Assessment (NCHA)?
4. What statistical significant associations exist among the 12 CVD risk factors?
5. Do students cluster together based on CVD risk factors? If so, how many clusters emerged from the data and what combinations of risk factors make each cluster unique?

The purpose of research question one was to describe the prevalence of each CVD risk factor in the sample of undergraduate students. Descriptive statistics were most appropriate and included frequency, range, minimum, maximum, means, standard deviations, variance skewness, percentages, and cumulative percentages.

The intent of research question two was to determine the differences in prevalence for each of the CVD risk factors between genders, ethnic groups, and class status. Because the variances in the dependent variables were unequal or skewed, the nonparametric Mann-Whitney *U* tests were performed to compare CVD risk factors among genders and ethnic groups. Because the variances in the dependent variables were unequal or skewed and there are more than two levels of the independent variable, the nonparametric Kruskal-Wallis Test tests were done to compare CVD risk factors among the different classes. The Mann-Whitney *U* statistical analysis was completed as a post hoc assessment to identify which of the four levels showed statistically significantly different in SBP.

The purpose of the third research question was to examine the differences in CVD risk factors found with the CSU sample compared to data from the NCHA. An ANOVA statistical analysis was calculated for continuous data ($p \leq .05$), and Pearson Chi-square was used for categorical data ($p \leq .05$).

The purpose of research question four was identify what associations were present among the 11 CVD risk factors. A Spearman rho Correlation Matrix examined associations between variables. Due to the large number of risk factors (N = 25), the Bonferroni correction factor was used as a conservative approach for statistical significance by dividing the typical p value of .05 by the number of variables (.05/25 = .0002) (Morgan, Leech, Gloeckner, & Barrett, 2012). Therefore, statistical significant was set at the .002 level. Additionally, simultaneous multiple regression was conducted to investigate the best predictors of various dependent variables.

The fifth research question identified clusters of students with similar CVD risk factors. The K-Means Cluster Analysis was utilized in this study as it maximizes the separation between clusters and produces statistically significant differences between distinct clusters within a sample. Clusters were developed for multiple dependent variables. Original data was standardized into Z-scores for the purposes of comparison between variables. The appropriate number of clusters was validated by comparing the number of iterations necessary to obtain statistical significance between all clusters (Everitt, Landau, & Leese, 2001; Manly, 1994; Rencher, 2002). The number of iterations necessary to reach statistical significant difference between clusters was plotted on a scree plot. The scree plot is helpful in visualizing how many clusters are necessary to explain most of the variability in the data. See Table 6 for a complete set of research questions, necessary measurements, and the statistical analysis.

Table 6

Research Questions, Necessary Measurements, and Statistical Analysis Used

Research Questions	Necessary Measurements	Statistical Analysis
1. What is the prevalence of each CVD risk factor (family history, gender, tobacco use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30)), in the research sample of undergraduate students enrolled at CSU during the spring semester of 2017?	Clinical Measurements Anthropometric Measurements Health and Wellness Survey	Descriptive Statistics
2. What are the differences in prevalence for each of the CVD risk factors between males and females, ethnic groups, and class status?	Clinical Measurements Anthropometric Measurements Health and Wellness Survey	Mann-Whitney *U* Test Kruskal-Wallis Test
3. What are the differences in CVD risk factors found with the CSU undergraduate population compared to data from the National College Health Assessment (NCHA)?	Clinical Measurements Anthropometric Measurements Health and Wellness Survey	Pearson Chi-Square
4. What statistical significant associations exist among the 12 CVD risk factors?	Clinical Measurements Anthropometric Measurements Health and Wellness Survey	Spearman rho Correlation
5. Do students cluster together based on CVD risk factors? What combination of CVD risk factors makes each cluster unique?	Clinical Measurements Anthropometric Measurements Health and Wellness Survey	K-Means Cluster Analysis

Multiple factors were taken into consideration when conducting and interpreting the data. Specific statistical analyses were selected based on assumptions, homogeneity of variances and whether variables were normally distributed or deviated from normal distribution (Gliner et al., 2000). Effect size was noted to interpret the strength of the relationships if significant and or the strength of association between independent and dependent variables (Gliner et al., 2000). Finally, internal and external validity were considered when interpreting the data.

Internal validity

When results were interpreted, internal validity was considered when examining the differences, correlations, and clusters of CVD risk factors and gender, White versus Non-White, class status, and comparisons with national college student data. Internal validity was assumed to be low, due to the fact that there was no causal relationship and no control group involved in the study (Gliner et al., 2000). An additional threat to internal validity was the selection criteria for study subjects. Participation was voluntary and a convenience sample of CSU undergraduate students were recruited for the research study.

External validity

Reflections were made for both population and ecological external validity. Comparisons between the sample of undergraduate study participants and the demographic data from CSU were made with respect to gender, age, race, and year in school. A potential threat to external validity was the subject's participation was voluntary. It is possible that students with a greater interest in their personal health, fitness, or wellness were more likely to participate, therefore, underrepresenting the theoretical population. To minimize the threat and encourage a wide variety of student involvement, recruitment efforts were campus wide. External validity regarding population was low to medium (Gliner et al., 2000).

Ecological external validity was also evaluated. All study assessments and survey questions were very specific to a specific point in time. No extrapolations were made that would assume the data to be valid into future years. Additionally, caution was used when assuming that the survey responses were representative of the student's typical behavior. Finally, attention was given to the self-reporting nature of the survey since self-reporting is not a direct measure of the actual behavior in a typical environment. Therefore, the ecological population external validity is assumed to be medium (Gliner et al., 2000).

Content Validity

Content validity was high due to the fact that the survey questions were derived from National College Health Assessment (NCHA), a nationally recognized research survey, the Student Stress Survey (SSS), a survey (Ross et al., 1999), and the International Physical Activity Questionnaire (IPAQ), which has extensive reliability and validity testing in 12 countries.

Additionally, content validity was high with all physical measurements. The blood pressures and blood analysis were performed by trained RNs who followed specific protocols and used high quality, calibrated equipment. Content validity was also high with measurements of height, weight, and waist circumference. Finally, all equipment was calibrated and in excellent working function.

CHAPTER 4: RESULTS

Using a non-experimental, cross-sectional research design, the investigator identified the prevalence and clustering of risk factors associated with cardiovascular disease (CVD) in undergraduate student ages 18 – 25 years old enrolled at CSU, during the spring semester, 2017. The statistical analyses used in this quantitative study were descriptive, differential and associational in nature.

The purpose of this chapter is to present the data collected and analyzed to answer the following

research questions:

1. What is the prevalence of each CVD risk factor (family history, gender, tobacco use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30))?
2. For each CVD risk factor, what differences are seen in prevalence between genders, ethnic groups, and class status?
3. What are the differences in CVD risk factors found with the CSU data compared to data from the National College Health Assessment (NCHA)?
4. What correlations exist among the 12 CVD risk factors?
5. Do students cluster together based on CVD risk factors? If so, how many clusters emerged from the data and what combinations of risk factors make each cluster u unique?

Description of the sample

Student demographics. The sample of this study included 180 undergraduate students enrolled at CSU during the spring semester, 2017, and who volunteered to participate. The average age was 21.40 years with a range of 18 – 25 year. Over half, 62.18 percent (*N* = 113) were female. More than half, 53.75 percent (N = 86) were seniors. For statistical analysis, race was recoded as White and Non-White for students identified as American Indian or Alaska Native, Arab, Asian, Black or African American, Hispanic/Latino, or Native Hawaiian or Pacific Islander (see table 4.2). The sample included 81.88 percent (*N* = 131) White and 18.12 percent (*N* = 29) non-White. Two-thirds or 67.51 percent (*N* = 122) had a grade point average (GPA) between 3.00 – 4.00, on a 4.00 scale and 6.88 percent (*N* = 11) were in the university honor's program. The majority of participants, 85.63 percent (*N* = 154) occupied off-campus housing. Additionally, more than half or 72.78 percent (*N* = 131) worked for pay while enrolled at CSU. For those employed, the majority or 58.33 percent (*N* = 105) worked between 10 – 30 hours per week. When asked to describe their general health, only a small percentage or 15.19 percent (*N* = 24) rated it as excellent while the majority or 53.16 percent (*N* = 84) rated their health as very good. Although the study was open to the entire university, the majority, or 78.62 percent (*N* = 114) were from the department of Health and Exercise Science. Therefore, the student sample was not representative of the total CSU undergraduate student population with respect to major of study, class status, and gender but was representative by race.

Student history of known cardiovascular disease or related risk factors. From a student health perspective, no student reported a previous or known history of heart disease or hypertension, however, a few or 1.27 percent (*N* = 2) reported a history of a stroke, or diabetes, or an elevated cholesterol level. Slightly higher percentages were seen with both elevated triglycerides 1.91 percent (N = 3), and overweight and obesity at 5.06 percent (N = 8).

Family history of cardiovascular disease (CVD). For those that answered the family health history section, hypertension was found to be the most prevalent family health history concern at 37.34 percent (N = 59), followed by elevated cholesterol and overweight/obesity at 34.18 percent (N = 54), diabetes at 18.99 percent (N = 30), elevated triglycerides at 11.39 percent (N = 18), heart disease at 10.13 percent (N = 16), and stroke at 4.33 percent (N = 7). It is important to note that some students had several positive risk factors in their family history.

Tobacco use. It is important to note that only 85.00 percent (N = 153) of participants competed this section of the questionnaire. With respect to student tobacco usage, hookah use was the most prevalent at 35.00 percent (N = 63), followed by cigars at 22.80 percent (N = 41), cigarettes at 20.60 percent (N = 37), electronic cigarettes at 16.70 percent (N = 30), and smokeless tobacco at 17.00 percent (N = 26).

Alcohol Consumption. As seen with tobacco use, only 85.00 percent (N = 153) of participants competed this section of the questionnaire. Student's alcohol consumption showed a high and consistent use with beer at 83.66 percent (N = 128), wine at 83.01 percent (N = 127), and liquor at 84.97 percent (N = 130). Vaporized alcohol use was found at a much lower rate at 6.23 percent (N = 13

For questions regarding drinking and driving, only 31.67 percent (N = 57) students provided answers. Of those that did respond 73.69 percent (N = 42) reported a history of drinking five or more drinks in one setting. Lastly, a total of 85.00 percent (N = 153) students answered the last question regarding driving after drinking five or more alcoholic beverages. It was found that 38.90 percent (N = 70) reported driving after drinking five or more drinks.

Drug use. The use of illicit drugs was another category included in the student's questionnaire. A total of 83.89 percent (*N* = 151) students completed this section of the questionnaire. The most prevalent drug used by this sample was marijuana with smoking marijuana at 59.60 percent (*N* = 90), and marijuana edibles the second most prevalent drug used by this group of undergraduate students at 48.34 percent (*N* = 73). Additional drug use from most prevalent to least prevalent included amphetamines (Adderall, diet pills) at 24.50 percent (*N* = 37), cocaine and sedative use had equal prevalence at 14.74 percent (N = 22), hallucinogens at 11.54 percent (N = 17), MDMA (ecstasy) at 10.90 percent (N = 16), and methamphetamines, anabolic steroids, and inhalants all had a consistently low use 0.64 percent (N = 1). No student indicated an opiates drug use. When asked if operating a motorized vehicle was ever done after drug use, a small percentage of 4.43 percent (N = 7) admitted to doing so.

Exercise habits or pattern. One of the final sections on the health and lifestyle questionnaire involved the student's physical exercise habits. A total of 83.89 percent (*N* = 151) students completed this section of the questionnaire. A significant portion of subjects 85.43 percent (*N* = 129) reported exercising regularly as defined by at least three days per week. The number of active days from most to least prevalent were five days per week at 26.28 percent (*N* = 34), followed by six days per week at 14.74 percent (*N* = 19), four days per week at 13.46 percent (*N* = 17), three days per week at 12.82 percent (*N* = 17), seven days/week at 9.62 percent (*N* = 12), and one and two days per week had the lowest occurrence at 2.56 percent (*N* = 3).

Quantifiable amount of exercise performed weekly. Three questions quantified the amount of exercise performed weekly. First, students reported on the frequency of walking during leisure time. Of those that were active, responses from most prevalent to least prevalent included seven days per week at 35.26 percent (N = 45), five days per week at 22.44 percent (N

= 29), six days per week at 12.18 percent (N = 16), three days per week at 4.49 percent (N = 6), four days per week at 3.21 percent (N = 4), one day per week at 2.56 percent (N = 3) and two days per week at 1.92 percent (N = 2).

Students also stated how many days per week they performed moderate exercise. Of those that were active, responses from most prevalent to least prevalent included five days per week at 23.72 percent (N = 31), seven days per week at 17.95 percent (N = 23), four days per week at 14.10 percent (N = 18), six days per week at 11.54 percent (N = 15), three days per week at 10.26 percent (N = 13), one day per week at 2.56 percent (N = 3), and two days per week at 1.92 percent (N = 2).

Lastly, students specified how many days per week they performed vigorous exercise. Of those that were active, responses from most to least prevalent include three days per week at 17.31 percent (N = 22), four and five days per week had the same occurrence at 16.67 percent (N = 21), two days per week at 10.90 percent (N = 14), one day per week at 9.62 percent (N = 12), six days per week at 7.05 percent (N = 9), and seven days per week at 3.85 percent (N = 5). See table 7 for a summary of exercise habits or patterns.

Table 7

Established Exercise Habits or Patterns (N – 129)

Days of Exercise Per Week	Walking		Moderate Intensity		Vigorous Intensity	
	n	*Percent*	*n*	*Percent*	*n*	*Percent*
1	3	2.56	3	2.56	12	9.62
2	2	1.93	2	1.92	14	10.90
3	6	4.49	13	10.26	22	17.31
4	4	3.21	18	14.10	21	16.67
5	29	22.44	31	23.72	21	16.67
6	16	12.18	15	11.54	9	7.05
7	45	35.26	23	17.95	5	3.85

Selecting a desired behavior change. Students were also asked to select a desired behavior change from an established list of options. Responses from most to least prevalent included; diet modification (24.22%), increase sleep time and improve stress management had equal occurrence (13.28%), increase exercise habits and weight loss also had equal responses (12.50%), improve time management (8.59%), increase in activity habits and weight gain had a consistent but low percentage (3.13%), decrease/eliminate tobacco use (2.34%), and decrease/eliminate drug use (1.56%).

Table 8 shows the number and percentages of the CSU undergraduate students not coded as missing, by gender, age, ethnicity, departmental major, class ranking, GPA, honors program involvement, work status in college, self-description of general health, tobacco use, alcohol use drug use, exercise habits, and desires for behavior change.

Table 8

Demographic Characteristics of the CSU Undergraduate Student Sample (N = 180)

Characteristics	*n*	%	CSU Data
Gender			
Male	67	37.20	49.54
Female	113	62.80	50.46
Age			
18	12	7.50	
19	13	8.12	
20	19	11.87	
21	35	21.88	
22	32	20.00	
23	20	12.50	
24	11	6.88	
25	4	2.50	
Ethnicity			
American Indian or Alaska Native	3	1.88	0.44
Arab	1	0.63	Not Available
Asian	7	4.38	2.87
Black or African American	5	3.13	2.27
Hispanic/Latino	13	8.13	10.52
Native Hawaiian or Pacific Islander	0	0.00	0.12
White	131	81.88	70.71
Housing			
Campus residence hall	23	14.38	
Fraternity or sorority housing	3	1.88	
Other university housing	8	5.00	
Parent/Guardian	18	11.25	
Other family member	1	0.63	
Spouse	2	1.25	
Other off-campus housing	100	62.50	
Home Owner	5	3.13	
Major			
Biology	3	2.07	
Biochemistry	1	0.69	
Biomedical Sciences	1	0.69	
Business	3	2.07	
Computer Science	1	0.69	
Construction Management	1	0.69	
Ecosystem Science and Sustainability	1	0.69	
Engineering	7	4.83	

Environmental & Natural Resources	1	0.69
Family and Consumer Science	2	1.38
Food Science and Human Nutrition	4	2.76
GUEST Program	1	0.69
Health and Exercise Science	114	78.62
Human Development and Family Studies	1	0.69
Journalism	1	0.69
Natural Sciences	6	4.14
Neuroscience	1	2.76
Political Science	4	2.23
Psychology	5	3.45
Social Work	1	0.69
Sociology	3	2.07
Spanish	1	0.69
Class Ranking		
Freshman	20	12.50
Sophomore	19	11.88
Junior	35	21.88
Senior	86	53.75
GPA		
4.00	5	3.13
3.99 – 3.50	45	28.13
3.49 – 3.00	58	36.25
2.99 – 2.50	44	27.50
2.49 – 2.00	6	3.75
Academic Probation	2	1.25
Honors Program		
Yes	11	6.88
No	149	93.13
Work While Attending School		
Yes	80	74.07
No	28	25.93
Hours Worked Per Week		
1 – 10	19	15.70
11 – 19	48	44.44
20 – 29	38	31.40
30 – 39	8	6.61
40 or more	8	6.61
Describe Current Health		
Excellent	24	15.19
Very Good	84	53.16
Good	45	28.48
Fair	4	2.53
Poor	1	0.63
Personal Health History (Perceived)		
Heart Disease	0	0.00

Stroke	2	1.27
Hypertension	0	0.00
Diabetes	2	1.27
Elevated Cholesterol	2	1.27
Elevated Triglycerides	3	1.91
Overweight/Obesity	8	5.06
Actual Measurements		
Elevated Cholesterol	20	12.35
Low HDL (male)	19	32.20
Low HDL (female)	15	14.56
Elevated LDL	42	30.66
Elevated Triglyceride	21	12.96
Elevated Glucose	20	12.35
Elevated BMI (overweight)	49	30.25
Elevated BMI (obese)	10	6.17
Elevated Systolic Blood Pressure (SBP)	30	18.52
Elevated Diastolic Blood Pressure (DBP)	15	9.26
Family Health History		
Heart Disease	16	10.13
Stroke	7	4.43
Hypertension	59	37.34
Diabetes	30	18.99
Elevated Cholesterol	54	34.18
Elevated Triglycerides	18	11.39
Overweight/Obesity	54	34.18
Tobacco Use (within the last 30 days)		
Cigarettes	37	20.60
Electronic Cigarettes	30	16.70
Hookah	63	35.00
Cigars, Pipes, Clove Cigarettes	41	22.80
Smokeless Tobacco	26	17.00
Alcohol Use (within the last 30 days)		
Beer	128	82.28
Wine	128	82.28
Liquor	132	85.44
Vaporized Alcohol	13	8.23
More than 5 drinks in one setting	42	73.68
More than 4 drinks in one setting	77	80.21
Drive after drinking any amount	70	45.75
Drive after drinking 5 or more drinks	6	10.34
Drive after drinking 4 or more drinks	16	16.00
Number of Drinks at last social		
0	13	8.23
1	26	16.46
2	23	14.56
3	19	12.03

4	21	13.29
5	22	13.92
6	10	6.33
7	13	8.23
8	6	3.80
9	0	0.00
10	3	1.90
11	0	0.00
More than 11	2	1.27
Number of hours drinking at last social		
0	13	8.28
1	21	13.29
2	23	14.56
3	31	19.62
4	39	24.68
5	13	8.23
6	9	5.70
7	4	2.53
8	3	1.90
9	0	0.00
10	2	1.27
11	0	0.00
More than 11	0	0.00
Drug Use (within the last 30 days)		
Marijuana	90	57.69
Marijuana (edibles)	73	46.79
Drive after smoking marijuana	32	20.25
Cocaine	23	14.74
Methamphetamines	1	0.64
Other Amphetamines (Adderall, diet pills)	32	20.51
Sedatives (sleeping aids)	23	14.74
Hallucinogens	18	11.54
Anabolic Steroids	1	0.64
Opiates	0	0.00
Inhalants	1	0.64
MDMA (Ecstasy)	17	10.90
Other Illegal drugs	3	1.92
Drive after using any illegal drugs	7	4.43
Physical Exercise (at least 3 days/week)		
Yes	134	85.90
No	22	14.10
Number of Days/Week for Exercise		
0	22	14.10
1	4	2.56
2	4	2.56
3	20	12.82

4	21	13.46
5	41	26.28
6	23	14.74
7	15	9.62
Walk in Leisure Time (Days per Week)		
0	22	14.10
1	4	2.56
2	3	1.92
3	7	4.49
4	5	3.21
5	35	22.44
6	19	12.18
7	55	35.26
Moderate Exercise (Days per Week)		
0	22	14.10
1	4	2.56
2	3	1.92
3	16	10.26
4	22	14.10
5	37	23.72
6	18	11.54
7	28	17.95
Vigorous Exercise (Days per Week)		
0	22	14.10
1	15	9.62
2	17	10.90
3	27	17.31
4	26	16.67
5	26	16.67
6	11	7.05
7	6	3.85
Desire for Behavior Change		
Decrease/eliminate tobacco use	3	2.34
Decrease/eliminate alcohol use	7	5.47
Decrease/eliminate drug use	2	1.56
Increase exercise habits	16	12.50
Increase activity habits	4	3.13
Diet modification	31	24.22
Increase sleep time	17	13.28
Improve time management	11	8.59
Improve stress management	17	13.28
Participate in preventive health screenings	0	0.00
Weight loss	16	12.50
Weight gain	4	3.13

Research Question #1 - What is the prevalence of each CVD risk factor (family history, gender, tobacco use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30))?

The purpose of research question one was to identify the prevalence of CVD risk factors (family history, gender, tobacco use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30)). To determine the prevalence of each CVD risk factor (in undergraduate college students attending CSU during the spring semester of 2017, data was collected from the blood pressure and blood lipid analysis, the anthropometric measurements, and the health history and lifestyle questionnaire. A total of 706 CVD risk factors were identified in the student population. Specific risk factors and prevalence is discussed below. Table 4.2 shows the number and percentage of CVD risk factors found in this sample population. Figure 1 displays the percentage of CVD risk factors found in this sample population.

Family history of cardiovascular disease (CVD). A family history of CVD is an important risk factor for consideration during a diagnostic and preventive health evaluation. A total of 238 positive responses for family history of CVD were found. Responses from most to least prevalent include 37.34 percent ($N = 59$) had hypertension, elevated cholesterol and overweight/obesity had the same prevalence of 34.18 percent ($N = 54$), 18.99 percent ($N = 30$) had diabetes, 11.39 percent ($N = 18$) had elevated triglycerides, 10.13 percent ($N = 16$) had heart disease, and 4.33 percent ($N = 7$) had a family history of stroke.

Various forms of tobacco use. It was discovered that 49.02 percent of students ($N = 75$) reported using tobacco within the past 30 days. Many students indicated multiple methods of tobacco use. Hookah smoking was the most prevalent CVD risk factors and the most common form of tobacco use at 35 percent ($N = 65$). Additional forms of tobacco included cigars, pipes, and clove cigarettes, 27.22 percent ($N = 43$), cigarettes at 24.68 percent ($N = 39$), electronic cigarettes at 20.89 percent ($N = 33$), and smokeless tobacco at 17.72 percent ($N = 28$). See Figure 2.

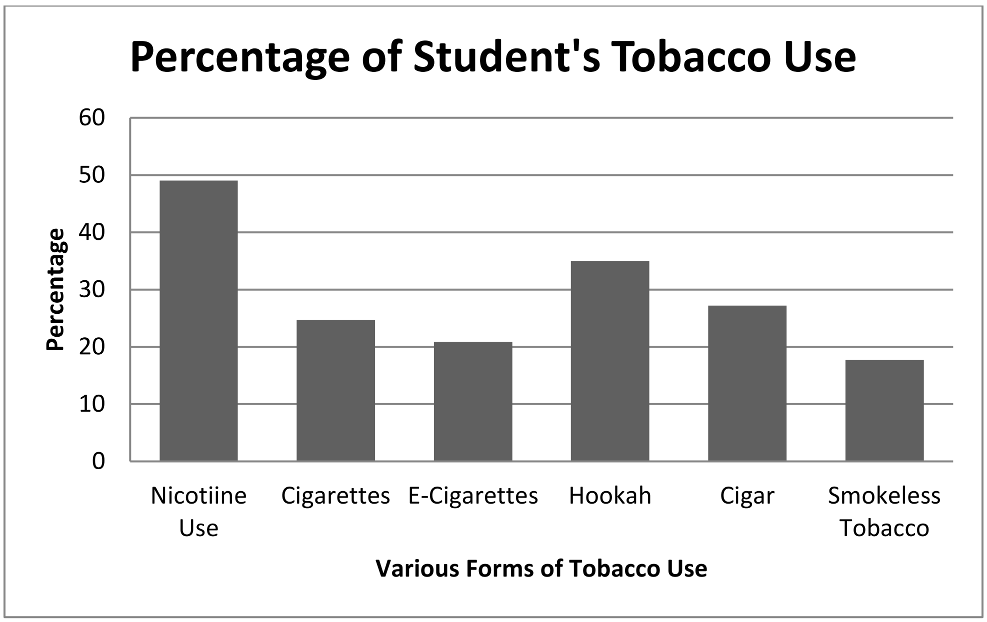

Figure 2. Percentage of undergraduate students using various types of nicotine.

Systolic blood pressure (SBP) and diastolic blood pressure (DBP). Elevations in both SBP and DBP were found in the student sample. Approximately one-fifth, 19.75 percent ($N = 32$) had an elevated SBP. From that total, 16.67 percent ($N = 27$) had pre-hypertension (120-139 mm/Hg), and 1.85 percent ($N = 3$), had Stage 1 (≥140 – 159 mm/Hg), and 1.23 percent ($N = 2$) had Stage 2 (≥ 160 mm/Hg) hypertension. When compared to SBP, a smaller percentage of students, 14.81 percent ($N = 24$) had an elevated diastolic blood pressure. From that total, 12.35

percent (N = 20) had pre-hypertension (80-89 mm/Hg), and 2.47 percent (N = 4) had Stage 1 (≥90-99 mm/Hg) hypertension. No student had Stage 2 (≥ 100mm/Hg) diastolic hypertension.

Blood lipids and glucose. The blood analysis revealed 117 abnormal findings. More than one-tenth of the students, 12.35 percent (N = 20) had an elevated total cholesterol level. With respect to HDLs, males had a greater percentage of abnormal results with 32.20 percent (N = 19) compared to females at 14.56 (N = 15). Approximately one-third or 30.66 percent (N = 42) had an elevated LDL value. Triglycerides were high in 12.96 percent (N = 21) of students. Elevated fasting glucose levels were seen in 12.35 percent (N = 20) of the sample with 11.73 percent (N = 19) categorized as pre-diabetes (100-125 mg/dL) and 0.62 percent (N = 1) being categorized as diabetic (≥ 126 mg/dL).

Inactivity and obesity. Inactivity and obesity are two additional risk factors for CVD. In this student sample, 14.10 percent (N = 22) identified as being inactive. A calculated BMI showed that 24.07 percent (N = 39) of students were overweight and 6.17 percent (N = 10) were obese.

Alcohol Consumption. Student's alcohol consumption showed a high and consistent use with beer at 83.66 percent (N = 128), wine at 83.01 percent (N = 127), and liquor at 84.97 percent (N = 130). Vaporized alcohol use was found at a much lower rate at 6.23 percent (N = 13). Alcohol consumption tends to be high in the college student population (Knight et al., 2002; O'Malley & Johnston, 2002). In 2006, the Center of Disease Control recommended that the addition of alcohol consumption be evaluated with respect to CVD risk factors in the college student population. Therefore, alcohol and drug use was included in this study. Alcohol consumption showed a high and consistent use with beer at 82.28 percent (N= 128), wine at 82.28 percent (N = 128), liquor at 85.44 percent (N = 132), and vaporized alcohol was at a much lower rate of 8.23 percent (*N* = 13). Within the last 30 days, 80.21 percent (*N* = 77) reported drinking four or more drinks in one setting and 73.68 percent (*N* = 42) reported drinking five or more drinks in one setting. In addition to this high percent of large quantities of alcohol, 45.75 percent (N = 70) reported driving after drinking alcohol within the last 30 days.

Drug Use. The most commonly used drug among this sample was marijuana use at 83.66 percent (*N* = 128) followed by marijuana edibles at 47.68 percent (*N* = 72). Additional drugs identified from most prevalence to least prevalent include amphetamines at 19.87 percent (*N* = 30), sedatives at 14.57 percent (*N* = 22), cocaine at 13.91 percent (*N* = 21), hallucinogens at 11.26 percent (*N* = 17), MDMA (ecstasy) at 10.60 percent (*N* = 16), methamphetamines at 1.32 percent (*N* = 2), and anabolic steroids at 0.40 (*N* = 1). Finally, an option for other drugs resulted in 1.99 percent (N = 3). See table 9 for a complete list of number and percentage of CVD risk factors found in the CSU undergraduate student sample and figure 3 for a visual display of the prevalence of the CVD risk factors.

Table 9

Number and Percentage of CVD risk factors found in the CSU Undergraduate Student Sample (N = 180)

Characteristics	*n*	%
Family History		
CVD	16	10.13
Stroke	7	4.43
Hypertension	59	37.34
Diabetes	30	18.99
Elevated Cholesterol	54	34.18
Elevated Triglycerides	18	11.39
Overweight/Obesity	54	34.18
Male Gender	67	37.22
Total Tobacco Use (within the last 30 days)	75	49.02

Cigarettes	39	24.68
Electronic Cigarettes	33	20.89
Hookah	65	35.00
Cigars, Pipes, Clove Cigarettes	43	27.22
Smokeless Tobacco	28	17.72
Hypertension		
SBP	32	19.75
Pre-Hypertensive (120-139 mm/Hg)	27	16.67
Stage 1 (140-159 mm/Hg)	3	1.85
Stage 2 (≥ 160 mm/Hg)	2	1.23
DBP	24	14.81
Pre-Hypertensive (80-89 mm/Hg)	20	12.35
Stage 1 (90-99 mm/Hg)	4	2.47
Stage 2 (≥ 100 mm/Hg)	0	0.00
Total Cholesterol (≥ 200 mg/dL)	20	12.35
HDL		
Male (< 40 mg/dL)	19	32.20
Female (< 50 mg/dL)	15	14.56
LDL (≥ 101 mg/dL)	42	30.66
Triglycerides (≥ 151 mg/dL)	21	12.96
Glucose (≥ 100 mg/dL)	20	12.35
Pre-diabetes (100-125 mg/dL)	19	11.73
Diabetes (≥ 126 mg/dL)	1	00.62
Inactivity	22	14.10
Overweight (BMI 25-29 kg/m^2)	39	24.07
Obese (BMI ≥ 30 kg/m^2)	10	6.17
Alcohol		
Beer	128	83.66
Wine	127	83.01
Liquor	130	84.97
5 drinks in one setting	42	73.68
4 drinks in one setting	77	80.21
Drive after drinking	70	45.75
Drug		
Marijuana	89	58.94
Marijuana Edibles	72	47.68
Cocaine	21	13.91
Methamphetamines	2	1.32
Amphetamines	30	19.87
Sedatives	22	14.57
Hallucinogens	17	11.26
Anabolic Steroids	1	0.40
Opiates	29	19.21
MDMA (Ecstasy)	16	10.60
Other Drugs	3	1.99

A total of 706 CVD risk factors were identified including; 208 for nicotine use, 238 with family history of CVD, 42 for high LDLs, 32 for elevated SBP, 24 for elevated DBP, 22 for inactivity, 21 for elevated triglycerides, 20 for elevated total cholesterol, 20 for elevated blood glucose, 19 for low HDLs in males, 15 for low HDLs in females, 39 for BMI ≥ 25 kg/m^2), 4 for increase in waist circumference for females, and 2 for an elevated waist circumference in males. The range of CVD risk factors per student was from zero to six (see Table 11). The significance in the totality of CVD risk factors in this apparently healthy undergraduate student sample is startling and warrants further examination.

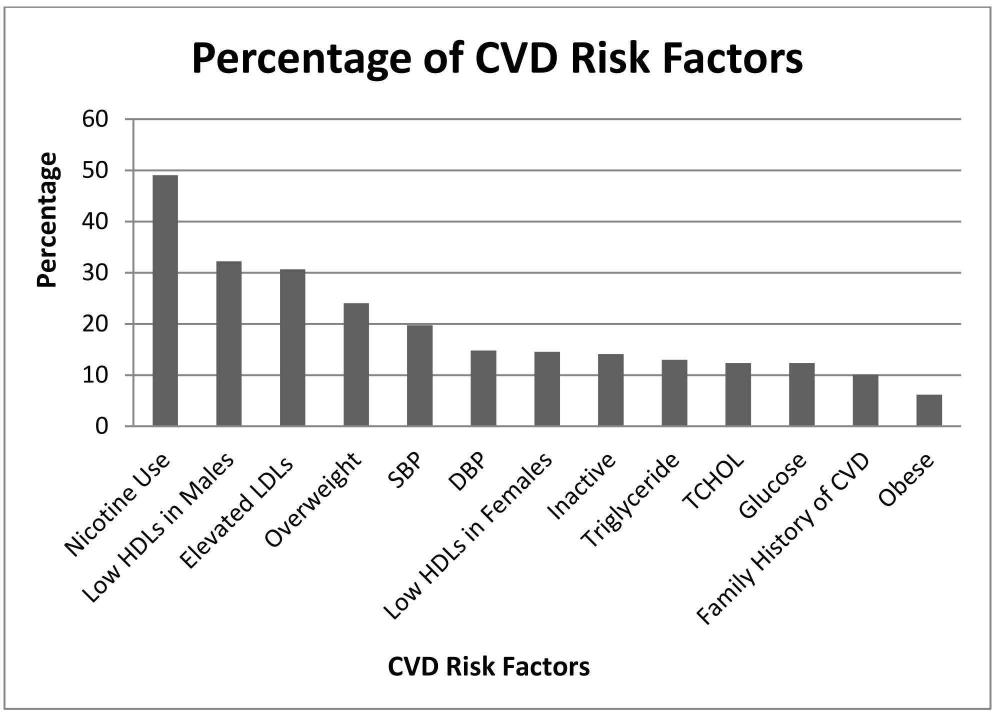

*Figure 3***.** Percentage of CVD risk factors in the CSU student sample during the spring, 2017.

Legend: HDLs – high density lipoproteins, LDLs – low density lipoproteins, SBP – systolic blood pressure, DBP – diastolic blood pressure, TCHOL – total cholesterol, CVD – cardiovascular disease.

The display clearly shows the percentage for each CVD risk factor in the CSU student sample. Nicotine use had the highest prevalence at 49.02 percent (*N* = 75), followed by low HDLs in males at 32.20 percent (*N* = 19), elevated LDLs at 30.66 percent (*N* = 42), overweight at 24.07 percent (*N* = 39), elevated SBP at 19.75 percent (*N* = 32), elevated DBP at 14.81 percent (*N* = 24), low HDLs in females at 14.56 percent (*N* = 15), inactive at 14.10 (N = 22), elevated triglycerides at 12.96 (*N* =21), elevated total cholesterol at 12.35 percent (*N* = 20), elevated blood glucose at 12.35 (*N* = 20), family history of CVD at 10.13 percent (*N* = 16), and obesity at 6.17 percent (*N* = 10).

Means, standard deviations, and skewness for eight continuous risk factors for CVD are shown in Table 10. Systolic blood pressure, total cholesterol, HDLs, and glucose were normally distributed. LDLs, Triglycerides, and overweight/obese were positively skewed and diastolic blood pressure was negatively skewed. Each risk factor has a specific range used to define a normal, therefore comparisons of means for each test is inappropriate.

Table 10

Means, Standard Deviations, and Skewness for Continuous CVD Risk Factors

Risk Factors	*M*	*SD*	Skewness
Blood Pressure			
Systolic Blood Pressure	110.25	10.51	0.59
Diastolic Blood Pressure	70.81	10.38	-1.61
Blood Analysis			
Total Cholesterol	167.59	31.87	0.86
HDL	59.59	17.16	0.46
LDL	92.12	27.70	1.20
Triglycerides	91.67	57.62	2.49
Glucose	87.76	12.05	0.95
Overweight/Obese	23.91	2.98	1.45
Exercise Habits	4.81	1.37	-.393

Identified cardiovascular risk factors. The number of CVD risk factors per student was also evaluated in this research study. It was discovered that 16.11 percent (*N* =29) of students had no risk factors for CVD, 21.67 percent (*N* = 39) had one risk factor, 24.44 percent (*N* = 44) had two risk factors, 16.11 percent (*N* = 29) had three risk factors, 15.56 percent (*N* = 28) had four risk factors, 4.44 percent (*N* = 8) had five risk factors, and 2.22 percent (*N* = 4) of students had six risk factors.

Multiple scores for the tobacco use and family history. Several undergraduate students used multiple forms of nicotine and or had a positive family history for CVD, and related diseases and risk factors such as stroke, hypertension, diabetes, elevated cholesterol levels, elevated triglycerides, and a family history of overweight or obesity. When each of these is counted as an individual risk factor, the grand total for CVD risk factors found in this undergraduate student sample was as follows: 16.11 percent (*N* = 29) of students had zero risk factors for CVD, 13.89 percent (*N* =25) had one risk factor, 14.44 percent (*N* = 26) had two risk factors, 11.67 percent (*N* = 21) had three risk factors, 10.56 percent (*N* = 19) had four risk factors, 8.89 percent (*N* = 16) had five risk factors, 6.11 percent (*N* = 11) had six risk factors, 10.00 percent (*N* = 18) had seven risk factors, 5.56 percent (*N* = 10) had eight risk factors, 0.56 percent (*N* = 1) had nine risk factors, 2.22 percent (*N* = 4) had 10 risk factors, 0.56 percent (*N* = 1) had 12 risk factors, and 0.56 percent (*N* = 1) student had 14 risk factors. See table 11.

Table 11

Frequency and Percentages of Cardiovascular Risk Factors

Number Risk Factors	Single Scores for Risk Factor		Multiple Scores for Risk Factor	
	n	Percent	n	Percent
0	29	16.11	29	16.11
1	39	21.67	26	14.44
2	44	24.44	26	14.44
3	29	16.11	21	11.67
4	28	15.56	19	10.56
5	8	4.44	16	8.89
6	4	2.22	11	6.11
7	--	--	18	10.00
8	--	--	10	5.56
9	--	--	1	0.56
10	--	--	4	2.22
11	--	--	0	0.00
12	--	--	1	0.56
13	--	--	0	0.00
14	--	--	1	0.56

A total of 93 risk factors associated with metabolic syndrome were found in the student sample. From the total, 30.25 percent (N = 49) of students had one risk factor, 9.88 percent (N = 16) had two risk factors, and 2.47 percent (N = 4) had three CVD risk factors. No student had more than three risk factors with respect to metabolic syndrome. Collectively these results indicate a significant prevalence of 767 CVD risk factors identified among the CSU student sample.

Research Question #2 - For each CVD risk factor, what differences are seen in prevalence between genders, ethnic groups, and class status?

The purpose of the second research question was to investigate differences between genders, ethnic groups, and class rankings. Because the variances in the dependent variables were unequal or skewed, the nonparametric Mann-Whitney *U* tests were performed to compare

CVD risk factors among genders. Table 12 shows 10 statistically significant differences between males and females. Differences found from the lipid analysis and blood pressure assessments are presented first, followed by differences in nicotine use and method of delivery, alcohol consumption, and drug use.

The 101 females students have higher mean ranks (90.46) than the 59 males (63.46) for total cholesterol, U = 1974.00, p = .<.001, r = -.28, which was a statistically significant difference and, according to Cohen (1988), is between a small and a typical effect size. Also, female and male students did show a statistically significant difference for HDL. Mean ranks were 96.57and 52.99, respectively, U = 1356.50, p = .<.001, r = -.45, which is considered between a typical and a large effect size. Male and female students did show a statistically significant difference for glucose. Mean ranks were 99.25 and 69.54, respectively, U = 1873.00, p = .<.001, r = -.31, which is considered a typical effect size. Male and female students did show a statistically significant difference for TCHOL/HDL. Mean ranks were 99.31 and 68.91, respectively, U = 1809.00, p = .<.001, r = -.32, which is considered a typical effect size. Male and female students did show a statistically significant difference for SBP. Mean ranks were 102.06 and 67.91, respectively, U = 1707.50, p = .<.001, r = -.36, which is considered between a typical to large effect size. Males and female students did show a statistically significant difference for DBP. Mean ranks were 97.69 and 70.46, respectively, U = 1965.50, p = .<.001, r = -.28, which is considered a smaller than typical to typical effect size.

Table 12 also shows four statistically significant differences between males and females for nicotine use and method of delivery. The data showed that males and females did have a statistically significant difference in cigarette smoking. Mean ranks were 84.81 and 73.21 respectively, U = 2348.00, p = .036, r = -.17, and, according to Cohen (1988), is between a smaller than typical to typical effect size. The data also showed males and females had a statistically significant difference in e-cigarette smoking. Mean ranks were 84.55 and 73.36 respectively, U = 2362.50, p = .031, r = -.17, which is between a smaller than typical to typical effect size. In addition, the data showed males and females had a statistically significant difference in cigar use. Mean ranks were 93.84 and 67.90 respectively, U = 1833.00, p = .<.001, r = -.37, which is considered a larger than typical to much larger than typical effect size. Finally, males had a statistically significant difference in smokeless tobacco when compared to females. Mean ranks were 90.46 and 69.88 respectively, U = 2025.50, p = .<.001, r = -.34, which is considered a larger than typical to a much larger than typical effect size.

Table 12 also shows two statistically significant differences between males and females for alcohol consumption. With respect to alcohol, the data showed that males and females did show a statistically significant difference in beer consumption. Mean ranks were 89.84 and 70.25 respectively, U = 2061.00, p = .007, r = -.22, and, according to Cohen (1988), is between a smaller than typical effect size to a typical effect size. Males and females showed a statistically significant difference in wine consumption. Mean ranks were 57.09 and 89.49 respectively, U = 1601.00, p = .001, r = -.37, and, according to Cohen (1988), is a typical effect size. Males and females also showed a statistically significant difference in anabolic steroid use. Mean ranks were 77.36 and 76.00 respectively, U = 2604.00, p = .019, r = -.11, and, according to Cohen (1988), is a smaller than typical effect size.

Table 12 also shows that male and female students did not show a statistically significant difference in six CVD risk factors. Male and female students did not show a statistically significant difference for triglycerides. Mean ranks were 73.36 and 84.67 respectively, U = 2558.50, p = .136, r = -.12, and, according to Cohen (1988), is a smaller than typical effect size.

Also, male and female students did not show a statistically significant difference for LDL. Mean ranks were 71.68 and 66.10, respectively, *U* = 1877.50, *p* = .431, r = -.07, which is considered a smaller than typical to typical effect size. Male and female students did not show a statistically significant difference for BMI. Mean ranks were 90.37 and 75.58, respectively, *U* = 2456.00, *p* = .052, r = -.15, which is considered between a smaller than typical to typical effect size. Male and female students did not show a statistically significant difference for hookah use. Mean ranks were 81.63 and 75.07, respectively, *U* = 2529.00, *p* = .306, r = -.08, which is considered a much smaller than typical and smaller than typical effect size. Male and female students did not show a statistically significant difference for family history of CVD. Mean ranks were 85.50 and 73.97, respectively, *U* = 2422.50, *p* = .053, r = -.16, which is considered a smaller than typical and typical effect size. Finally, male and female students did not show a statistically significant difference in exercise habits. Mean ranks were 75.00 and 77.38, respectively, *U* = 2604.00, *p* = .599, r = -.04, which is considered a much smaller than typical effect size.

Table 12 also shows that males and females did not show a statistically significant difference in liquor consumption. Mean ranks were 69.61 and 82.13 respectively, *U* = 2315.00, *p* = .084, r = -.14, and, according to Cohen (1988), is a smaller than typical effect size. Additionally, males and females did not show a statistically significant difference in marijuana use. Mean ranks were 81.81 and 73.40 respectively, *U* = 2390.00, *p* = .227, r = -.10, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in marijuana edibles. Mean ranks were 77.34 and 76.01 respectively, *U* = 2614.00, *p* = .840, r = -.01, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in cocaine use. Mean ranks were 76.89 and 76.27 respectively, *U* = 2666.00, *p* = .888, r = -.01, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in methamphetamine use. Mean ranks were 78.21 and 75.21 respectively, U = 2592.00, p = .063, r = -.15, and, according to Cohen (1988), is between a smaller than typical effect size and a typical effect size. Males and females did not show a statistically significant difference in amphetamine use. Mean ranks were 75.55 and 77.05 respectively, U = 2635.00, p = .773, r = -.02, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in sedative use. Mean ranks were 71.93 and 79.17 respectively, U = 2432.00, p = .110, r = -.13, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in hallucinogen use. Mean ranks were 77.50 and 75.92 respectively, U = 2632.00, p = .695, r = -.03, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in opiate use. Mean ranks were 76.50 and 76.50 respectively, U = 2688.00, p = 1.000, r = 0.00, and, according to Cohen (1988), is a smaller than typical effect size. Males and females did not show a statistically significant difference in MDMA (Ecstasy) use. Mean ranks were 79.36 and 74.83 respectively, U = 2528.00, p = .251, r = -.09, and, according to Cohen (1988), is a smaller than typical effect size. Lastly, males and females did not show a statistically significant difference in other illegal drug use. Mean ranks were 77.71 and 75.79 respectively, U = 2620.00, p = .281, r = -.09, and, according to Cohen (1988), is a smaller than typical effect size.

Table 12

Nonparametric Mann-Whitney Analysis Summary Table Comparing Gender on the Following CVD Risk Factors: Total Cholesterol, HDL, LDL, Triglycerides, Glucose, TCHOL/HDL, SBP, DBP, BMI, Family History of CVD, Cigarette Use, E-Cigarette Use, Hookah Use, Cigar Use, Smokeless Tobacco, Beer, Wine, Liquor, Marijuana, Marijuana Edibles, Cocaine, Methamphetamines, Amphetamines, Sedatives, Hallucinogens, Anabolic Steroids, Opiates, MDMA (Ecstasy), and Other Illegal Drugs.

Variable	*n*	Mean Rank	*U*	*Z*	*p*	*r*
Total Cholesterol			1974.00	-.3.56	<.001*	-.28
Female	101	90.46				
Male	59	63.46				
Total	160					
HDL			1356.50	-5.74	<.001*	-.45
Female	101	96.57				
Male	59	52.99				
Total	160					
LDL			1877.50	-0.79	.431	-.07
Female	89	66.10				
Male	46	71.68				
Total	135					
Triglycerides			2558.50	-1.49	.136	-.12
Female	101	84.67				
Male	59	73.36				
Total	160					
Glucose			1873.00	-3.91	<.001*	-.31
Female	101	69.54				
Male	59	99.25				
Total	160					
TCHOL/HDL			1809.00	-4.01	<.001*	-.32
Female	101	68.91				
Male	59	99.31				
Total	160					
BMI			2456.00	-1.94	.052	-.15
Female	102	75.58				
Male	59	90.37				

Total	161					
SBP			1707.50	-4.51	<.001*	-.36
Female	101	67.91				
Male	59	102.06				
Total	160					
DBP			1965.50	-3.60	<.001*	-.28
Female	101	70.46				
Male	59	97.69				
Total	160					
Family History of CVD			2422.50	-1.93	.053	-.16
Female	97	73.97				
Male	57	83.50				
Total	154					
Cigarette Use			2348.00	-2.10	.036*	-.17
Female	97	73.21				
Male	57	84.81				
Total	154					
E-Cigarette Use			2362.50	-2.16	.031*	-.17
Female	97	73.36				
Male	57	84.55				
Total	154					
Hookah Use			2529.00	-1.02	.306	-.08
Female	97	75.07				
Males	57	81.63				
Total	154					
Cigar Use			1833.00	-4.54	<.001*	-.37
Female	97	67.90				
Male	57	93.84				
Total	154					
Smokeless Tobacco Use			2025.50	-4.25	<.001*	-.34
Female	97	69.88				
Male	57	90.46				
Total	154					
Exercise Habits			2604.00	-0.53	.599	-.04
Female	96	77.38				
Male	56	75.00				
Total	152					

Beer			2061.00	-2.69	.007*	-.22
Female	97	70.25				
Males	57	89.84				
Total	154					
Wine			1601.00	-4.53	<.001*	-.37
Female	97	89.49				
Males	57	57.09				
Total	154					
Liquor			2315.00	-1.73	.084	-.14
Female	97	82.13				
Males	57	69.61				
Total	154					
Marijuana			2390.50	-1.21	.227	-.10
Female	96	73.40				
Males	56	81.81				
Total	152					
Marijuana Edibles			2641.00	-0.20	.840	-.02
Female	96	76.01				
Males	56	77.34				
Total	152					
Cocaine			2666	-0.14	.888	-.01
Female	96	76.27				
Males	56	76.89				
Total	152					
Methamphetamines			2592	-1.86	.063	-.15
Female	96	75.50				
Males	56	78.21				
Total	152					
Amphetamines			2635	-0.29	.773	-.02
Female	96	77.05				
Males	56	75.55				
Total	152					
Sedatives			2432	-1.60	.110	-.13
Female	96	79.17				
Males	56	71.93				
Total	152					

Hallucinogens			2632	-0.39	.695	-.03
Female	96	75.92				
Males	56	77.50				
Total	152					
Anabolic Steroids			2640	-1.31	.019*	-.11
Female	96	76.00				
Males	56	77.36				
Total	152					
Opiates			2688	0.00	1.000	0.00
Female	96	76.50				
Males	56	76.50				
Total	152					
MDMA (Ecstasy)			2528	-1.15	.251	-.09
Female	96	74.83				
Males	56	79.36				
Total	152					
Other Illegal Drugs			2620	-1.08	.281	-.09
Female	96	75.79				
Males	56	77.71				
Total	152					

The second part of research question two focused on differences in CVD risk factors between White and Non-White students. The variances in the dependent variables were unequal or skewed; therefore, the nonparametric Mann-Whitney *U* tests compare CVD risk factors among Non-White and White students.

Table 13 shows two CVD risk factors that were statistically significant different between Non-White and White students. Non-White and White students did have a statistically significant difference in hookah use. Mean ranks were 59.42 and 80.04 respectively, $U = 939.00$, $p = .028$, r = -.18, and, according to Cohen (1988), is between a smaller than typical to typical effect size. The data also showed Non-White and White students had a statistically significant difference in smokeless tobacco use. Mean ranks were 64.50 and 79.33 respectively, U = 1035.50, p = .037, r = -.1, which is considered between a smaller than typical to typical effect size.

In addition to the statistically significant differences found in the data, Table 13 also shows 14 comparisons between Non-White and White students that were not statistically significant different. The blood analysis and blood pressure relationships are presented first, followed by nicotine use and method of delivery, alcohol consumption, and drug use.

Table 13 shows Non-White and White students did not show a statistically significant difference for total cholesterol. Mean ranks were 87.87 and 79.68, respectively, U = 1576.50, p = .412, r = -.06, and according to Cohen (1988), is between a much smaller than typical to smaller than typical effect size. Non-White and White students did not show a statistically significant difference for HDL. Mean ranks were 67.73 and 83.56, respectively, U = 1410.00, p = .113, r = -.13, which is considered a smaller than typical effect size. Non-White and White students did not show a statistically significant difference for LDL. Mean ranks were 81.54 and 65.85, respectively, U = 999.50, p = .081, r = -.15, which is considered between a smaller than typical to typical effect size. Non-White and White students did not show a statistically significant difference for triglycerides. Mean ranks were 90.69 and 73.36, respectively, U = 1503.00, p = .246, r = -.09, which is considered between a smaller than typical to typical effect size. Non-White and White students did not show a statistically significant difference for glucose. Mean ranks were 82.35 and 80.74, respectively, U = 1720.00, p = .872, r = -.01, which is considered a much smaller than typical effect size. Non-White and White students did not show a statistically significant difference for TCHOL/HDL. Mean ranks were 89.54 and 78.75, respectively, U = 1507.00, p = .277, r = -.09, which is considered a smaller than typical effect size. Non-White and White students did not show a statistically significant difference for BMI.

Mean ranks were 96.15 and 78.70, respectively, *U* = 1387.00, *p* = .082, *r* = -.14, which is considered between a smaller than typical to typical effect size. Non-White and White students did not show a statistically significant difference for SBP. Mean ranks were 70.33 and 83.06, respectively, *U* = 1477.50, *p* = .201, *r* = -.10, which is considered a smaller than typical effect size. Non-White and White students did not show a statistically significant difference for DBP. Mean ranks were 75.25 and 82.11, respectively, *U* = 1605.50, *p* = .491, *r* = -.05, which is considered a much smaller than typical effect size. Non-White and White students did not show a statistically significant difference for family history of CVD. Mean ranks were 76.11 and 77.77, respectively, *U* = 1256.00, *p* = .826, *r* = -.18, which is considered a smaller than typical to typical effect size. Lastly, Non-White and White students did not show a statistically significant difference for exercise. Mean ranks were 53.00 and 63.52 respectively, *U* = 558.00, *p* = .321, *r* = -.08, which is considered between a smaller than typical to typical effect size.

In addition, Table 13 shows three more comparisons that proved to not have a statistically significant difference between Non-White and White regarding nicotine use and method of delivery. Non-White and White students did not show a statistically significant difference for cigarette use. Mean ranks were 66.84 and 79.00, respectively, *U* = 1080.00, *p* = .134, *r* = -.12, and according to Cohen (1988), is a smaller than typical effect size. Non-White and White students did not show a statistically significant difference for e-cigarette use. Mean ranks were 78.21 and 77.40, respectively, *U* = 1269.00, *p* = .915, *r* = -.01, which is considered a much smaller than typical effect size. Non-White and White students did not show a statistically significant difference for cigar use. Mean ranks were 64.95 and 79.27, respectively, *U* = 1044.00, *p* = .088, *r* = -.14, which is considered between a smaller than typical to typical effect size.

Table 13

Nonparametric Mann-Whitney Analysis Summary Table Comparing Non-White versus White on the Following CVD Risk Factors: Total Cholesterol, HDL, LDL, Triglycerides, Glucose, TCHOL/HDL, SBP, DBP, BMI, Family History of CVD, Cigarette Use, E-Cigarette Use, Hookah Use, Cigar Use, Smokeless Tobacco, Beer, Wine, Liquor, Marijuana, Marijuana Edibles, Cocaine, Methamphetamines, Amphetamines, Sedatives, Hallucinogens, Anabolic Steroids, Opiates, MDMA (Ecstasy), and Other Illegal Drugs

Variable	N	Mean Rank	*U*	*Z*	*p*	*r*
Total Cholesterol			1576.50	-.82	.412	-.06
Non-White	26	87.87				
White	135	79.68				
Total	161					
HDL			1410.00	-1.59	.113	-.13
Non-White	26	67.73				
White	135	83.56				
Total	161					
LDL			999.50	-1.74	.081	-.15
Non-White	23	81.54				
White	113	65.85				
Total	136					
Triglycerides			1503.00	-1.16	.246	-.09
Non-White	26	90.69				
White	135	73.36				
Total	161					
Glucose			1720.00	-0.16	.872	-.01
Non-White	26	82.35				
White	135	80.74				
Total	161					
TCHOL/HDL			1507.00	-1.09	.277	-.09
Non-White	26	89.54				
White	134	78.75				

Total	160					
BMI			1387.00	-1.74	.082	-.14
Non-White	26	96.15				
White	136	78.70				
Total	162					
SBP			1477.50	-1.28	.201	-.10
Non-White	26	70.33				
Male	135	83.06				
Total	161					
DBP			1605.50	-0.69	.491	-.05
Non-White	26	75.25				
White	135	82.11				
Total	161					
Family History of CVD			1256.00	-.220	.826	-.18
Non-White	19	76.11				
White	135	77.77				
Total	154					
Cigarette Use			1080.00	-1.50	.134	-.12
Non-White	19	66.84				
White	135	79.00				
Total	154					
E-Cigarette Use			1269.99	-.106	.915	-.01
Non-White	19	78.21				
White	135	77.40				
Total	154					
Hookah Use			939.00	-2.19	.028*	-.18
Non-White	19	59.42				
White	135	80.04				
Total	154					
Cigar Use			1044.00	-1.71	.088	-.14
Non-White	19	64.95				

White	135	79.27				
Total	154					
Smokeless Tobacco Use			1035.50	-2.08	.037*	-.17
Non-White	19	64.50				
White	135	79.33				
Total	154					
Exercise Habits			558.00	-.992	.321	-.08
Non-White	12	53.00				
White	112	63.52				
Total	124					
Beer			508.00	-4.34	<.001**	-.35
Non-White	19	36.74				
White	135	83.24				
Total	154					
Wine			745.00	-3.07	.022*	-.25
Non-White	19	49.21				
White	135	81.48				
Total	154					
Liquor			622.00	-3.73	<.001**	-.30
Non-White	19	42.74				
White	135	82.39				
Total	154					
5 Drinks in 1 Setting			88.50	-2.54	.011*	-.34
Non-White	8	15.56				
White	49	31.19				
Total	57					
4 Drinks in 1 Setting			275.00	-2.32	.020*	-.24
Non-White	11	31.05				
White	86	51.30				
Total	97					

Driving After any Alcohol			849.50	-2.62	.009*	-.21
Non-White	19	54.71				
White	135	80.71				
Total	154					
Marijuana Edibles			922.50	-2.14	.033*	-.17
Non-White	19	58.55				
White	133	79.06				
Total	152					

*p = 0.05, **p= *0.01*

The third part of research question number two focused on differences in CVD risk factors between class status (freshman, sophomores, juniors, and seniors). Because the variances in the dependent variables were unequal or skewed and there are more than two levels of the independent variable, the nonparametric Kruskal-Wallis Test compared CVD risk factors among the different classes. The statistical assessment showed that SBP was the only CVD risk factor that was statistically significantly different between the four classes, X^2 (3, N = 158) = 9.46, p = .024 (see Table 14). The post hoc Mann-Whitney U statistical analysis identified which of the four class rankings showed statistically significantly different in SBP (see Table 15).

Table 14

Nonparametric Kruskal Wallis Analysis Summary Table Comparing Class Status on the Following CVD Risk Factors: Total Cholesterol, HDL, LDL, Triglycerides, Glucose, TCHOL/HDL, SBP, DBP BMI, Family History of CVD, Cigarette Use, E-Cigarette Use, Hookah Use, Cigar Use, and Smokeless Tobacco

Variable	N	Mean Rank	X^2	*df*	*p*
Total Cholesterol			2.90	3	.407
Freshman	18	87.06			
Sophomore	21	67.33			
Junior	34	86.68			
Senior	85	78.04			
Total	158				
HDL			1.72	3	.632
Freshman	18	77.08			
Sophomore	21	71.93			
Junior	34	87.60			
Senior	85	78.64			
Total	158				
LDL			3.27	3	.352
Freshman	18	69.86			
Sophomore	21	59.79			
Junior	34	59.45			
Senior	85	72.50			
Total	134				
Triglycerides			1.34	3	.719
Freshman	18	81.50			
Sophomore	21	83.69			
Junior	34	85.31			
Senior	85	75.72			
Total	158				
Glucose			3.34	3	.342
Freshman	18	82.17			
Sophomore	21	95.64			
Junior	34	77.90			

Senior	85	75.59			
Total	158				
TCHOL/HDL			0.72	3	.868
Freshman	18	83.08			
Sophomore	21	80.95			
Junior	34	73.46			
Senior	85	79.89			
Total	157				
BMI			2.15	3	.543
Freshman	18	85.06			
Sophomore	21	70.64			
Junior	34	87.62			
Senior	85	78.22			
Total	159				
SBP			9.46	3	.024*
Freshman	18	51.75			
Sophomore	21	88.24			
Junior	34	73.71			
Senior	85	85.54			
Total	158				
DBP			4.73	3	.193
Freshman	18	66.11			
Sophomore	21	72.05			
Junior	34	73.54			
Senior	85	86.56			
Total	158				
Family History of CVD			1.40	3	.707
Freshman	20	83.20			
Sophomore	16	75.22			
Junior	35	79.79			
Senior	83	75.60			
Total	154				
Cigarette Use			1.22	3	.749
Freshman	20	78.38			

Sophomore	17	72.68			
Junior	35	76.71			
Senior	83	79.54			
Total	155				
E-Cigarette Use			2.00	3	.572
Freshman	20	85.25			
Sophomore	17	84.79			
Junior	35	73.07			
Senior	83	76.94			
Total	155				
Hookah Use			1.44	3	.696
Freshman	20	80.88			
Sophomore	17	73.35			
Junior	35	74.79			
Senior	83	79.61			
Total	155				
Cigar Use			1.58	3	.665
Freshman	20	72.40			
Sophomore	16	71.44			
Junior	35	76.80			
Senior	83	80.19			
Total	154				
Smokeless Tobacco Use			1.19	3	.755
Freshman	20	69.48			
Sophomore	16	66.57			
Junior	35	81.01			
Senior	83	78.10			
Total	154				
Exercise Habits			0.63	3	.890
Freshman	20	76.90			
Sophomore	15	80.70			
Junior	35	74.19			
Senior	82	76.62			
Total	152				
Beer			16.13	3	.001*

Freshman	20	60.05			
Sophomore	16	49.50			
Junior	35	72.54			
Senior	83	89.19			
Total	154				
Wine			5.74	3	.125
Freshman	20	69.88			
Sophomore	16	57.13			
Junior	35	77.56			
Senior	83	83.24			
Total	154				
Liquor			1.09	3	.781
Freshman	20	73.78			
Sophomore	16	72.13			
Junior	35	74.19			
Senior	83	80.83			
Total	154				
Driving after Drinking Alcohol			31.85	3	<.001*
Freshman	20	50.78			
Sophomore	16	60.28			
Junior	35	60.81			
Senior	83	94.30			
Total	154				
Marijuana			4.81	3	.180
Freshman	20	66.85			
Sophomore	15	67.40			
Junior	35	88.24			
Senior	82	75.75			
Total	152				
Marijuana Edibles			8.07	3	.045*
Freshman	20	64.88			
Sophomore	15	58.80			
Junior	35	88.33			
Senior	82	77.52			
Total	152				

Cocaine			3.60	3	.309
Freshman	20	74.30			
Sophomore	15	66.00			
Junior	35	81.06			
Senior	82	77.01			
Total	152				
Methamphetamines			1.09	3	.780
Freshman	20	75.50			
Sophomore	15	75.50			
Junior	35	77.66			
Senior	82	76.43			
Total	152				
Amphetamines			3.55	3	.314
Freshman	20	69.48			
Sophomore	15	66.57			
Junior	35	81.01			
Senior	82	78.10			
Total	152				
Sedatives			0.45	3	.929
Freshman	20	73.68			
Sophomore	15	75.67			
Junior	35	78.63			
Senior	82	76.43			
Total					
Hallucinogens			3.55	3	.314
Freshman	20	68.00			
Sophomore	15	73.07			
Junior	35	78.86			
Senior	82	78.20			
Total	152				
Anabolic Steroids			0.85	3	.837
Freshman	20	76.00			
Sophomore	15	76.00			
Junior	35	76.00			
Senior	82	76.93			

Total	152				
Opiates			0.00	3	1.000
Freshman	20	76.50			
Sophomore	15	76.50			
Junior	35	76.50			
Senior	82	76.50			
Total					
MDMA (Ecstasy)			5.61	3	.132
Freshman	20	68.50			
Sophomore	15	68.50			
Junior	35	77.07			
Senior	82	79.67			
Total	152				
Other Illegal Drugs			2.48	3	.480
Freshman	20	75.00			
Sophomore	15	80.07			
Junior	35	77.17			
Senior	82	75.93			
Total					

*p = 0.05

A Post hoc Mann-Whitney test compared the four classes on SBP, beer consumption, driving after drinking alcohol and marijuana edibles, see table 15. A Bonferroni corrected p value of 0.0125 was used to indicate statistical significance. Two statistically significant differences were found with SBP with the first between freshmen and sophomores and the second between freshmen and seniors. The mean rank for SBP for sophomores (24.31, n =21) was significantly higher than that of the freshman (14.97, n = 18), z = -2.57, p = .010, r = -.41, and according to Cohen (1988), is between a typical to large effect size. The mean rank for SBP for seniors (55.62, *n* =85) was significantly higher than that of the freshman (34.92, *n* = 18), *z* = -2.68, *p* = .007, *r* = -.26, and according to Cohen (1988), is between a smaller than typical to typical effect size.

Table 15

Post Hoc Nonparametric Mann-Whitney Analysis Summary Table Comparing Class Status on SBP

Variable	N	Mean Rank	*U*	*Z*	*p*	*r*
SBP			98.50	-2.57	.010*	-.41
Freshman	18	14.97				
Sophomores	21	24.31				
Total	39					
SBP						
Freshman	18	34.92	457.00	-2.68	.007*	-.26
Senior	85	55.62				
Total	103					
Beer			526.00	-2.58	.010*	-.25
Freshmen	20	36.80				
Seniors	83	55.66				
Total	103					
Beer			336.00	-3.18	.001*	-.32
Sophomores	16	29.50				
Seniors	83	53.95				
Total	99					
Driving After Drinking Alcohol			365.00	-4.14	<.001*	-.41
Freshmen	20	28.75				
Seniors	83	57.60				
Total	103					
Driving After Drinking Alcohol			357.00	-3.09	.002*	-.31
Sophomores	16	30.81				

Seniors	83	53.70				
Total	99					
Driving After Drinking Alcohol			830.50	-3.93	<.001*	-.36
Juniors	20	41.73				
Seniors	83	66.99				
Total	103					
Marijuana Edibles			276.00	-2.56	.011*	-.36
Sophomores	15	18.40				
Juniors	35	28.54				
Total	50					

*p = 0.0125

Research Question #3 - What are the differences in CVD risk factors found with the CSU data compared to data from the National College Health Assessment (NCHA)?

The purpose of the third research question was to investigate differences in CVD risk factors between the CSU student data and national student data. A chi-square statistic was conducted. Assumptions were checked and met. Table 4.7 shows the Pearson Chi-square results and indicates that CSU students and undergraduate college students throughout the nation do not differ in how they perceive or rank their general health as "good", history of elevated cholesterol levels, history of diabetes, cigarette use, e-cigarette use, marijuana use, alcohol use, BMI to identify overweight, and participation in moderate exercise.

College students throughout the nation are more likely to rank their general health as "good", have an elevated cholesterol level, and more likely to be diabetic than CSU students. However, CSU students are more likely to use cigarettes, e-cigarettes, hookah, marijuana, alcohol, be overweight, and participate in moderate exercise when compared to undergraduate college students throughout the nation.

Table 16 shows that CSU students and national students do have statistically significant differences in rating general health as "very good or excellent" $X^2 = 5.97$, $df = 1$, $N = 158$, $p = .015$, elevated blood pressure $X^2 = 4.96$, $df = 1$, $N = 160$, $p = .026$, hookah use $X^2 = 43.91$, $df = 1$, $N = 160$, $p = .001$, and BMI to identify obese $X^2 = 7.41$, $df = 1$, $N = 162$, $p = .007$. CSU undergraduate students are more likely to rank their general health as "very good" or "excellent", less likely to have a history of elevated blood pressure, more likely to use hookah, and less likely be obese when compared to undergraduate college students across the nation.

Table 16

Comparison of CVD Risk Factors from the CSU Undergraduate Student Sample and the NCHA Student Sample

		Comparison				
Variable	*n*	CSU	National	*df*	X^2	*p*
General Health				1	1.25	.264
Good		45	11,528			
Not Good		115	21,984			
Total	33,672	158	33,512			
General Health						
Excellent or Very Good		108	16,890	1	5.97	.015*
Not Excellent or Good		50	16,622			
Total	33,672	158	33,512			
Elevated Total Cholesterol				1	1.87	.171
Normal		158	32,440			
Elevated		2	1,072			
Total	33,672	160	33,512			
Elevated Blood Pressure				1	4.96	.026*
Normal		160	32,473			
Elevated		0	1,039			

Total	33.672	160	33,512			
Diabetes				1	0.00	.956
Normal		158	33,076			
Elevated		2	436			
Total	33,672	160	33,512			
Cigarette Use				1	0.16	.690
Use		39	7,606			
Do Not Use		121	25,905			
Total	33,672	160	33,512			
E-Cigarette Use				1	2.78	.095
Use		33	5,027			
Do Not Use		127	28,485			
Total	33,672	160	33,512			
Hookah Use				1	43.91	< .001**
Use		63	6602			
Do Not Use		95	26,910			
Total	33,672	158	33,512			
Marijuana Use				1	1.98	.160
Use		73	12,533			
Do Not Use		87	20,979			
Total	33,672	160	33,512			
Alcohol Use				1	0.22	.642
Consume		132	26,173			
Do Not Consume		26	7171			
Total	33,672	160	33,512			
BMI (Overweight)				1	0.03	.856
Yes		39	7808			
No		123	25,704			
Total	33,672	162	33,512			

BMI (Obese)				1	7.41	.007**
Yes		10	4893			
No		152	28619			
Total	33,672	162	33,512			
Participate in Moderate Exercise				1	1.15	.284
Yes		134	25,369			
No		22	8143			
Total	33,672	156	33,512			

*p = < .05, ** p = < .01

Additional findings

An unanticipated, yet very interesting and important discovery was made when studying the comparison data between the CSU sample and the student's data from NCHA. Both groups had very similar data on their perception or awareness of having elevated total cholesterol level, fasting blood glucose, SBP, and DBP. However, it is noteworthy that statistical significant differences were seen in all four CVD risk factors when perception data was compared to clinically measured data.

A Pearson chi-square analysis was completed to investigate the difference between the CSU student's perception of their health and the clinically measured results. Assumptions were check and met. Table 17 shows the Pearson chi-square results and indicates that perceived and measured results are significantly different for total cholesterol (X^2 = 13.62, df = 1, N = 322, p = .001), SBP (X^2 = 32.67, df = 1, N = 322, p = .001), DBP (X^2 = 22.18, df = 1, N = 322, p = .001), and fasting blood glucose levels (X^2 = 13.62, df = 1, N = 322, p = .001). CSU undergraduate students were more likely to have elevations in total cholesterol, SBP, DBP, and fasting glucose levels than perceived.

Table 17

Comparison of Estimates versus Measured CVD Risk Factors in the CSU Undergraduate Student Sample

Variable	*n*	CSU Comparison Perceived	Measured	*df*	X^2	*p*
Total Cholesterol				1	13.62	< .001**
Normal		158	142			
Elevated		2	20			
Total	322	160	162			
SBP				1	32.67	< .001**
Normal		160	132			
Elevated		0	30			
Total	322	160	162			
DBP				1	22.18	< .001**
Normal		160	138			
Elevated		0	24			
Total	322	160	162			
Diabetes						
Normal		158	142	1	13.62	< .001**
Elevated		2	20			
Total	322	160	162			

$*p$ = <.05; $**p$ = < .01

Research Question #4 - What correlations exist among the 12 CVD risk factors?

The purpose of the fourth research question was to learn of any correlations among the CVD risk factors. A Spearman rho correlation was computed to examine the interrelations of the variables since a number of variables were skewed, ordinal data was used, and the assumption of linearity was markedly violated. A total of 25 variables were evaluated in the correlation matrix. The Bonferroni correction factor was used to correct for the high number of variables reducing the acceptable level for statistical significance from 0.05 to 0.002. The Spearman rho correlation matrix was too large to fit on a single paper but can be found in Appendix K. Correlations found for a much larger than typical, larger than typical, typical, and smaller than typical effect size, according to Cohen (1988) can be found on Tables 18, 19, 20, and 21 respectively.

Four positive correlations and one negative correlation was found in the category of a much larger than typical effect size according to Cohen (1988) (see Table 18). One of the strongest correlations was between BMI and waist circumference $r(90) = .76$, $p = < .001$. This means that students that had a high BMI were also very likely to have a large waist circumference. An equally strong correlation was seen between SBP and gender r(90) = .76, $p = < .001$. This means that students with higher SBP were likely to be males. A third strong correlation was between TCHOL / LDL $r(90) = .75$, $p = < .001$. This correlation indicated that as student's total cholesterol level increases they were likely to have high LDLs as well. A fourth correlation was between marijuana use and editable marijuana use $r(90) = .72$, $p = < .001$. This correlation indicated that students that were more likely to engage in smoking marijuana were also more likely to engage in consumption of marijuana editable. A final correlation in this much larger than typical effect size category was a negative correlation between HDL / TCHOLHDL $r(90) = -.77$, $p = < .001$. This correlation means that as HDL levels increases, the TCHOL/HDL ratio will decrease.

Table 18

Correlations with a Much Larger Than Typical Effect Size According to Cohen (1988)

r	r^2	*Correlated Variables*	*p*
.76	.58	BMI / Waist Circumference	.001***
.76	.58	SBP / Gender	.001***
.75	.56	TCHOL / LDL	.001***
.72	.52	Marijuana Use / Editable Marijuana Use	.001***
-.77	.59	HDL / TCHOL/HDL	.001***

*p = <.05; **p = < .01; ***p = ≤.002

There were five positive correlations that were found to have a larger than typical effect size according to Cohen (1988) (see Table 19). A strong correlation was between LDL and TCHOL/HDL ratio $r(90) = .63$, $p = < .001$. This finding indicates that has students LDL increased their TCHOL/HDL ratio increase as well. Likewise a strong correlation was seen between SBP and DBP r(90) = .63, $p = < .001$. This information means that as student's SBP increased DBP did as well. Another correlation was seen between exercising at least 3 days per week and vigorous exercise $r(90) = .55$, $p = < .001$. This data is interpreted interpreted to mean that as students participation in exercise at least three days per week increased, they are likely to also participate in vigorous exercise. An additional correlation was seen between hookah use and cigar use $r(90) = .51$, $p = < .001$, meaning that has students use with hookah increased, they were they are likely to also participate in smoking cigars. A final correlation in this grouping of larger than typical effect size was seen between moderate exercise and vigorous exercise $r(90) = .50$, $p = < .001$, meaning that as student's participation in moderate exercise increases, they were they are more likely to also participate in vigorous exercise.

Table 19

Correlations with a Larger Than Typical Effect Size According to Cohen (1988)

Correlated Variables	*p*	*r*	r^2
LDL / TCHOL/HDL	.001***	.63	.40
SBP / DBP	.001***	.63	.40
Exercise at least 3 days/week / Vigorous Exercise	.001***	.55	.30
Hookah Use / Cigar Use	.001***	.51	.26
Moderate Exercise / Vigorous Exercise	.001***	.50	.25

*p = <.05; **p = < .01; ***p = ≤.002

Note. LDL = Low Density Lipoproteins, TCHOL/HDL = Total Cholesterol/High Density Lipoproteins, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure

There were a total of 40 correlations in the next category that had a typical effect size according to Cohen (1988) (see Table 20). Thirty-three correlations were positive and seven correlations were negative. Positive correlations are interpreted as one CVD risk factor increased, the corresponding CVD risk factor did as well. Negative correlations are interpreted as when one CVD risk factor increased, the second CVD risk factor decreased.

Table 20

Correlations with a Typical Effect Size According to Cohen (1988)

Correlated Variables	*p*	*r*	r^2
HDL / Gender	.001***	.49	.24
Waist Circumference / Gender	001***	.43	.18
Hookah Use / Smokeless Tobacco Use	.001***	.43	.18
Cigar Use / Smokeless Tobacco Use	.001***	.43	.18
Gender / Cigar Use	.001***	.42	.18
DBP / Gender	.001***	.41	.17
TCHOL/HDL / Gender	.001***	.40	.16
Hookah Use / Editable Marijuana Use	.001***	.40	.16
E-Cigarettes Use / Hookah Use	.001***	.39	.15
E-Cigarette Use / Marijuana Use	.001***	.38	.14
TCHOL/HDL / BMI	.001***	.37	.14
E-Cigarette Use / Cigar Use	.001***	.37	.14
E-Cigarette Use / Smokeless Tobacco Use	.001***	.34	.12

Hookah Use / Marijuana Use	.001***	.34	.12
Exercise Habits / Moderate Exercise	.001***	.34	.12
TCHOL/HDL / Waist Circumference	.002***	.33	.11
DBP / Cigarette Use	.002***	.33	.11
TCHOL / Triglycerides	.001***	.33	.11
Triglycerides / BMI	.002***	.32	.10
DBP – Marijuana Use	.002***	.32	.10
Gender / Cigarette Use	.002***	.32	.10
Cigarette Use / Editable Marijuana Use	.002***	.32	.10
Cigarette Use / E-Cigarette Use	.003**	.31	.10
TCHOL / Editable Marijuana Use	.003**	.31	.10
Cigarette Use / Hookah Use	.001***	.31	.10
Cigarette Use / Cigar Use	.001***	.31	.10
Cigarette Use / Smokeless Tobacco Use	.001***	.31	.10
Gender / Smokeless Tobacco Use	.004**	.30	.09
TCHOL/HDL / Age	.004**	.30	.09
SBP / Cigar Use	.004**	.30	.09

Cigarette Use / Marijuana Use	.004**	.30	.09
Family History of CVD / Vigorous Exercise	.005**	-.30	.09
Family History of CVD / Moderate Exercise	.004**	-.30	.09
HDL / SBP	.004**	-.30	.09
E-Cigarette Use / Exercise Habits	.001***	-.34	.12
HDL / BMI	.001***	-.34	.12
HDL / Waist Circumference	.001***	-.34	.12
HDL / Age	.001***	-.41	.17

*p = <.05; **p = < .01; ***p = ≤.002

Note. HDL = High Density Lipoprotein, LDL = Low Density Lipoprotein, TCHOL/HDL = Total Cholesterol/High Density Lipoproteins, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, BMI = Body Mass Index.

There were a total of 40 correlations in the next category that had a smaller than typical effect size according to Cohen (1988) (see Table 21). A total of 28 correlations were positive and 12 correlations were negative. Positive correlations were interpreted as one CVD risk factor increased, the corresponding CVD risk factor does as well. For negative correlations as one CVD risk factor increased, the second CVD risk factor decreased.

Table 21

Correlations with a Smaller Than Typical Effect Size According to Cohen (1988)

Correlated Variables	*p*	*r*	r^2
Cigar Use / Marijuana Use	.006**	.29	.08
Triglycerides / TCHOL/HDL	.006**	.29	.08
Gender / Age	.006**	.29	.08
Gender / E-Cigarettes Use	.007**	.28	.08
DBP / E-Cigarettes Use	.008**	.28	.08
Age / Exercise Habits	.008**	.28	.08
Glucose / Gender	.008**	.28	.08
SBP / Age	.009**	.28	.08
TCHOL / HDL	.011*	.27	.07
SBP / E-Cigarettes Use	.015*	.26	.07
SBP / Waist Circumference	.014*	.26	.07
TCHOL / Vigorous Exercise	.012*	.26	.07
DBP / Smokeless Tobacco Use	.019*	.25	.06
LDL / Editable Marijuana Use	.019*	.25	.06

Glucose / Waist Circumference	.018*	.25	.06
Age / Moderate Exercise	.017*	.25	.06
DBP / Age	.016*	.25	.06
DBP / Editable Marijuana Use	.026*	.24	.05
LDL / BMI	.024*	.24	.06
DBP / Waist Circumference	.033*	.23	.05
LDL / Vigorous Exercise	.032*	.23	.05
Smokeless Tobacco Use / Editable Marijuana Use	.026*	.23	.05
BMI / Gender	.042*	.22	.05
SBP / Smokeless Tobacco Use	.042*	.22	.05
Age / Vigorous Exercise	.037*	.22	.05
TCHOL/HDL / Glucose	.035*	.22	.05
DBP / Hookah Use	.049*	.21	.04
Waist Circumference / Cigar Use	.047*	.21	.04
Cigar Use / Moderate Exercise	.049*	-.21	.04
LDL / White versus Non-White	.046*	-.21	.04
TCHOL / SBP	.034*	-.22	.05

Waist Circumference / White versus Non-White	.034*	-.22	.05
Hookah Use / Vigorous Exercise	.030*	-.23	.05
BMI / White versus Non-White	.029*	-.23	.05
Hookah Use / Exercise Habits	.020*	-.25	.06
Triglycerides / DBP	.015*	-.26	.07
HDL / LDL	.013*	-.26	.07
Cigarette Use / Exercise Habits	.012*	-.27	.07
Exercise Habits / Marijuana Use	.010**	-.27	.07
E-Cigarettes / Vigorous Exercise	.006**	-.29	.08

*p = <.05; **p = < .01; ***p = ≤.002

Note. HDL = High Density Lipoprotein, LDL = Low Density Lipoprotein, TCHOL/HDL = Total Cholesterol/High Density Lipoproteins, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, BMI = Body Mass Index

Table 22 shows all the correlations interrelated to tobacco use. There were 34 correlations in this matrix. There were 28 positive correlations and six negative correlations. This table is not organized by effect size, by rather by various forms of tobacco use and the correlated CVD risk factor. Positive correlations were interpreted as meaning that as one CVD risk factor increased, the second CVD risk factor did as well. Negative correlations were interpreted as one CVD risk factor increased, the second CVD risk factor decreased.

Table 22

Correlations Matrix for Variables Interrelated to Tobacco Use

Correlated Variables	*p*	*r*	r^2
Hookah Use / Cigar Use	.001***	.51	.26
Hookah Use / Smokeless Tobacco Use	.001***	.43	.18
Hookah Use / Marijuana Use	.001***	.34	.12
Hookah Use / DBP	.049*	.21	.04
Hookah Use / Vigorous Exercise	.030*	-.23	.05
Hookah Use / Exercise Habits	.020*	-.25	.06
Cigar Use / Smokeless Tobacco Use	.001***	.43	.18
Cigar Use / Gender	.001***	.42	.18
Cigar Use / SBP	.004**	.30	.09
Cigar Use / Marijuana Use	.006**	.29	.08
Cigar Use / Waist Circumference	.047*	.21	.04
Cigar Use / Moderate Exercise	.049*	-.21	.04
E-Cigarettes Use / Hookah Use	.001***	.39	.15
E-Cigarette Use / Marijuana Use	.001***	.38	.14

E-Cigarette Use / Cigar Use	.001***	.37	.14
E-Cigarette Use / Smokeless Tobacco Use	.001***	.34	.12
E-Cigarettes Use / Gender	.007**	.28	.08
E-Cigarettes Use / DBP	.008**	.28	.08
E-Cigarettes Use / SBP	.015*	.26	.07
E-Cigarettes / Vigorous Exercise	.006**	-.29	.08
E-Cigarette Use / Exercise Habits	.001***	-.34	.12
Cigarette Use / Editable Marijuana Use	.002***	.32	.10
Cigarette Use / E-Cigarette Use	.003**	.31	.10
Cigarette Use / Hookah Use	.001***	.31	.10
Cigarette Use / Cigar Use	.001***	.31	.10
Cigarette Use / Smokeless Tobacco Use	.001***	.31	.10
Cigarette Use / Marijuana Use	.004**	.30	.09
Cigarette Use / DBP	.002***	.33	.11
Cigarette Use / Gender	.002***	.32	.10
Cigarette Use / Exercise Habits	.012**	-.27	.07
Smokeless Tobacco Use / Gender	.004**	.30	.09

Smokeless Tobacco Use	.019**	.25	.06
Smokeless Tobacco Use / Editable Marijuana Use	.026**	.23	.05
Smokeless Tobacco Use / SBP	.042*	.22	.05

**p* = <.05; ***p* = < .01; ****p* = ≤.002

Note. SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure

Table 23 shows all the correlations interrelated to hypertension. There were a total of 24 correlations in the next category that had a smaller than typical effect size according to Cohen (1988). All the correlations were positive, meaning that as one CVD risk factor increased, the corresponding CVD risk factor increased as well.

Table 23

Correlations Matrix for Variables Interrelated to Hypertension

Correlated Variables	*p*	*r*	r^2
SBP / DBP	.001**	.58	.34
SBP / Gender	.001**	.36	.13
SBP / Smokeless Tobacco	.002**	.27	.07
SBP / Waist Circumference	.001**	.26	.07
SBP / Cigar	.005**	.24	.06

SBP / Marijuana Use	.013*	.22	.05
SBP / Age	.011*	.20	.04
SBP / Marijuana Editable	.021*	.20	.04
SBP / Hookah Use	.029*	.19	.04
SBP/Exercise ≥ 3 Days/Week	.028*	.19	.04
SBP / Glucose	.024*	.18	.03
SBP / E-Cigarette Use	.032*	.18	.03
SBP / BMI	.028*	.17	.03
SBP / Cigarette Use	.049*	.17	.03
DBP / Marijuana Use	.001**	.31	.10
DBP / Marijuana Editable	.001**	.28	.08
DBP / Gender	.001**	.28	.08
DBP / Cigarettes	.002**	.27	.07
DBP / Waist Circumference	.001**	.26	.07
DBP / Smokeless Tobacco	.015**	.21	.04
DBP / E-Cigarette Use	.017*	.20	.04
DBP / Hookah	.018*	.20	.04

DBP / BMI	.025*	.18	.03
DBP / Cigar	.048*	.17	.03

*p = <.05; **p = < .01; ***p = ≤.002

Note. HDL = High Density Lipoprotein, LDL = Low Density Lipoprotein, TCHOL/HDL = Total Cholesterol/High Density Lipoproteins, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, BMI = Body Mass Index

Table 24 shows all the correlations interrelated to elevated total cholesterol. There were a total of nine correlations in the next category that had a smaller than typical effect size according to Cohen (1988). A total of 7 correlations were positive and 2 correlations were negative. Positive correlations were interpreted as one CVD risk factor increased, the corresponding CVD risk factor does as well. For negative correlations as one CVD risk factor increased, the second CVD risk factor decreased.

Table 24

Correlations Matrix for Variables Interrelated to Elevated Total Cholesterol

Correlated Variables	p	r	r^2
TCHOL / LDL	.001***	.77	.59
TCHOL / Triglycerides	.001***	.36	.13
TCHOL / HDL	.001***	.32	.10
TCHOL / Marijuana Editable	.001***	.28	.08

TCHOL / Vigorous Exercise	.006**	.26	.07
TCHOL / BMI	.012*	.20	.04
TCHOL / TCHOL/HDL	.037*	.16	.03
TCHOL / Gender	.001***	-.28	.08
TCHOL / Hookah	.034*	-.18	.03

**p* = <.05; ***p* = < .01; ****p* = ≤.002

Note. HDL = High Density Lipoprotein, LDL = Low Density Lipoprotein, TCHOL/HDL = Total Cholesterol/High Density Lipoproteins, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, BMI = Body Mass Index

Table 25 shows all the correlations interrelated to drug use. There were a total of 13 correlations in the next category that had a smaller than typical effect size according to Cohen (1988). A total of 12 correlations were positive and one correlation was negative. Positive correlations were interpreted as one CVD risk factor increased, the corresponding CVD risk factor does as well. For negative correlations as one CVD risk factor increased, the second CVD risk factor decreased.

Table 25

Correlations Matrix for Variables Interrelated to Drug Use

Correlated Variables	*p*	*r*	r^2
Marijuana Use / Editable Marijuana Use	.001***	.72	.52

Marijuana Use / E-Cigarette Use	.001***	.38	.14
Marijuana Use/ Hookah Use	.001***	.34	.12
Marijuana Use/ DBP	.002***	.32	.10
Marijuana Use/ Cigarette Use	.004**	.30	.09
Marijuana Use / Cigar Us	.006**	.29	.08
Marijuana Use / Exercise Habits	.010*	-.27	.07
Editable Marijuana Use / Hookah Use	.001***	.40	.16
Editable Marijuana Use / Cigarette Use	.002***	.32	.10
Editable Marijuana Use / TCHOL	.003**	.31	.10
Editable Marijuana Use / LDL	.019*	.25	.06
Editable Marijuana Use / DBP	.026*	.24	.05
Editable Marijuana Use / Smokeless Tobacco Use	.026*	.23	.05

*p = <.05; **p = < .01; ***p = ≤.002

Note. LDL = Low Density Lipoprotein, TCHOL = Total Cholesterol, DBP = Diastolic Blood Pressure

Table 26 shows correlations interrelated to obesity. Eight correlations were found in this category that had a smaller than typical effect size according to Cohen (1988). Six correlations were positive and two were negative. Positive correlations were interpreted as one CVD risk factor increased, the corresponding CVD risk factor does as well. For negative correlations as one CVD risk factor increased, the second CVD risk factor decreased.

Table 26

Correlations Matrix for Variables Interrelated to Obesity

Correlated Variables	*p*	*r*	r^2
BMI / Waist Circumference	.001***	.76	.58
BMI / LDL	.024*	.24	.06
BMI / Gender	.042*	.22	.05
BMI / White versus Non-White	.029*	-.23	.05
Waist Circumference / Glucose	.018*	.25	.06
Waist Circumference / DBP	.033*	.23	.05
Waist Circumference / Cigar Use	.047*	.21	.04
Waist Circumference / White versus Non-White	.034*	-.22	.05

*p = <.05; **p = < .01; ***p = ≤.002

Note. LDL = BMI = Body Mass Index, Low Density Lipoprotein, DBP = Diastolic Blood Pressure

Table 27 shows all the correlations interrelated to metabolic syndrome. There were a total of 49 correlations in the next category that had a smaller than typical effect size according to Cohen (1988). A total of 38 correlations were positive and 11 correlations were negative. Positive correlations were interpreted as one CVD risk factor increased, the corresponding CVD risk factor does as well. For negative correlations as one CVD risk factor increased, the second CVD risk factor decreased.

Table 27

Correlations Matrix for Variables Interrelated to Metabolic Syndrome

r	r^2	*Correlated Variables*	*p*
.76	.58	BMI / Waist Circumference	.001***
.37	.14	BMI / TCHOL/HDL	.001***
.32	.10	BMI / Triglycerides	.002***
.22	.05	BMI / Gender	.042**
-.23	.05	BMI / White versus Non-White	.029**
-.34	.12	BMI / HDL	.001***
.24	.06	BMI / LDL	.024**
.43	.18	Waist Circumference / Gender	.001***
.33	.11	Waist Circumference / TCHOL/HDL	.002***

.26	.07	Waist Circumference / SBP	.014**
.25	.06	Waist Circumference / Glucose	.018**
.23	.05	Waist Circumference / DBP	.033**
.21	.04	Waist Circumference / Cigar Use	.047**
-.22	.05	Waist Circumference / White versus Non-White	.034**
-.34	.12	Waist Circumference / HDL	.001***
.76	.58	SBP / Gender	.001***
.63	.40	SBP / DBP	.001***
.30	.09	SBP / Cigar Use	.004**
.28	.08	SBP / Age	.009**
.26	.07	SBP / E-Cigarettes Use	.015*
.22	.05	SBP / Smokeless Tobacco Use	.042*
-.22	.05	SBP / TCHOL	.034*
-.30	.09	SBP / HDL	.004**
.41	.17	DBP / Gender	.001***
.33	.11	DBP / Cigarette Use	.002***
.32	.10	DBP – Marijuana Use	.002***

.28	.08	DBP / E-Cigarettes Use	.008**
.25	.06	DBP / Smokeless Tobacco Use	.019*
.25	.06	DBP / Age	.016*
.24	.05	DBP / Editable Marijuana Use	.026*
.21	.04	DBP / Hookah Use	.049*
-.26	.07	DBP / Triglycerides	.015*
.33	.11	TCHOL / Triglycerides	.001***
.26	.07	TCHOL / Vigorous Exercise	.012*
-.77	.59	HDL / TCHOL/HDL	.001***
.49	.24	HDL / Gender	.001***
-.41	.17	HDL / Age	.001***
.27	.07	HDL / TCHOL	.011*
-.26	.07	HDL / LDL	.013*
.75	.56	LDL / TCHOL	.001***
.63	.40	LDL / TCHOL/HDL	.001***
.25	.06	LDL / Editable Marijuana Use	.019*
.23	.05	LDL / Vigorous Exercise	.032*

-.21	.04	LDL / White versus Non-White	.046*
.40	.16	TCHOL/HDL / Gender	.001***
.30	.09	TCHOL/HDL / Age	.004**
.29	.08	TCHOL/HDL / Triglycerides	.006**
.22	.05	TCHOL/HDL / Glucose	.035*
.28	.08	Glucose / Gender	.008**

*p = <.05; **p = < .01; ***p = ≤.002

Table 28 shows all the correlations interrelated to alcohol use. There were a total of 11 correlations in the next category that had a smaller than typical effect size according to Cohen (1988). A total of 28 correlations were positive and 12 correlations were negative. Positive correlations were interpreted as one CVD risk factor increased, the corresponding CVD risk factor does as well. For negative correlations as one CVD risk factor increased, the second CVD risk factor decreased.

Table 28

Correlations Matrix for Variables Interrelated to Alcohol Use

r	r^2	*Correlated Variables*	*p*
.40	.16	Beer / Smokeless Tobacco	.001***
.39	.15	Beer / Cigarettes	.001***

.39	.15	Beer / SBP	.001***
.38	.09	Beer / Gender	.001***
.36	.13	Beer / Cigars	.001***
.30	.09	Beer / DBP	.008**
.03	.0009	Beer / Class Status	.026*
.28	.08	Wine / Gender	.014*
-.30	.09	Liquor / Age	.009**
.47	.22	Liquor / Wine	.001***
.32	.10	Liquor / Beer	.005**

*p = <.05; **p = < .01; *** p = ≤.002

Additional Findings – Multiple Regressions for Key Dependent Variables

In additional to the correlations above, simultaneous multiple regressions were completed to identify the best predictive variables for key dependent variables, such as tobacco use, hookah use, elevated systolic blood pressure (SBP), elevated diastolic blood pressure (DBP), body mass index (BMI), and elevated total cholesterol.

Simultaneous multiple regression was conducted to investigate the best prediction of tobacco use. The means, standard deviations, and intercorrelations can be found on Table 29. The combination of variables to predict tobacco use from gender, marijuana edibles, amphetamines, and exercise was significantly significant $F(4,146) = 10.76$, $p < .001$. The beta coefficients are presented in Table 30. Note that gender, marijuana edibles, amphetamines, and lack of exercise significantly predicted tobacco use when all four variables were included. The adjusted R^2 value was .207. This indicated that 21% of the variance in tobacco use can be explained by this model. According to Cohen (1988), this was between a typical and larger than typical effect.

Table 29

Means, Standard Deviations, and Intercorrelations for Tobacco Use and Predictor Variables (N = 151)

Variable	*M*	*SD*	Gender	Edibles	Amphetamines	Exercise
Tobacco Use	1.29	.61	.31*	.35**	.38**	-.80
Predictor Variables						
Gender	.36	.48	--	.02	-.01	.04
Edibles	.48	.50		--	.50**	.17*
Amphetamines	.21	.41			--	.12
Exercise	.85	.35				--

**p* = <.05; ***p* = < .01

Table 30

Simultaneous Multiple Regression Analysis Summary for Gender, Edibles, Amphetamines, and Exercise Predicting Tobacco Use (N = 151)

Variable	*B*	*SE B*	*β*	*t*	*p*
Gender	.21	.09	.16	2.24	.027*
Edibles	.28	.10	.23	2.76	.007**
Amphetamines	.42	.13	.28	3.36	<.001**

Exercise	-.27	.13	-.16	-2.16	.033*
Constant	1.23	.12			

Note. R^2 = .21; F(4,146) = 10.76, p <.001

Simultaneous multiple regression was conducted to ithe best predictors of hookah use. The means, standard deviations, and intercorrelations are on Table 31. Variables to predict hookah use from cigarette use, e-cigarette use, smokeless tobacco, and liquor was significantly significant F(4,149) = 27.69, p <.001. The beta coefficients are presented in Table 32. Note that cigarette use, e-cigarette use, smokeless tobacco, and liquor significantly predict hookah use when all four variables are included. The adjusted R^2 value was .411, therefore, 41 percent of the variance in hookah use can be explained by this model. According to Cohen (1988), this was between a large to much larger than typical effect.

Table 31

Means, Standard Deviations, and Intercorrelations for Hookah Use and Predictor Variables (N = 154)

Variable	*M*	*SD*	Cigarette Use	E-Cigarette Use	Smokeless Tobacco	Liquor
Hookah Use	.41	.49	.55**	.44**	.40 **	.31**
Predictor Variables						
Cigarette Use	.24	.43	--	.44**	.44**	.11
E-Cigarette Use	.20	.40		--	.34**	.12
Smokeless Tobacco	.17	.38			--	.09
Liquor	.85	.36				--

*$p < .05$; **$p < .01$

Table 32

Simultaneous Multiple Regression Analysis Summary for Cigarette Use, Smokeless Tobacco, Liquor, and Exercise Predicting Hookah Use (N = 154)

Variable	*B*	*SE B*	*β*	*t*	*p*
Cigarette Use	.43	.09	.38	5.12	<.001**
E-Cigarette Use	.24	.09	.20	2.79	.006**
Smokeless Tobacco	.20	.09	.15	2.13	.035*
Liquor	.32	.09	.23	3.74	<.001**
Constant	-.05	.08			

Note. $R^2 = .41$; $F(4,149) = 27.69$, $p <.001$

Simultaneous multiple regression was conducted to investigate the best prediction of systolic hypertension. The means, standard deviations, and intercorrelations are on Table 33. The combination of variables to predict systolic hypertension from class status, gender, DBP, and exercise was significantly significant $F(4, 128) = 18.38$, $p <.001$. The beta coefficients are presented in Table 34. Note that gender, DBP and exercise significantly predict systolic hypertension when all four variables were included. The adjusted R^2 value was .345. This indicates that 35 percent of the variance in BMI can be explained by this model. According to Cohen (1988), this was between a large and larger than typical effect.

Table 33

Means, Standard Deviations, and Intercorrelations for Systolic Hypertension and Predictor Variables (N = 133)

Variable	*M*	*SD*	Class Status	Gender	DBP	Exercise
Systolic Hypertension	110.12	10.05	.20**	.32**	.52**	.16*
Predictor Variables						
Class Status	3.24	1.01	--	-.02	.16*	.08
Gender	.36	.48		--	.19*	.05
DBP	70.99	10.86			--	-.05
Exercise	.85	.36				--

**p*<.05; ** *p*<.01

Table 34

Simultaneous Multiple Regression Analysis Summary for Class Status, Gender, Glucose, DBP, Cigars, and Exercise Predicting Systolic Hypertension (N = 133)

Variable	*B*	*SE B*	*β*	*t*	*p*
Class Status	1.17	.72	.12	1.64	.104
Gender	4.81	1.50	.23	3.21	.002**
DBP	.43	.07	.47	6.38	<.001**
Exercise	4.50	1.99	.16	2.27	.025*
Constant	70.24	5.25			

Note. $R^2 = .35$; $F(4, 128) = 18.38$, $p < .001$

Simultaneous multiple regression was conducted to investigate the best prediction of diastolic hypertension. The means, standard deviations, and intercorrelations are on Table 35. The combination of variables to predict diastolic hypertension from class status, SBP, diabetes, and exercise was significantly significant $F(4,127) = 13.61$, $p < .001$. The beta coefficients are presented in Table 36. Note that SBP significantly predicts diastolic hypertension when all four variables are included. The adjusted R^2 value was .278. This indicates that 28 percent of the variance in diastolic hypertension can be explained by this model. According to Cohen (1988), this was a larger than typical effect.

Table 35

Means, Standard Deviations, and Intercorrelations for Diastolic Hypertension and Predictor Variables (N = 132)

Variable	*M*	*SD*	Class Status	SBP	Diabetes	Exercise
Diastolic Hypertension	70.99	10.86	.16*	.52**	.01	-.05
Predictor Variables						
Class Status	3.24	1.01	--	.20**	-.28**	. 08
SBP	110.12	10.05		--	-.11	-.16*
Diabetes	.02	.12			--	-.21
Exercise	.85	.36				--

*p<.05; ** p<.01

Table 36

Simultaneous Multiple Regression Analysis Summary for Class Status, SBP, Diabetes, and Exercise Predicting Diastolic Hypertension (N = 132)

Variable	*B*	*SE B*	*β*	*t*	*p*
Class Status	.87	.85	.08	1.02	.309
SBP	.58	.08	.54	6.99	<.001**
Diabetes	7.01	6.91	-.08	1.02	.312
Exercise	-4.02	2.29	-.13	-1.76	.082
Constant	7.53	9.04			

Note. $R^2 = .28$; $F(4, 127) = 13.61$, $p < .001$

Simultaneous multiple regression was conducted to investigate the best prediction of BMI. The means, standard deviations, and intercorrelations are on Table 37. The combination of variables to predict BMI from waist circumference, LDL, DBP, and gender was significantly significant $F(4,130) = 83.10$, $p < .001$. The beta coefficients are presented in Table 38. Note that waist circumference and gender significantly predict BMI when all four variables were included. The adjusted R^2 value was .710. This indicates that 71 percent of the variance in BMI can be explained by this model. According to Cohen (1988), this was a larger than typical effect.

Table 37

Means, Standard Deviations, and Intercorrelations for BMI and Predictor Variables (N = 135)

Variable	*M*	*SD*	LDL	DBP	Waist Circumference	Gender
BMI	23.90	2.64	.24**	.08	.83**	.14*
Predictor Variables						
LDL	92.25	27.79	--	.01	.24**	.08
DBP	71.16	10.27		--	.11	.23**
Waist Circumference	30.71	2.86			--	.34**
Gender	.34	0.47				--

*$p < .05$; **$p < .01$

Table 38

Simultaneous Multiple Regression Analysis Summary for LDL, DBP, Waist Circumference, and Gender Predicting BMI (N = 135)

Variable	*B*	*SE B*	β	*t*	*p*
LDL	.00	.01	.04	.87	.386
DBP	.01	.01	.02	.41	.685
Waist Circumference	.81	.05	.88	17.26	< .001**
Gender	-.89	.28	-.16	-3.17	.002**
Constant	-1.38	1.60			

Note. $R^2 = .72$; $F(4,130) = 83.10$, $p = .001$

Simultaneous multiple regression was conducted to investigate the best prediction elevated total cholesterol. The means, standard deviations, and intercorrelations are on Table 39. The combination of variables to predict elevated total cholesterol from LDL, triglycerides, waist circumference, cigars, and wine consumption was significantly significant $F(5,108) = 73.29$, $p < .001$. The beta coefficients are presented in Table 40. Note that LDL, triglycerides, waist circumference, cigars, and wine consumption significantly predict elevated total cholesterol when all five variables were included. The adjusted R^2 value was .772. This indicates that 77 percent of the variance in elevated total cholesterol can be explained by this model. According to Cohen (1988), this is a much larger than typical effect.

Table 39

Means, Standard Deviations, and Intercorrelations for TCHOL and Predictor Variables (N = 114)

Variable	*M*	*SD*	LDL	Triglycerides	Waist Circumference	Cigars	Wine
TCHOL	168.27	28.20	.81**	.30**	.09	-.14	.15
Predictor Variables							
LDL	91.29	25.52	--	.06	.25**	-.001	.05
Triglycerides	95.21	48.67		--	.25**	-.04	.10
Waist Circumference	30.84	2.91			--	.11	-.16*
Cigars	.24	.43				--	.17*
Wine	.86	.35					--

*$p < .05$; **$p < .01$

Table 40

Simultaneous Multiple Regression Analysis Summary for LDL, Triglycerides, Waist Circumference, Cigars and Wine Predicting TCHOL (N = 114)

Variable	*B*	*SE B*	*β*	*t*	*p*
LDL	.92	.05	.84	17.72	<.001**
Triglycerides	.16	.03	.27	5.66	<.001 **
Waist Circumference	-1.52	.48	-.16	-3.18	.002**
Cigars	-9.00	3.11	-.14	-2.89	.005**
Wine	9.02	3.85	.11	2.35	.021*
Constant	109.99	14.99			

Note. $R^2 = .767$; $F(5,108) = 73.29$, $p < .001$

Research Question #5 - Do students cluster together based on CVD risk factors? If so, how many clusters emerged from the data and what combinations of risk factors make each cluster unique?

K-means cluster analysis was used to group students together based on scores across multiple dependent variables. Original data was standardized into Z-scores for the purposes of similar comparisons between variables. The appropriate number of clusters was validated by comparing the number of iterations necessary to obtain statistical significance between all clusters. The objective to finding a stable model is to develop the most clusters, within reason, with the fewest number of interations necessary to achieve a statistically significant difference between all clusters. The six-cluster model displayed statistical significance between clusters after only four iterations. In comparison, a three cluster model and a four cluster model required six iterations, both the five and seven cluster models required 10 iterations, an eight cluster model required seven iterations, the nine cluster model did not achieve statistical significance even after 10 iterations, and the ten cluster model required four iterations. Therefore, it is with confidence that the six-cluster model is a strong and stable cluster.

Table 41

K-Means Cluster Analysis for Family History of Cardiovascular Disease (N = 114)

Clusters	*n*	Heart Disease	Stroke	Hyper-tension	Diabetes	High Cholesterol	High Triglycerides	Overweight/ Obese	*p*
1	6								<.001
M		0.08	-0.72	-0.02	-0.08	-0.40	-0.41	-0.38	
SD		0.00	0.00	0.94	0.87	0.90	1.41	1.00	
2	39								<.001
M		-0.04	-0.07	0.12	-0.05	0.20	0.05	0.07	
SD		0.94	0.64	0.89	0.92	0.93	0.79	0.91	
3	29								<.001
M		-0.09	-0.17	-0.28	0.02	-0.26	-0.23	-0.35	
SD		1.27	1.38	1.13	1.10	1.12	1.32	1.16	
4	21								<.001
M		-0.04	0.06	0.33	-0.03	0.18	0.17	0.53	
SD		0.92	1.07	0.86	1.02	0.94	0.67	0.58	
5	1								<.001
M		0.08	-0.07	0.58	0.28	0.41	-0.10	0.53	
SD									
6	18								<.001
M		-0.19	0.24	-0.11	0.16	-0.04	0.11	1.13	
SD		1.13	1.31	1.09	1.15	1.10	1.27	1.00	

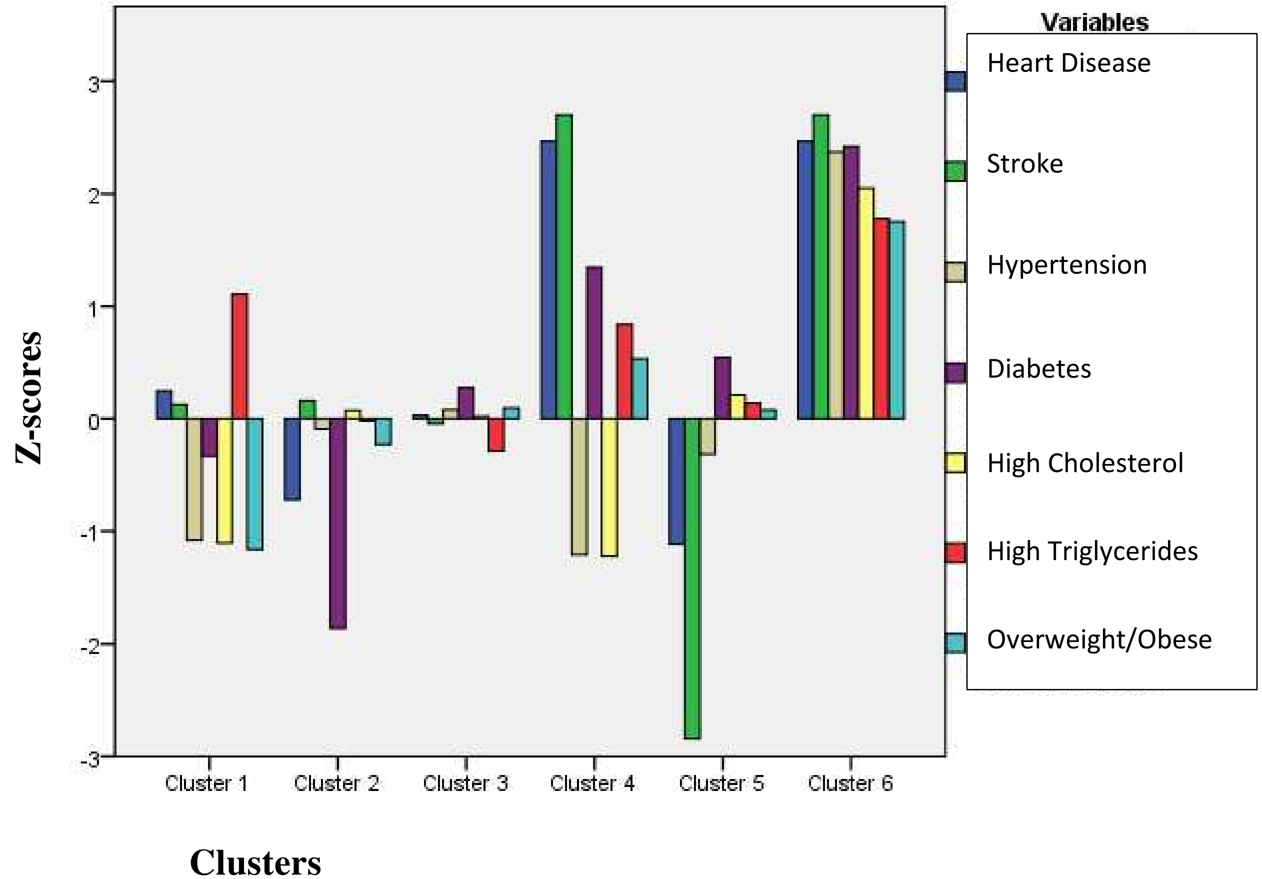

Figure 4. Six statistically significant different clusters for family history of cardiovascular disease and related risk factors including heart disease, stroke, hypertension, diabetes, high cholesterol, high triglycerides, overweight, and obesity.

Table 42

K-Means Cluster Analysis for TCHOL, HDL, LDL, Triglycerides, TCHOL/HDL, Exercise Habits, and General Health (N = 136)

Clusters	*n*	TCHOL	HDL	LDL	Triglycerides	TCHOL/HDL	Glucose	General Health	Exercise Habits	*p*
1	7									<.001
M		0.94	0.08	0.09	2.49	-0.35	0.32	1.08	-0.59	
SD		0.63	0.51	0.92	0.80	1.13	0.68	1.45	0.65	
2	46									<.001
M		-0.61	0.19	-0.69	-0.42	-0.57	-0.32	-0.11	-0.17	
SD		0.71	0.69	0.42	0.33	0.35	0.75	0.73	1.05	
3	32									<.001
M		0.59	-0.58	0.97	-0.04	0.85	0.40	-0.07	0.11	
SD		0.64	0.64	0.54	0.53	0.60	1.01	1.05	0.96	
4	27									<.001
M		0.60	0.84	0.10	0.03	-0.38	-0.51	-0.01	0.40	
SD		0.62	0.79	0.77	0.61	0.43	0.78	0.88	0.73	
5	3									<.001
M		2.92	-1.56	3.22	1.46	4.47	0.07	-1.57	0.87	
SD		1.13	0.34	0.99	0.62	0.53	0.84			
6	21									<.001
M		-0.65	-0.87	-0.57	-0.51	0.38	1.01	0.27	0.08	
SD		0.47	0.62	0.49	0.92	0.64	1.21	1.03	0.90	

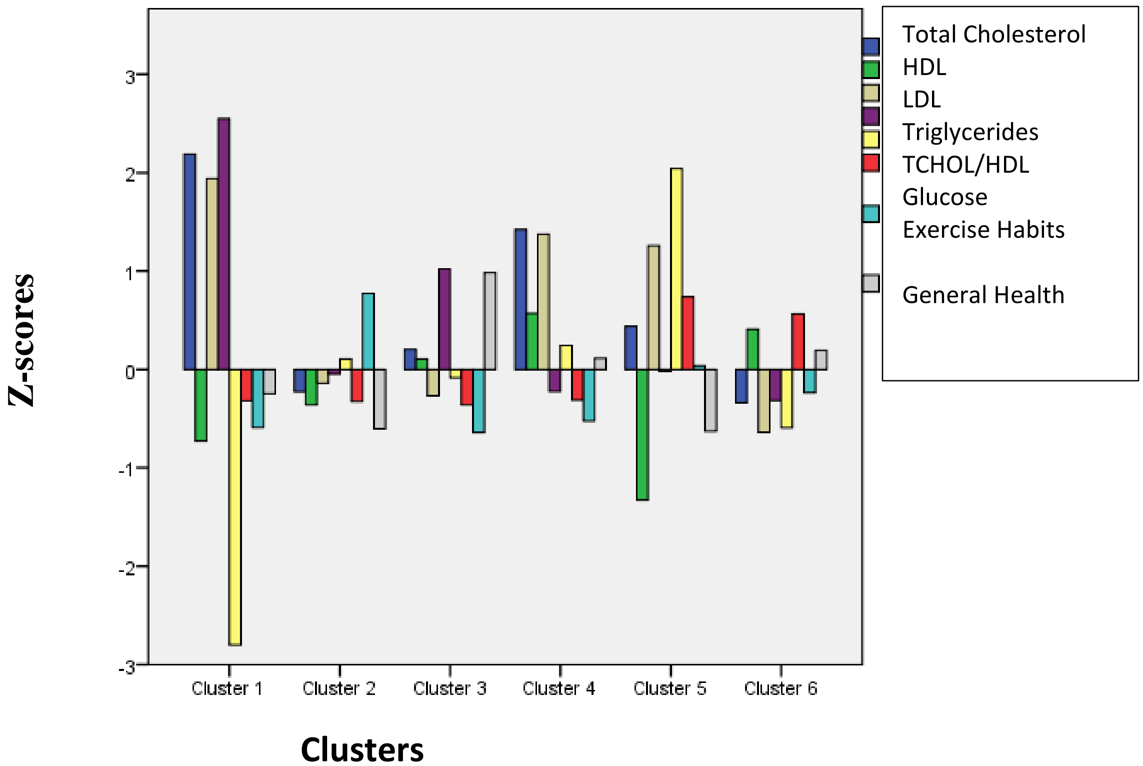

Figure 5. Six statistically significant different clusters for total cholesterol, HDL, LDL, triglycerides, TCHOL/HDL, glucose, exercise habits, and rating of general health. Legend: TCHOL - Total cholesterol level, HDL - High Density Lipoprotein, LDL - Low Density Lipoprotein, TCHOL/HDL - A ratio of total cholesterol divided by high density lipoproteins,

Table 43

K-Means Cluster Analysis for Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) (N = 136)

Clusters	*n*	Systolic Blood Pressure	Diastolic Blood Pressure	*p*
1	26			<.001
M		-0.16	-0.28	
SD		0.72	1.03	
2	9			<.001
M		-0.02	0.19	
SD		0.73	0.91	
3	4			<.001
M		0.25	0.23	
SD		1.01	1.03	
4	48			<.001
M		-0.80	-0.57	
SD		0.76	0.79	
5	53			<.001
M		-0.02	-0.20	
SD		1.15	0.34	
6	21			<.001
M		0.84	0.44	
SD		1.00	0.78	

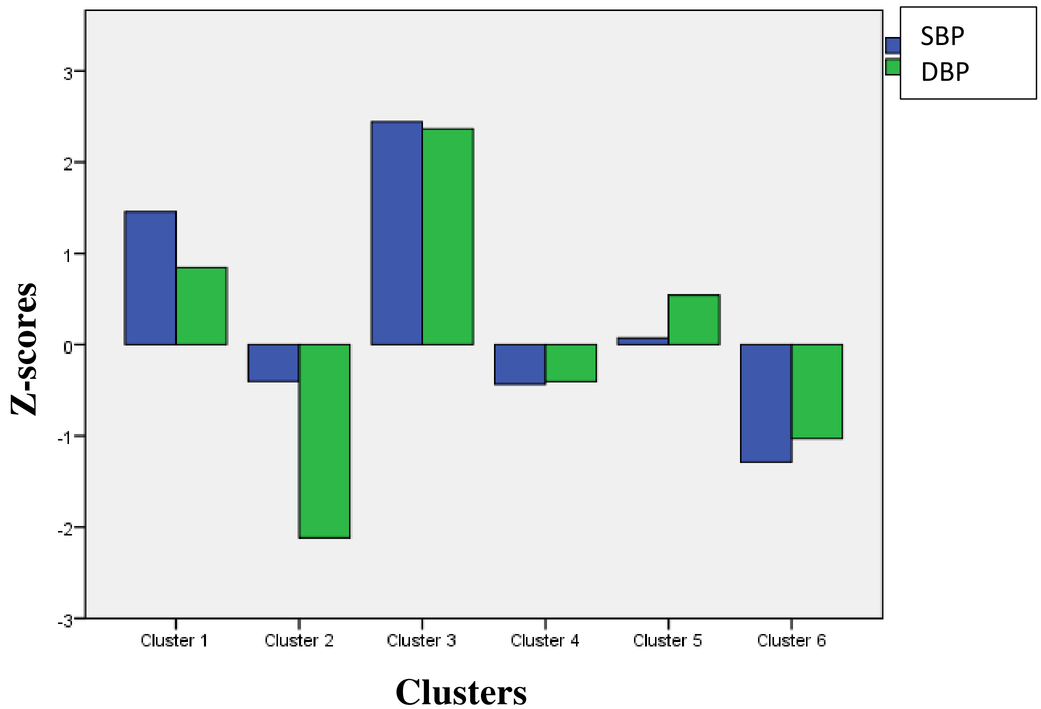

Figure 6. Six statistically significant different clusters for systolic blood pressure and diastolic blood pressure.

Legend: SBP – systolic blood pressure, DBP – diastoic blood pressure

Table 44

K-Means Cluster Analysis for Marijuana, Edibles, Cigarettes, Hookah. Cigars, and Smokeless Tobacco. (N = 154)

Clusters	Marijuana	Edibles	Cigarettes	E-Cigarettes	Hookah	Cigars	Smokeless Tobacco
1							
n	6	6	6	6	6	6	6
M	0.31	0.47	0.62	0.23	0.01	0.08	0.22
SD	1.08	0.75	2.00	0.66	0.68	1.00	0.91
2							
N	39	39	39	39	39	39	39
M	-0.14	-0.14	-0.23	-0.18	-0.17	-0.12	-0.07
SD	0.83	0.66	0.60	0.52	0.61	0.82	0.95
3							
n	28	28	28	28	28	28	28
M	0.49	0.17	-0.14	-0.04	0.03	-0.16	-0.13
SD	1.55	1.42	0.68	0.84	1.48	0.79	0.42
4							
n	21	21	21	21	21	21	21
M	-0.31	0.30	-0.25	-0.31	-0.14	-0.48	-0.22
SD	0.36	0.94	0.59	0.26	0.62	0.42	0.33
5							
n	1	1	1	1	1	1	1
M	-0.72	-0.71	-0.48	-0.37	-0.62	-0.56	-0.33
SD							
6							
n	17	17	17	17	17	17	17
M	-0.07	-0.16	0.44	0.37	0.49	0.82	0.34
SD	0.71	0.74	1.82	1.70	1.65	1.71	1.54

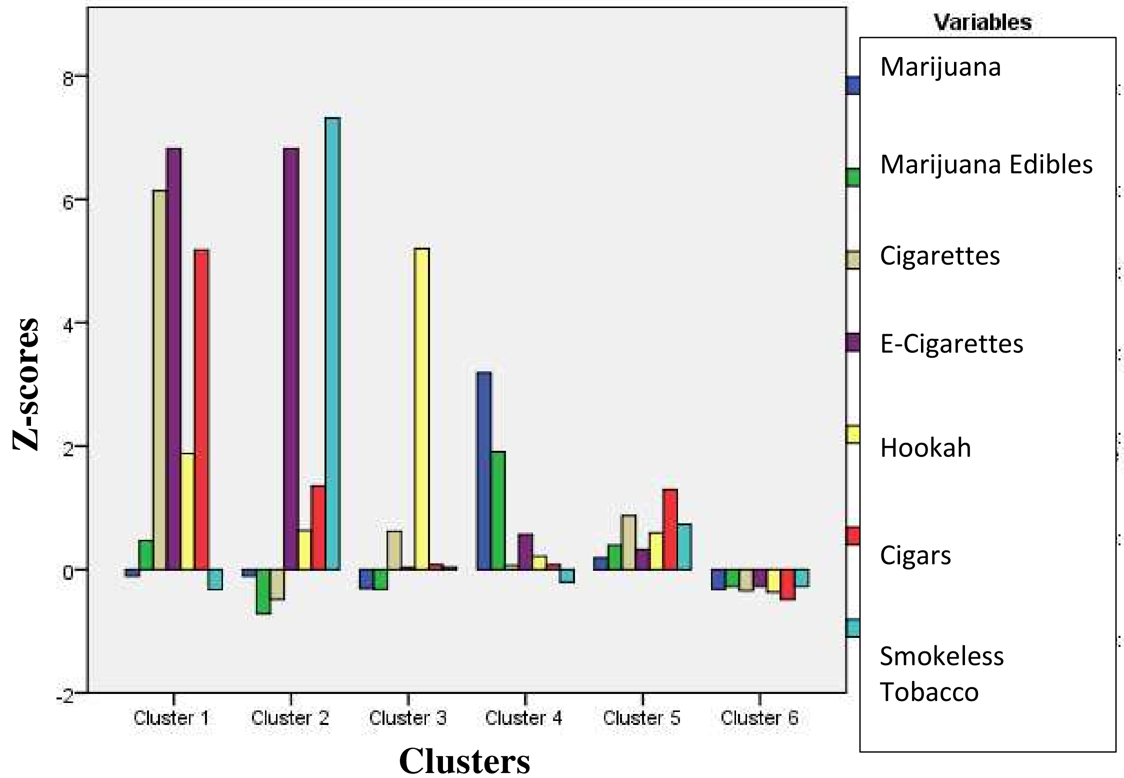

Figure 7. Six statistically significant different clusters for marijuana, edibles, cigarettes, Hookah, cigars, and smokeless tobacco.

Table 45

K-Means Cluster Analysis for Beer, Wine, and Liquor

Clusters	*n*	*Beer*	*Wine*	*Liquor*	*p*
1	27				<.001
M		0.74	0.74	1.09	
SD		0.95	1.13	1.46	
2	28				<.001
M		0.04	0.14	0.10	
SD		0.93	1.12	0.98	
3	15				<.001
M		-0.34	-0.15	-0.42	
SD		0.78	0.80	0.77	
4	4				<.001
M		-0.13	0.37	0.31	
SD		0.92	1.05	0.88	
5	21				<.001
M		-0.19	-1.31	-1.39	
SD					
6	59				<.001
M		0.07	-0.35	-0.07	
SD		0.94	0.81	1.10	

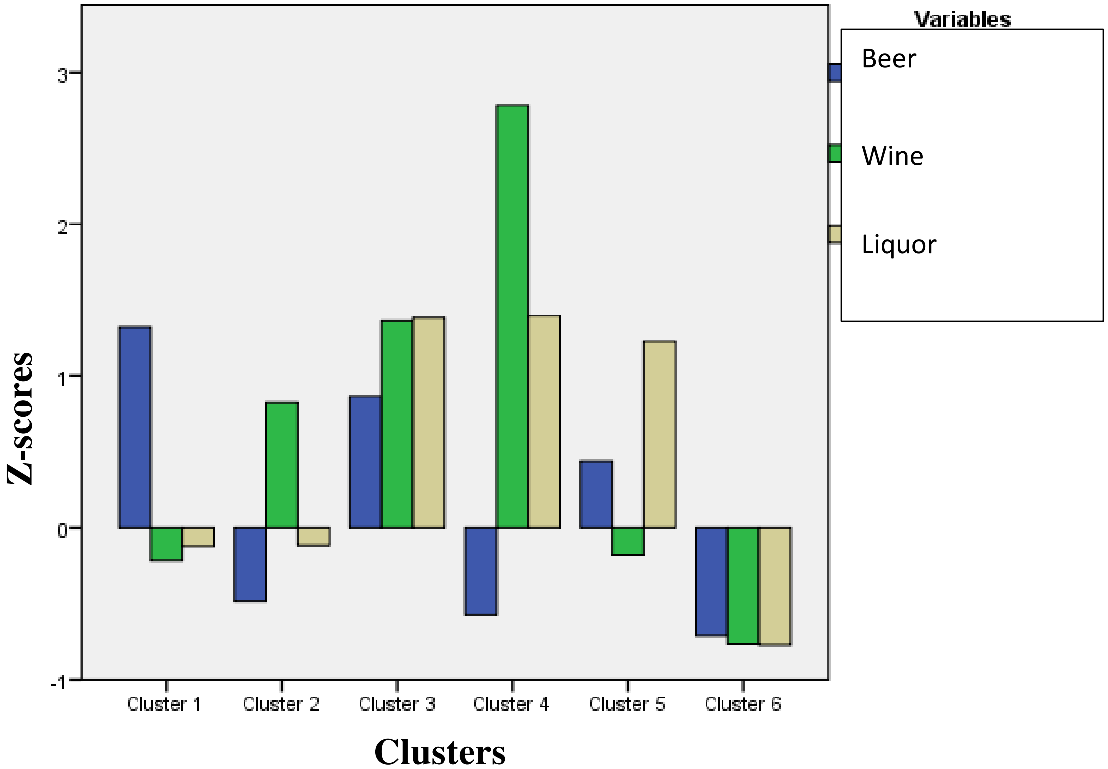

Figure 8. Six statistically significant different clusters representing beer, wine, and liquor use.

Table 46

K-Means Cluster Analysis for General Health, Cigarette, E-Cigarettes, Hookah, Cigars, Smokeless Tobacco, Beer, Wine, Liquor (N = 136)

Clusters	*n*	General Health	Cig	E-Cig	Hookah	Cigar	Smokeless Tobacco	Beer	Wine	Liquor	*p*
1	7										<.001
M		1.08	0.62	0.23	0.01	0.08	0.22	0.74	0.74	1.09	
SD		1.45	2.00	0.66	0.68	0.99	0.91	0.95	1.13	1.46	
2	46										<.001
M		-0.11	-0.23	-0.18	-0.16	-0.12	-0.07	0.04	0.14	0.10	
SD		0.73	0.60	0.53	0.61	0.82	0.95	0.93	1.11	0.98	
3	32										<.001
M		-0.07	-0.14	-0.04	0.03	-0.16	-0.14	-0.34	-0.15	-0.42	
SD		1.05	0.68	0.84	1.48	0.79	0.42	0.78	0.80	0.77	
4	27										<.001
M		-0.01	-0.25	-0.31	-0.14	-0.47	-0.22	-0.13	0.36	0.31	
SD		0.88	0.59	0.26	0.62	0.42	0.33	0.92	1.05	0.88	
5	3										<.001
M		-1.57	-0.48	-0.37	-0.62	-0.56	-0.33	-0.10	-1.31	-1.39	
SD		-	-	-	-	-	-	-	-	-	
6	18										<.001
M		0.27	0.44	0.37	0.49	0.82	0.34	0.07	-0.35	-0.07	
SD		1.03	1.82	1.70	1.65	1.71	1.50	0.94	0.81	1.10	

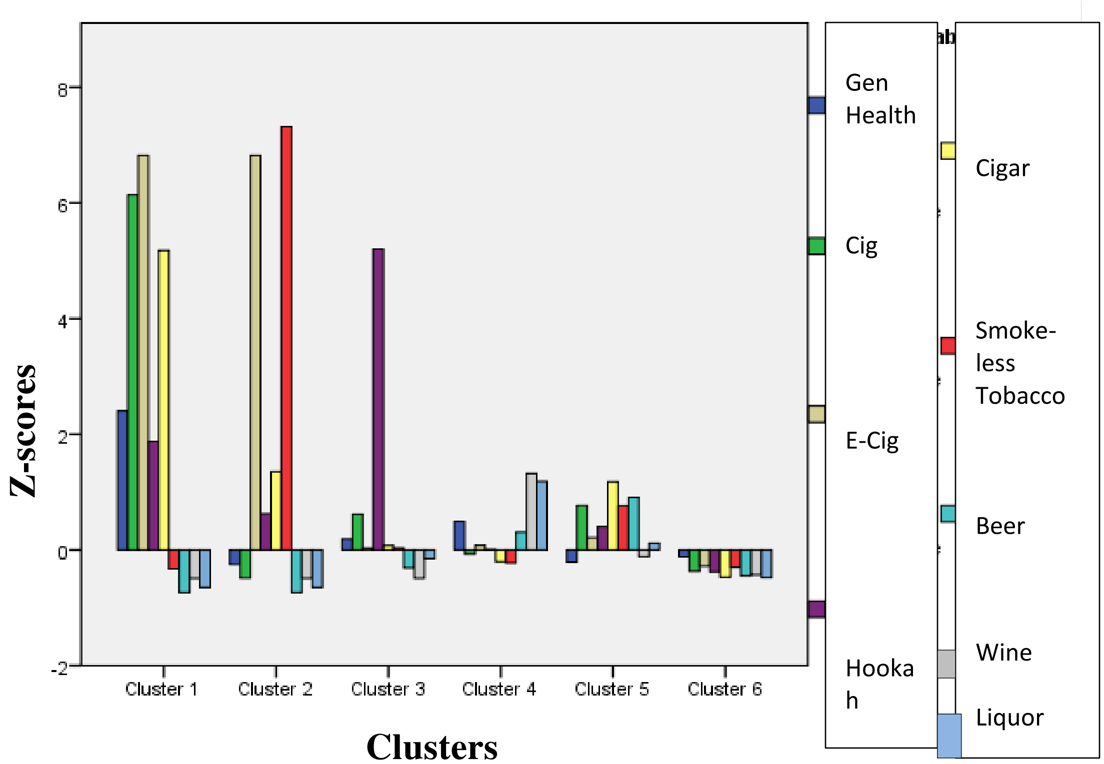

Figure 9. Six statistically significant different clusters representing general health, cigarette, e-cigarettes, hookah, cigars, smokeless tobacco, beer, wine and liquor.

Table 47

K-Means Cluster Analysis for Cocaine, Amphetamines, Sedatives, Hallucinogens, Anabolic Steroids, Ecstasy (MDMA), Other legal Drugs, Methamphetamines (N = 136)

Clusters	*n*	Marijuana	Edibles	Cocaine	Methamphetamines	Amphetamines	Sedatives	Hallucinogens	Steroids	Ecstasy	Other	*p*
1	16											<.001
M		0.31	0.47	0.50	-1.09	0.66	-0.30	0.17	-0.08	0.13	-0.14	
SD		1.08	0.75	2.01	0.00	1.77	0.00	1.29	0.00	1.23	0.00	
2	1											<.001
M		-0.14	-0.14	-0.03	0.17	-0.20	0.08	-0.11	-0.08	-0.04	-0.14	
SD		0.83	0.66	1.35	1.77	0.39	1.27	0.85	0.00	1.06	0.00	
3	3											<.001
M		0.49	0.17	-0.09	0.09	0.11	-0.07	0.09	-0.08	-0.13	0.37	
SD		1.55	1.42	0.74	1.04	1.04	0.61	1.13	0.00	0.72	1.88	
4	78											<.001
M		-0.31	0.30	0.07	-0.11	-0.19	-0.05	-0.05	-0.08	-0.06	-0.14	
SD		0.36	0.94	0.72	0.00	0.35	0.75	0.95	0.00	0.83	0.00	
5	1											<.001
M		-0.72	-0.71	-0.32	-0.11	-0.35	-0.30	-0.35	-0.08	-0.33	-0.14	
SD		-	-	-	-	-	-	-	-	-	-	
6	53											<.001
M		-0.07	-0.16	-0.13	-0.11	-0.25	0.08	0.20	-0.08	0.16	0.28	
SD		0.71	0.74	0.54	0.00	0.29	1.31	1.24	0.00	1.46	1.74	

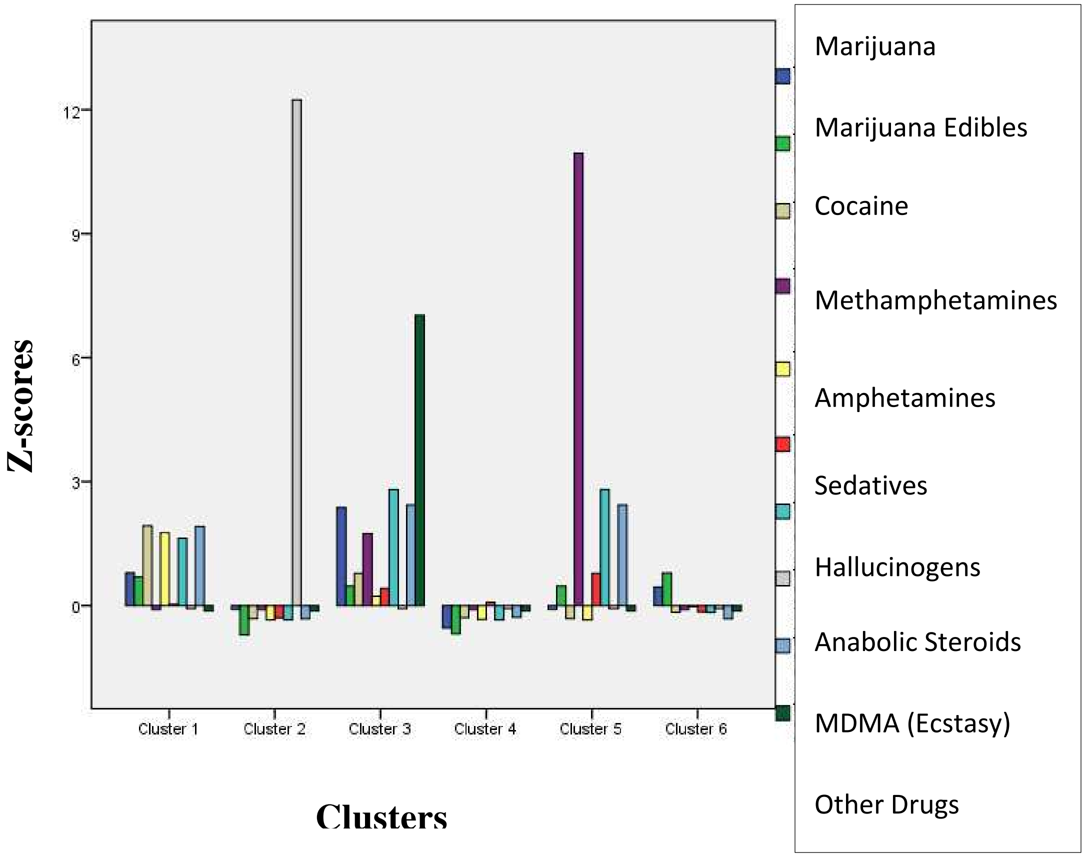

Figure 10. Six statistically significant different clusters representing drug use including marijuana, marijuana edibles, cocaine, methamphetamines, amphetamines, sedatives, hallucinogens, anabolic steroids, MDMA (Ecstasy) and other drugs.

CHAPTER 5: DISCUSSION

The purpose of this chapter is to provide a summary of the research study followed by an interpretation and discussion of the findings. This chapter is divided into the following sections: (a) interpretation of statistical results and implications for practice, (b) limitations (c) recommendations for future research, and (d) concluding comments.

The overarching purpose of this investigation was to identify the prevalence and clustering of risk factors associated with cardiovascular disease (CVD) with undergraduate students' age 18 – 25 years old enrolled at Colorado State University (CSU), during the spring semester, 2017. The study was grounded in a solid theoretical foundation, included a lipid analysis, anthropometric measurements, and used a health and wellness questionnaire. The questionnaire was developed from questions from the National College Health Assessment (NCHA), a nationally recognized research survey, the Student Stress Survey (SSS), (Ross et al., 1999), and the International Physical Activity Questionnaire (IPAQ), which has extensive reliability and validity testing in 12 countries.

The five research questions had very specific aims for the study. The prevalence of each CVD risk factor provided an overview of the complete data set. Identified risk factors were then compared between gender, ethnic groups, and class status. Next, the CSU data were compared to national data for college students as found in the National College Health Assessment (NCHA), 2016. Correlations between various risk factors were also identified and listed by effect size as well as by risk factor. From these correlations, simultaneous multiple regression was conducted to investigate interrelated variables for predicting tobacco use, hookah use, systolic hypertension, diastolic hypertension, body mass index (BMI), and elevated total cholesterol. Lastly, K-means cluster analyses were performed as a powerful exploratory examination of the data. The K-means analyses separated the data into six statistically significantly different clusters with each having the greatest possible distinction from the other clusters.

It was the author's intent to answer the following research questions:

Research Question #1: What is the prevalence of each CVD risk factor (family history, gender, nicotine use, elevated blood pressure, elevated cholesterol levels, low HDL's, elevated LDL's, elevated triglycerides, elevated fasting glucose, inactivity, excess weight (BMI ≥ 30))?

Risk factor profiles in young adults strongly predict long-term cardiovascular disease (CVD) (Arts et al., 2014). The degree of atherosclerosis is directly correlated with the number of risk factors present; therefore, identifying risk factors for CVD is an important step in identifying areas of concern before disease manifests within the body and causes harm or death. According to the National Health Lung and Blood Institute (NHLBI), one risk factor doubles the risk for CVD, two risk factors increases the risk for CVD fourfold, and three or more risk factors increases the risk for CVD more than tenfold (Gibbons et al., 2013). Therefore, an exponential relationship exists between the number of cardiovascular risk factors and the probability of developing CVD in both young and old individuals.

Totality of risk factors associated with cardiovascular disease (CVD). An unexpected high number of CVD risk factors were found in this apparently health group of college students. A total of 706 CVD risk factors were identified including; 208 for nicotine use, 238 with family history of CVD, 42 for high LDLs, 32 for elevated SBP, 24 for elevated DBP, 22 for inactivity, 21 for elevated triglycerides, 20 for elevated total cholesterol, 20 for elevated blood glucose, 19 for low HDLs in males, 15 for low HDLs in females, 39 for BMI ≥ 25 kg/m^2), 4 for increase in waist circumference for females, and 2 for an elevated waist circumference in males. The range of CVD risk factors per student was from zero to six (see Table 11). The significance in the totality of CVD risk factors in this apparently healthy undergraduate student sample is startling and warrants further examination.

In addition, several undergraduate students indicated multiple forms of tobacco use and had a positive family history for CVD, and several related diseases and risk factors such as stroke, hypertension, diabetes, elevated cholesterol levels, elevated triglycerides, and overweight or obesity. When each variable is counted as an individual risk factor, the range of CVD risk factors was found to be between zero and 14 different risk factors. Either method of tallying risk factors results in a significant prevalence of CVD risk factors among the CSU student sample.

Prevalence of Non-Modifiable Risk Factors for Cardiovascular Disease

Family history. With respect to family history of CVD and related risk factors, 238 positive results were revealed. Students indicated a positive family history for heart disease, stroke, hypertension, diabetes, elevated cholesterol, elevated triglycerides, overweight, and obesity. Cardiovascular disease is a multifactorial chronic disease. Therefore, it was not surprising to see several students indicate a positive family history for multiple related risk factors.

Comparative results. It is mportance of identifying a positive family history for CVD. Khoddam and Doran (2013), found at least 30.5 percent of college freshman had at least one parent that had a history of CVD. In addition, the authors found that students with a family history of CVD weighed more, smoked, and less likely to exercise, adhere to a low-fat dietary intake, seek health educational information, have knowledge regarding family health history, and have a blood cholesterol test done prior to starting college. Despite small fluctuations in percentages between studies, the lifestyle pattern remains consistent for students with a family history of CVD in several other studies (Imes & Lewis, 2014; Spencer, 2002). These findings and predictable patterns for students with a positive family history of CVD should be taken seriously by health care providers, school administrators, health educators, and of course the student him/herself.

Potential risk for one with a positive family history of cardiovascular disease (CVD).

It is important for college students to learn about their family history for CVD and be intentional in developing a healthy lifestyle to minimize the potential impact of genetic predisposition in their own lives. The Heart Federation (2013), the National Heart Lung and Blood Institute (NHLBI) (2013), and the American College of Sports Medicine (ACSM) (2013), all state that one's risk of heart attack increases if a first-degree male relative suffered a heart attack prior to the age of 55, or if a first-degree female relative suffered a heart attack prior to the age of 65. If both parents have suffered from heart disease before the age of 55, an individual's risk of developing heart disease can rise to 50 percent compared to the general population. The same relationship exists for developing a stroke. A genetic relationship also exists for other CVD risk factors such as hypertension, abnormal blood lipids, and type-2 diabetes.

Although a family history of CVD indicates a greater potential for disease development, it is important to understand that the disease is not imminent. Students identified with a positive family history for CVD are encouraged to embrace a healthy lifestyle that can often lessen the genetic influences associated with CVD. Naturally, this advice also extends to students with a negative family history of CVD. They too are encouraged to be proactive in their health and adapt a healthy lifestyle to minimize potential disease development. Behavior change begins with awareness of health that often comes from a preventive health screenings. Therefore, preventive health screenings coupled with an evaluation of family history of CVD is highly recommended for the college student population.

Age. Although a significant determinant of CVD is age, young individuals can also develop CVD. This progressive disease development begins during childhood and continues into adulthood. Disease development in the younger population has been identified with an accelerated accumulation of plague in the coronary vessels, obesity, diabetes, hypertension and dyslipidemia (Franklin et al., 2001; Freedman et al., 2001; Gall et al., 2009). Since arteries can be occluded with plaque over time, it is wise to take advantage of early college years for preventive screening and intervention. Like any chronic disease, the earlier in life CVD risk factors are detected the greater chance for successful intervention and lifestyle adjustments to protect future health.

The age range for subjects in this research study was between 18 – 25 years old, with a mean age of 21 years and 4 months. The importance of this young age group should not be overlooked. Study participants were apparently healthy and most did not have a history of any elevated CVD risk factors, however, 706 CVD risk factors were identified in a sample of 180 undergraduate college students. The student range for CVD risk factors was from zero, or the absence of any risk factors to six risk factorsin this outwardly healthy college student sample.

Cardiovascular disease is a chronic disease that has numerous risk factors associated with it. Therefore, a complete preventive CVD screening with measured blood lipids and blood pressure in the young college student population is recommended. Program goals for this young population include student knowledge of personal risk factors for CVD and the establishment of early interventions targeted as reducing or eliminating identified risk factors that may further progress into disease later in life if left untreated.

Gender. Gender is another non-modifiable risk factor for CVD. Middle aged men suffer from CVD 2 to 5 times more than women (Go et al., 2014), especially prior to menopause. Research has shown total cholesterol, LDL-C, and triglycerides to be higher in males when compared to females and multiple risk factors accelerated the CVD process (Kuklina et al., 2010).

Identified risk factors found with male students. In this study there were 37.20 percent ($N = 67$) male participants. When compared to female participants, males were less likely to exercise and had lower HDLs. In addition, males had higher LDLs, glucose, TCHOL/HDL, BMI, SBP, DBP, and family history of CVD. With respect to nicotine use, males had a higher use of cigarettes, e-cigarettes, hookah, cigars, and smokeless tobacco compared to females.

The study revealed only one CVD risk factor that was more favorable in males than females. Males were found to have a lower total cholesterol level than females. However, the extremely low HDL value also found in males' resulted in a higher TCHOL/HDL ratio which ideally should be as low as possible.

Males in this study showed unfavorable results in 15 out of the 16 CVD risk factors. The gender difference found in this study were numerous and should be shared with students, professionals in Student Affairs, Administration, the Health and Medical Center, and the Student Recreational Center. The typical college lifestyle includes reductions in exercise habits, unbalanced food choices, stress and time management, and experimentation with alcohol and drug use. Programming efforts to educate males on their risk of CVD and lifestyle coaching is essential during the college years to help prepare these men for their future years with deliberate lifestyles targeted at decreasing their risk for CVD.

Lifestyle management. The results from this preventive screening are alarming, especially due to the young age of these male students who reside in an active community within one of the healthy states in America. It is important for all undergraduate students (especially males) to become educated on existing and potential risk factors for CVD. Participants in this study have taken the initial step of being screened and educated on their results for CVD risk factors. Efforts towards reducing or eliminating risk factors associated with CVD at a young age may help eliminate or reduce the severity of a cardiac event later in life.

Prevalence of Modifiable CVD Risk Factors

Tobacco Use. Tobacco use was the number one most prevalent CVD risk factor found in the study. With respect to student tobacco use in the CSU student sample close to half 49.02 percent (N = 75), reported using tobacco within the last 30 days. From the various forms of tobacco, hookah use was the most prevalent, followed by cigars, cigarettes, electronic cigarettes, and smokeless tobacco. Although this high prevalence was surprising, it was also troubling to discover that many CSU student in the sample reported using multiple forms of tobacco. Student results ranged from one form of tobacco use to five different forms of tobacco use within the past 30 days. Hookah and e-cigarette smoking have increased in popularity, especially among college students, and may help explain the high prevalence in tobacco use.

Explanations for the increase in hookah smoking. In this study, the highest prevalence of tobacco use was found from hookah smoking. Hookah smoking has gained popularity among college students because it is inexpensive, available in flavored tobacco, and has a quick lighting charcoal. Additionally, purchases can now be made online which makes it especially appealing and expedient for underage and college students. Also, there is an increase in the number of hookah bars conveniently located close to college campuses. A final explanation is the mistaken belief that hookah smoking is safer than cigarette smoking.

Hookah nicotine ingestion compared to cigarette nicotine ingestion. Many tobacco users believe that hookah smoking is less harmful that traditional cigarette smoking. However, according to Cobb, et al (2010) a hookah session typically involves close to 200 puffs, with an average puff volume exceeding 500 ml. In comparison, a cigarette involves 20-13 puffs with an average volume of 50 ml per puff. Additionally, a cigarette is usually completed within five minutes while a single hookah session last approximately 60 minutes or longer. Therefore, the typical inhalation from a single cigarette is approximately 500-600 ml of smoke, while the typical inhalation from a hookah session can equate to the inhalation of approximately 90,000-100,000 ml of smoke. Clearly, hookah smoking is not a safer alternative to cigarette smoking.

There has been a rise in the number of hookah bars throughout the U.S., especially in close proximity to college campuses. In the U.S., 30-40 percent of the student hookah smokers have never smoked a cigarette (Cobb, Ward, Maziak, Shihadeh, & Eissenberg, 2010). The fact that many hookah smokers are tobacco naïve is troublesome. Research has shown that hookah smokers are more likely to also experiment with cigarette smoking. Therefore, hookah smoking may be the gateway to cigarette smoking. Finally, approximately 10 percent of students report smoking tobacco and marijuana through the same hookah. The literature has shown hookah smoking rates vary between 7 percent and 43 percent on college campuses (see Appendix A), despite the fact that the nicotine from one hookah session is equivalent to 1 to 50 cigarettes (Aryal, 2014; Cobb et al., 2010; Grekin & Ayna, 2012).

Student smokers are at much greater risk of cardiovascular disease than those who begin smoking as an adult due to the accumulation effect of nicotine and associated particles in the lung tissue. For those less than 35 years of age, smoking is one of the main risk factors associated with an acute myocardial infarction (MI) compared to those 65 and older. All of the males in this study were under 25 years of age, placing them at significant risk for disease development. The vast number of CVD risk factors, especially with respect to tobacco use, places this group of students at a significant risk of developing CVD if adjustments to reduce these risk factors are not implemented.

Hypertension. High blood pressure or hypertension is the leading cause of CVD worldwide (Mendis et al., 2011). In the United States, about 77.9 million (1 of every 3) adults have high blood pressure (Bonaca et al., 2012).

Prevalence of hypertension in the CSU study sample. In the CSU sample, after multiple measurements were taken, close to 20 percent of participants had elevated systolic blood pressure (SBP). Although most of the students were categorized as pre-hypertensive, a small percent was classified Stage 1 Hypertensive (140 – 159 mm/Hg), or Stage 2 Hypertensive (≥ 160 mm/Hg). Close to 15 percent of students had diastolic hypertension, with the majority of these students classified as Pre-Hypertensive (80 – 89 mm/Hg), and a small percent classified as Stage 1 Hypertensive (90 – 99 mm/Hg). No students were classified as Stage 2 Hypertensive (≥ 100 mm/Hg). For the CSU data, systolic hypertension was ranked as the fifth most prevalent CVD risk factor followed by diastolic hypertension as the sixth most prevalent risk factor.

According to Pyle, Lalumandier, & Sawyer, (2000), 3.4 percent of college students have hypertension, and college males had a greater occurrence than age-matched females. In comparison, the CSU data showed a substantially higher percentage of hypertension at 20 percent. It is important to note that the CSU students had their blood pressures measured by a Registered Nurse and many studies have students complete a questionnaire asking if they have high blood pressure.

Colorado State University student's perception of hypertension. It is interesting to note that when asked, no study participate perceived they would have an elevated blood pressure or had ever been told they had hypertension. However, after clinically measurements were complete, close to 20 percent of students had an elevated SBP and close to 15 percent of students had an elevated DBP. Clearly, the distinct difference between perception of having this risk factor and the reality of having elevated blood pressure cannot be ignored. Hypertension is referred to as a "silent killer" because there are often no symptoms. The disease tends to go undetected for years while causing mechanical damage to the endothelium cells of the arterial system, leading to CVD.

Blood pressure comparisons between national college students and Colorado State University. It is also interesting to note that the data from the NCHA (2016) showed approximately 3 percent of college students have hypertension. However, it is extremely important to understand that blood pressures were not clinically measured during the study, as with many other research studies. Researchers simply asked students to complete a questionnaire regarding their history of high blood pressure or perception of having high blood pressure. If would be interesting to complement this national questionnaire with clinical measurements to gain insight into the reality of the true incidence of hypertension among national college students. It is the author's thought that many of these students do not know what their true blood pressure are, and therefore, simply assume that their blood pressures are normal.

Prevalence of undiagnosed hypertension. Hypertension is one of the most important causes of premature death worldwide and the prevalence is growing (Mendis et al., 2011). Currently, nearly one billion people have high blood pressure and it is estimated that by 2025, approximately 1.56 billion adults will be living with hypertension (Sowers et al., 2001). Untreated hypertension can cause an increase in morbidity and mortality.

Potential harm from undetected and uncontrolled hypertension. Hypertension is a serious medical condition. Undetected and uncontrolled hypertension can lead to a cascade of very serious cardiovascular conditions such as heart disease, peripheral vascular disease, and stroke. Hypertension was found in 69 percent of first heart attacks, 77 percent of first stroke, and 74 percent of congestive heart failure (Go et al., 2013).

Atherosclerotic is associated with hypertension, elevated total cholesterol, LDLs, and triglycerides. Untreated high blood pressure has also been associated with kidney failure and premature mortality and disability. Therefore, regular blood pressure screenings beginning at the age of 20, as recommended by the American Heart Association (AHA) and the American Pediatric Association (APA) are highly recommended as a standard annual screening for all college student.

Cholesterol. High blood cholesterol is a major and modifiable risk factor for CVD. Cholesterol is a waxy, fat-like substance consisting of excessive cholesterol, fat, calcium, and other substances in the blood. Although the human body need cholesterol to by physiologically healthy, too much cholesterol can cause adverse effects. CVD is a condition in which excessive plaque builds up inside the coronary arteries. By itself, the condition has no signs or symptoms and may go undetected for years until symptoms develop and CVD disease is diagnosed.

Clinical results of elevated total cholesterol. When asked about a known history of an elevated cholesterol level, only one percent of the CSU research sample indicated yes, or a positive history. However, after a clinical lipid analyses were complete, slightly over 12 percent of students were found to have an elevated blood cholesterol level. The same pattern of perception versus reality previously identified with hypertension was also present with blood cholesterol level. Like hypertension, an elevated cholesterol levels usually have no signs or symptoms, therefore, one may not be aware of the problem until symptoms develop and CVD disease is diagnosed.

Comparative results of elevated total cholesterol. Scientists and researchers have documented a large range 9.5 percent to 27 percent for elevated cholesterol levels in college students. By comparison, the measured elevated cholesterol level in this research study was slightly over 12 percent. Although the CSU data is at the lower end of the published range, health education programs may help students lower this percent even further.

Screening recommendations. After an extensive review of the literature and clinical trials, cholesterol screening guidelines have been established and serve as a tool for educating the public about their measured blood cholesterol level. The National Cholesterol Education Program – Adult Treatment Panel III (NCEP ATP III) (2002), recommends that routine screening for blood lipids begin at age 20 and every five years after, which is consistent with the United States Preventive Service Task Force (USPSTF) (Lorenzo et al., 2007), the National Heart Lung and Blood Institute (NHLBI) (Luepker et al., 2003) and the American Academy of Pediatrics (AAP) (Lloyd-Jones et al., 2010). After completing this research study, the author is in agreement with these recommendations. The goal is to identify those with elevated results and develop an appropriate plan to lower the cholesterol level to a proper level.

The college years appear to be the ideal time to begin a lipid panel screening. College students are transitioning into adulthood and should be aware and responsible for their health and well-being. Part of that health profile includes knowledge about blood lipids and how lifestyle behaviors can promote heart health throughout their adult life. Programming efforts to assist students in reducing an elevated total cholesterol level are certainly valuable, as the risk of a heart attack has been shown to decrease by 2 percent for every 1 percent decrease in blood cholesterol (Go et al., 2013).

High density lipoproteins (HDLs) and low density lipoproteins (LDLs). Cholesterol is transported in the body by fatty proteins known as HDLs and LDLs. HDLs are commonly referred to as the "good" cholesterol. These protein molecules act like scavengers in the blood by removing cholesterol from cells, the blood, and from the deposits in the walls of the blood vessels and transport the cholesterol to the liver for metabolism, thus reducing the risk of atherosclerosis or CVD.

Conversely, LDLs are typically referred to as the "bad" cholesterol since this type of protein molecule transports and deposits cholesterol in the walls of the arteries. Once deposited, it can become oxidized and damage the lining of the artery. This process accelerates the process of atherosclerosis or CVD.

Identified results for low high-density lipoproteins (HDLs). Abnormal or low HDL values were found in slightly more than 30 percent of male students and close to 15 percent of female students. The low HDLs found in male students was the second most prevalent risk factor found in the entire study. By comparison, the low HDL level in females was ranked as the seventh most prevalent CVD risk factor. Approximately one-third of all students had an elevated LDL value with no statistical significance between genders ($p = .431$). Active lifestyles and activity patterns are significant in increasing HDLs and decrease LDLs. College students spend many hours per day sitting in class, behind a computer, or studying for exams. Therefore, in an effort to keep HDLs as high as possible and LDLs as low as possible, it is important for college students to schedule activity or movement time for themselves. This can include anything from exercise sessions to simply adding more steps in per day. Athleticism does not have to be the goal. The goal should be an increase in movement, or the time spent in activity per day.

Triglycerides. Triglycerides are the most common type of fat in the blood and were found to be elevated in slightly over 12 percent of students in the CSU data. Although not a direct or primary risk factor for CVD, it is still important to monitor as it represents lipids passing through the systemic circulation and coronary arteries. It is important to note that high levels of both triglycerides and LDLs accelerate the atherosclerosis process and therefore, increase the risk for a heart attack or stroke. Reductions in triglycerides can be seen as one maintains a balance between caloric intake and energy expenditure and spends more time in activity. Therefore, both caloric balance and additional activity are recommended to the college student population in an effort to keep triglyceride levels within a normal and safe range.

Diabetes. Diabetes is a powerful, independent risk factor for CVD and CVD is the most common and costly vascular complication of diabetes (Association, 2013; Resnick & Howard, 2002). An elevated blood glucose level indicates diabetes.

Identified results for diabetes and pre-diabetes. In the CSU student sample, elevated fasting glucose levels were found in slightly over 12 percent of the sample. Although the majority of students with an elevated glucose level were categorized as pre-diabetes (100-125 mg/dL), one student was diagnosed as a diabetic (≥ 126 mg/dL) through this screening. Medical arrangements were made for him and his parents to learn about the disease process and treatment options appropriate for him at this young age. The significance of this abnormal finding is exactly the reason why preventive screenings are vital to health.

The pattern regarding perception of a risk factor and the reality of having the risk factor that was identified with elevated blood pressures and elevated total cholesterol levels was also seen in elevated blood glucose levels. No student identified with an elevated fasting blood glucose level was aware of the elevation and reported no memory of having it checked before. The magnitude of elevated fasting glucose levels found in this study ranked as the eleventh most prevalent CVD risk factor.

Early screening for diabetes is vital for college students. According to Perez (2014), those with undiagnosed diabetes have a more adverse cardiovascular risk factor profile, including obesity, hypertension, low HDL cholesterol, elevated LDL cholesterol, elevated triglycerides and fatal coronary heart disease.

Association with CVD. Data suggest that diabetes increases the risk of CVD two- to-threefold in men and four-to-six fold in women and a two-fold increase in the risk of stroke (Howard & Magee, 2000). According to Sowers (2001), diabetes accounts for up to 80 percent of deaths in those with CVD. In addition, diabetics have been shown to have a poorer prognosis after a cardiovascular event compared to those without diabetes. Clearly a strong associate exists between diabetes and CVD, therefore, it is highly recommended that a preventive screening for diabetes, blood lipids, and blood pressure be done for students beginning at the age of 20.

Physical Inactivity. Physical inactivity is major risk factor for CVD. Activity patterns have been studied and are well documented in all groups. The most significant declines in regular physical activity are during adolescence (ages 15-18) and young adulthood (ages 18-25) (Wallace et al., 2000). The American Heart Association (AHA) and the American College of Sports Medicine (ACSM) recommends adults acquire at least 150 minutes of physical activity per week and perform muscle strengthening activities at least twice per week (Bonaca et al., 2012; Go et al., 2014).

Identified results for inactivity. This CSU research study showed close to 15 percent of students indicated being inactive on the health and wellness questionnaire. This percentage ranked physical inactivity as the eighth most prevalent CVD risk factor among the study participants.

The importance of establishing and maintaining activity patterns. Inactive individuals are at a greater risk for developing CVD as those who are physically active. A lack of physical activity can exacerbate or intensify other CVD risk factors, such as high blood cholesterol, triglycerides, high blood pressure, prediabetes, diabetes, overweight and obesity (Gibbons et al., 2013). Conversely, regular exercise or activity patterns have been shown to improve health, weight management, mental concentration, quality of sleep, and energy levels, while reducing stress and anxiety. All physical and mental benefits associated with regular physical exercise are extremely important for college students and their health and well-being. Developing and maintaining exercise habits in college is important in the short-term as students manage stress and body weight, and improve mental concentration, cognitive development, energy levels, and overall health while progressing towards graduation. Exercise habits are equally as important in the long-term as exercise patterns continue and directly affect adult health status for future decades.

Activity options. Students attending CSU have ample opportunities to be active. CSU has recently received a platinum rating and been named among the Elite Bike Friendly Universities. It also has a large, modern Recreation Center with individual and group exercise activities. In addition the City of Fort Collins is nationally known for their biking, walking, and hiking paths, as well as organized recreational activities.

The slogan "Exercise is Medicine" is a global health initiative managed by the American College of Sport Medicine (ACSM). The efforts focus on including activity and exercise into lifestyles to help delay or avoid pharmaceutical aids that may become necessary later in life to manage CVD risk factors. The college years are an ideal time for students to embrace this slogan of "Exercise is Medicine", as they include and maintain activity into their college life and carry this deliberate pattern forward into adulthood.

Obesity. Obesity has reached epidemic proportions in the U.S. and is a significant risk factor for CVD. In the United States, the number of overweight adolescents has tripled since 1980, and research has shown that 66% of adults are overweight or obese (Ogden et al., 2006).

Prevalence of overweight and obese through the nation. According to the (Flegal, Carroll, Ogden, & Johnson, 2002), the percentage of obese adults in the state of Colorado is between 20 to 25 percent. Five other states including California, Hawaii, Massachusetts, Montana, Utah, and the District of Columbia have the same adult obesity percentage. No state in the nation has an adult obesity level less than 20 percent. Alabama, Louisiana, Mississippi, and West Virginia have the highest prevalence of adult obesity of 35 percent of greater. States in the south had the highest prevalence of obesity at 31.2 percent, followed by states in the Midwest at 30.7 percent, Northeast at 2.4 percent, and the West at 25.2 percent.

Weight changes during the college years. It is common for students to gain weight in college. An average weight gain during college for females has been shown to range from 3 to 10 pounds and 9 to 15 pounds for males (Racette 2008). In addition, the National College Health Association (NCHA, 2016) surveyed over 80,000 college students throughout the country in 2016 and found 23% of respondents were overweight (BMI 25-29 $kg.m^2$) and an additional 14.6% were obese (BMI $\geq$ 30 kg/m^2). Young overweight individuals have a greater risk of becoming obese adults and suffering negative health consequences associated with the condition when compared to non-overweight young individuals (Das & Evans, 2014).

Identified results for overweight and obesity. The prevalence of overweight CSU students in the sample was slightly over 24 percent and not statistically significantly different when compared to the national data (p = .856). However, only 6 percent of the CSU students were classified as obese which was statistically significantly different from the national data (p = .007). Therefore, the number of students classified as overweight is almost equal to other college students throughout the nation; however, the prevalence of obese CSU students is statistically significantly lower than the national occurrence. From the CSU data, overweight ranked as the fourth most prevalent CVD risk factor and obesity was the thirteenth ranked CVD risk factor.

Weight management is important for all ages, as it has a tremendous impact on health and CVD risk factor management. The Center of Disease Control (CDC) has identified Colorado has as one of the leanest states in the nation for adults. The lower rate of obesity found in this study well with the data on adult obesity rates for the state of Colorado.

Nutritional intake is very important in weight management, but long-term success is significantly more successful for those who also include an activity or exercise component to their routine. Regular exercise is beneficial for weight management as it increases metabolism, expends extra calories, decreases adipose tissue, and maintains or increases lean body mass. These college students will likely become future parents, serve as a role model for their family, and eventually evolve into the adults that represent our state's future health status as collected by the CDC. Programming efforts to help CSU students manage an appropriate and safe body weight are worth the investment for short-term and long-term benefits.

Alcohol Consumption. Alcohol consumption tends to be high in the college student population (Knight et al., 2002; O'Malley & Johnston, 2002). In 2006, the Center of Disease Control recommended that the addition of alcohol consumption be evaluated with respect to CVD risk factors in the college student population. Therefore, alcohol and drug use was included in this study. Alcohol consumption showed a high and consistent use with beer at 82.28 percent (*N*= 128), wine at 82.28 percent (*N* = 128), liquor at 85.44 percent (*N* = 132), and vaporized alcohol was at a much lower rate of 8.23 percent (*N* = 13). Within the last 30 days, 80.21 percent (*N* = 77) reported drinking four or more drinks in one setting and 73.68 percent (*N* = 42) reported drinking five or more drinks in one setting. In addition to this high percent of large quantities of alcohol, 45.75 percent (N = 70) reported driving after drinking alcohol within the last 30 days.

The value of longitudinal studies. Longitudinal studies that focus on CVD provide scientific evidence on the importance of early screening and reduction of CVD risk factors in young adults. The Framingham study examined its first volunteer in 1948 and has been studying CVD risk factors and developmental process since. The Muscatine study and the Bogalusa Heart study measured CVD risk factors in children and again as young adults. These longitudinal studies, have shown that risk factors identified in children are similar to adult results. Also, the more identified CVD risk factors, the more likely a cardiovascular related death.

The value of these and other longitudinal studies cannot be dismissed. The earlier preventive screening for CVD risk factors can begin, regardless of age, ethnicity, or geographic location, the greater the opportunity of targeted lifestyle management to bring risk factors into optimal ranges and decrease the potential for disease development. Therefore, it is imperative that college students identified with CVD risk factors be diligent in reducing these risk factors early in life to improve personal morbidity and mortality.

In 2003 the American Heart Association (AHA) suggested that CVD screening begin at the age of 20 (Romero, McMahan, & Cathorall, 2005b). Clearly, the 706 identified CVD risk factors identified in the CSU student sample support the AHA recommendations for preventive screenings. Early screenings, awareness, and health education during college are imperative as it represents the last formal structure for education, the establishment of independence and adult health behaviors, and disease development has not yet impaired functioning.

Research Question #2: For each CVD risk factor, what differences are seen in prevalence between genders, ethnic groups, and class status?

2a. Differences in cardiovascular risk factors between genders. Several statistically significant differences were found between males and females in this study. Differences in blood lipid and blood pressure will be reviewed first followed by differences seen in tobacco use.

Differences in blood lipids and blood pressure between genders. The CSU research study had 37.22 percent participation from males. The differences found between genders were the most surprising result for the researcher. Female students showed statistically significant differences in two CVD risk factors while male students showed statistically significant differences in nine CVD risk factors compared to females.

Female students had statistically significant differences in total cholesterol and HDLs when compared to males. Abnormal amounts of lipids are referred to as dyslipidemia. Male students were found to have dyslipidemia with statistically significant lower HDLs or the “good” cholesterol, a higher TCHOL/HDL ratio, and higher glucose levels compared to female students. Additionally, male students had higher systolic blood and higher diastolic blood pressure than females. A cardiovascular system functioning with elevated blood lipids coupled with excessive pressure creates an unfavorable cardiac profile for the individual.

Differences in tobacco use between male and female participants. In addition to the statistically significant differences in blood lipids and blood pressures seen in male participants, differences were also seen with the use of tobacco between genders. Males were found to have a statistically significant difference in cigarettes use, e-cigarette use, cigar use, and smokeless tobacco when compared to females. The only form of a nicotine delivery system that did not show a statistically significant difference between genders was the use of hookah (p = .306). Hookahs or waterpipes have become the newest trend among young adults and college students; therefore, it is not surprising to not find a statistically significant difference between males and females in the study. Dyslipidemia and excessive blood pressure coupled with nicotine creates a potentially dangerous cardiac profile. Recommendations include increasing HDLs, decreasing blood glucose, SBP and DBP, and eliminating all forms of nicotine.

Comparative results. A review of undergraduate student's tobacco use in the U.S., (see Appendix A) showed a very consistent pattern of male college students more likely to smoke than females, with the exception of Primack et al.(2008). (Rigotti et al., 2000). The CSU study smoking results align well with those cited in Appendix A, with the exception of hookah use, as no statistically significant difference was found between males and females at CSU for this method of tobacco use. Supportive reasons for this finding include three popular hookah bars close to campus, hookah tobacco is inexpensive, easy to purchase online, and hookah is viewed as a social activity for both males and females.

Historical and current trends. In the U.S. tobacco smoking remains the leading preventable cause of death(Cobb et al., 2010). For the last 20 years, health care professionals and public health administrators have worked tirelessly educating the public about the dangers associated with tobacco. Their work was beginning to prove beneficial as tobacco use was declining in all age groups for both males and females until 2013. However, Coloradoans are smoking more. Slightly over one million more packs of cigarettes were sold between 2014 and 2015. The increase in cigarette use is consistent in all age groups, therefore, it is expected that more college students are smoking cigarettes than in previous years.

In addition to increases seen in cigarette use, escalations in hookah and e-cigarettes are also evident. The steady decrease in tobacco use over the past two decades is currently being challenged by alternative methods of tobacco including hookah and e-cigarettes. Many nicotine users believe these alternative methods of smoking are less harmful than cigarettes; however the exact opposite is true. A single hookah session produces the equivalent nicotine content between 1 and 50 cigarettes (Cobb, 2010). In addition, many researchers have stated that hookah and e-cigarettes may prove to be a precursor to cigarette use, and likely to lead to adapting multiple forms of tobacco use. Cobb et al., (2010) refers to hookah or waterpipe smoking as an emerging health crisis in the U.S., therefore programming efforts to decrease the tobacco use among undergraduate students is worth the investment.

Male versus female smoking patterns. There are distinct differences in male and female smoking patterns. For example, daily cigarette use is less for women than men and women tend to use cigarettes with less nicotine content than men. Female smokers often cite weight and stress management as primary motivators to start and continue smoking. Male smokers cite looking cool, masculine, and stress management as primary motivators to engage in the activity. The smoking data collected with the CSU sample is consistent with many other research findings such as male college students tend to participate more in behaviors involving tobacco, marijuana, and alcohol, and are more likely to use e-cigarettes than female college students.

2b. Differences in cardiovascular differences among White versus Non-White.

Cardiovascular disease (CVD) is the leading cause of death in the U.S. and disproportionate rates are seen in racial and ethnic minority populations (Kurian & Cardarelli, 2007). Both biological and cultural differences in traditional diets, attitudes towards tobacco, alcohol, and drug use, health beliefs, and health practices all contribute to differences seen in

CVD risk factors among ethnic groups.

Ethnic differences in health. Many ethnic groups show higher rates of CVD and diabetes compared to White. African Americans have been shown to have a higher prevalence of hypertension, stroke, diabetes, and obesity. African American, Mexican-Americans, American Indians, and Alaska Natives have a higher prevalence of diabetes and SBP than White adults, giving them a less favorable health profile (Go et al., 2013; Winston et al., 2009). Asian Americans have low rates of obesity and CVD. Smoking and obesity are a special concern for Native Hawaiian and other Pacific Islander Americans, and obesity and diabetes are areas of concern for Latinos (Go et al., 2013; Winston et al., 2009).

Identified differences in tobacco use between White and Non-White college students. There were only two statistically significant differences found between the White and Non-White students in the research sample. White students were more likely to use hookah (p = .028), and use smokeless tobacco (p = .037) than Non-White students. Although these findings do not align with some of the previously reviewed research on tobacco use among ethnic groups, the effect size for both hookah and smokeless tobacco for White and Non-White was smaller than typical.

Supportive research. Numerous research studies have found a higher occurrence of tobacco use among white students, compared to other ethnic groups (Li et al., 2003; Meier et al., 2015; Mendis et al., 2011; Moran et al., 2004). The same pattern was also seen in the Harvard College alcohol and tobacco use survey, which was a major research study, conducted at 119 colleges. According to Rigotti (2000), the use of cigarettes and smokeless tobacco was more associated with White students than Hispanics, Blacks, and Asian. Five years later, follow-up research showed consistency in results with ethnic distributions for nicotine use with Whites at 36.1 percent, Hispanics at 25.6 percent, Asians at 23 percent, and African Americans at 15.9 percent (Rigotti et al., 2000). The results from the CSU study showed White students had a higher hookah and smokeless tobacco use than Non-White and aligns well with these research findings.

CSU findings and recommendations regarding tobacco use. The prevalence of tobacco use is significant at 49.02 percent among college students enrolled at CSU. Nicotine is a powerful psychoactive drug that is highly addictive. Tobacco use in college can easily evolve into an adult habit that is extremely difficult to stop, regardless of ethnicity. Both regular and intermittent smoking of any form can ultimately affect morbidity and mortality. A greater awareness and understanding of the CVD risk factors among racial and ethnic minority groups will help health care professionals, educators, school administrators, and public health professionals develop culturally sensitive preventive and interventional programs with a focus on reducing the risks associated with these ethnicities.

2c. Differences in cardiovascular differences among class rankings.

An interesting finding emerged when CVD risk factors were compared among freshman, sophomores, juniors, and seniors. A statistically significant difference was found in SBP between freshman and sophomores (p = 0.010) and between freshman and seniors (p = .007). Sophomores had a significantly higher SBP when compared to freshman and seniors also had a significantly higher SBP when compared to freshmen. Although no research studies were found that measured SBP throughout the college years, there are many influencing factors that may contribute to the higher SPB found in sophomores and seniors including exercise, weight fluctuations, chronic stress, nicotine use, and alcohol use.

Exercise habits. Exercise habits are one explanation as to why the SBP was lower in freshman compared to sophomores and seniors. Freshmen students have only recently graduated from high school and typically high school students are more physically active than college students. Kilpatrick et al., (2005) found that 65 percent of high school students are physical active and only 20 percent of college students are physical active.

Regular exercise produces numerous physiological benefits that directly affect health status. One such benefit is a reduction in resting and sub-maximal heart rate and blood pressure. As the heart strengthens with exercise, it is able to contract with greater force, or an enhanced stroke volume. As stroke volume increases, the heart does not have to beat as frequent and the blood is able to circulate through the systemic system with ease, resulting in a lower blood pressure. Active high school students entering college may still be experiencing these training adaptations resulting in lower SBP. College sophomores have been on campus for a year and if not as physically active as in high school, they may be experiencing detraining adaptations that can lead to higher SBP. It is likely that the same effect is occurring in the seniors. College seniors have settled into college life and lifestyle routines. Again, if not as active as in high school, the detraining adaptation will result in a higher resting SBP. Along with sophomores and seniors, the juniors also showed higher SBP than freshman (p = .047). This finding would have been statistically significant if the traditional 0.05 level was used for significance, however due to the four levels of class status, the author choose to use a conservative Bonferroni correction factor of 0.0125 for statistical significance. Therefore, a lack of physical activity in college students is a significant health problem and may be contributing factor in explaining the increases seen in SBP of sophomore and senior students compared to freshman.

Fluctuations in body weight. Weight fluctuation has been studies in college students. According to Racette et al., (2005), sophomore students gained 8.25 ±7.2 pounds from the beginning of their freshmen year. In addition, Racette el al. (2008), found that females gained between 3.75 ± 9.92 pounds and males gained 4.2 ± 6.4 pounds from their freshman to senior year. Body composition was not part of either study, so it is not possible to state if the change in body weight was due to an increase in muscle mass or fat mass. Regardless, these older students are carrying a greater total mass throughout the day which is more stressful on the cardiovascular system than the younger students and can result in higher SBPs.

Chronic stress. Chronic stress is another influencing factor on blood pressure. Freshmen students have only have only been in college for a few months to a year. They have not endured the amount of chronic academic, social, and personal management stress that the seniors have. Stress is an everyday reality that requires management. When the body experiences stress, dramatic surges in stress hormones, known as cortisol and epinephrine are released in the body that helps prepare the body to deal with the stress. Frequent spikes or chronic periods of excessive cortisol and epinephrine can damage the blood vessels and lead to elevations in blood pressure. These physiological changes could contribute to the statistically significant difference higher SBPs seen in sophomores and seniors compared to freshman.

Nicotine. Nicotine is a stimulant and often causes increases in SBP. Although not significant, seniors did have a higher nicotine use than freshmen for cigarettes, cigars, and smokeless tobacco. Frequent exposure to nicotine is another variable that has the potential to increase SBP.

Drug and alcohol use. There are additional factors that may help explain the elevation in SBP found in seniors compared to freshman. Although not statistically significant, the CSU seniors in the study were found to have a high drug use including marijuana, edibles, cocaine, methamphetamines, amphetamines, sedatives, hallucinogens, inhalants, and ecstasy. Alcohol consumption was also higher for seniors compared to freshman including beer (p = .001), wine, liquor, and having consumed 5 or more drinks in one setting.

Research Question #3: What are the differences in CVD risk factors found with the Colorado State University (CSU) data compared to data from the National College Health Assessment (NCHA)?

Four statistically significant differences were identified in the CVD risk factors when the CSU data was compared to the NCHA including general health, elevated blood pressure, hookah use, and body mass index (BMI).

General Health. There was a statistically significant different in the number of CSU students that rated their general health as “excellent” or “very good” compared to undergraduates that participated in the NCHA (p = .015). CSU is located in Fort Collins, Colorado, a town with an estimated population of 161,000. Along with an abundance of fine arts and cultural activities, the city prides itself with plenty of recreational and competitive activities for all ages and abilities. The university has a large and beautiful student recreation center that offers weight training, group fitness classes, yoga, rock climbing, aquatics, intramurals, and club sport teams. Students can join a formal or informal group, or enjoy individual exercise and activity routines. In addition, the university just completed building a large Medical and Health Center on campus to serve their needs. A sample of student programing includes alcohol and other drug awareness, body image and eating disorder classes, sexual health, diabetes education, smoking cessation, stress management, nutrition education, cooking classes, mental health, and campus safety information. With these resources available to every CSU student, it is confirming to see such a high response of students that consider their health as being "excellent" or "very good".

Data collected from the Center of Disease Control (CDC) may be another reason why CSU students rate their general health so well. The CDC has identified Colorado as one of the six healthiest states in the nation. Improved health is a result of abstaining from nicotine and drug, moderate amounts of activity, a well-balanced diet, weight management, stress management, and alcohol in moderation for those of legal age. The CSU research sample may be practicing this healthier way of life more than those who completed the NCHA.

Blood Pressure. Elevated blood pressure was another CVD risk factor that showed a statistically significant difference between the CSU student sample and those that completed the NCHA (p = 026). No CSU students indicated a history or knowledge of an elevated blood pressure. In comparison, 3.20 percent of those completing the NCHA indicated a positive history of an elevated blood pressure. This lack of perception in college students supports the importance of preventive screening.

Perception of an elevated blood pressure versus measured results. It is important to note that blood pressures were not measured on the students who completed the National College Health Assessment (NCHA). Students were simply asked on a survey if they had high blood pressure. Those responding positively (3.20 percent) must have had their blood pressure taken in the past and told their pressures were elevated.

The CSU student sample also completed a similar question regarding blood pressure. No student in the CSU sample indicated a known elevation in blood pressure. This finding can be explained in two ways. First, these students may have not had their blood pressure taken, or remember having it taken and been told it was elevated. Second, the students simple do not have hypertension. As previously seen, the CSU student sample was more likely to rate their health as "excellent" or "very good" compared to the national data, and a normal blood pressure is part of a good health profile.

Assumptions might prove misleading. It is very important to not assume a risk factor is within normal ranges. Although no CSU study participates indicated an elevated blood pressure, when measurements were complete close to 20 percent of students had an elevated systolic blood pressure (SBP) and almost 15 percent of students had an elevated diastolic blood pressure (DBP). This pattern between perception of an elevated blood pressure and clinical measurement of the blood pressure may lead one to believe there is a higher prevalence of elevated blood pressure than indicated on the NCHA. Elevated risk factors such as SBP, DBP, cholesterol, LDL's, triglycerides, and glucose can go undetected for years before health consequences develop that require treatment. It is imperative that college students establish a health care plan that includes preventive screening for CVD risk factors beginning at the age of 20.

Hookah Use. There was a statistically significantly difference between the CSU undergraduate research sample and the undergraduates that completed the NCHA regarding hookah use (p = < .001). The CSU sample of students had a much higher rate of hookah use when compared to college students throughout the nation. Research has monitored the prevalence of hookah use among college students for the last decade. Several conclusions can be made from this data including prevalence, gender differences, use among ethnic groups, specific regions in the nation, and Greek involvement.

Prevalence of hookah smoking in the United States (U.S.). In the U.S., the popularity of hookah smoking is very high. Approximately one in five, or 20 percent of college students reported smoking hookah in the past year (Grekin & Ayna, 2012). In comparison, approximately 30 percent of college students reported cigarette smoking within the last year. The data suggests that although cigarette smoking remains the most popular form of tobacco use among American college students, hookah smoking is a close second (Grekin & Ayna, 2012).

Ethnic differences with hookah smoking. Ethnicity helps explain the significant increase in hookah use with the CSU students. Research shows that African Americans are less likely to smoke hookah than any other race. According to Primack et al., (2008), 12.3 percent of African Americans smoked hookah compared to 31.4 percent of white students. Eissenberg et al., (2008) found the prevalence of hookah use to be 9.1 percent for black students and 35.5 percent for white students. CSU had an enrollment of 81.88 percent of White students and 18.12 percent that identified as Non-White students during the spring semester of 2017. Although administrators at the university work hard to recruit a diverse student population, the large majority of students are White. This ethnic helps explain the high hookah use seen at CSU compared to other national universities.

University location and Greek Life involvement. University location and Greek life involvement are two additional variables that have been associated with a high prevalence of hookah smoking. Research has shown that hookah users are likely to be young males, White, use other substances including alcohol, live in the West, attend a large university, and are active in a fraternity or sorority (Jarrett, 2011). CSU is located in the Rocky Mountain West, is a large institution with a total enrolment of 31,213 students. In the spring semester of 2017, approximately 12 percent of the student body was involved in Greek life. Collectively, CSU's location, enrollment size, and active Greek life contribute to the statistically significant difference seen with hookah use at CSU compared to national data from the NCHA.

Body Mass Index. Body mass index (BMI) is a calculation based on the concept that weight should be proportional to height (Insel, 2014). A BMI between 25-30 kg/m^2 indicates overweight and a BMI >30 kg/m^2 classifies one as obese. There was a statistical significant difference in obesity between the NCHA data and the CSU sample data ($p = .007$), with less students from CSU classified as obese.

Public health priority. Achieving and maintaining an ideal body weight is an important public health priority and have proven to be a serious challenge for many Americans. According to standards developed by the National Institute of Health (NIH), 36 percent of adults and 17 percent of youth are obese (Insel, 2014). The CDC has ranked Colorado along with five other states has the "healthiest" states in the nation based on prevalence of obesity. Colorado has consistently been in the top tier for healthiest states since the rankings began in 1985. Clearly, not all enrolled CSU students are Colorado natives. However, these students are living in and blending into to a culture that values health and activity. It is very possible that the CSU student body is more active in daily energy expenditure compared to university students located elsewhere.

Contributors to weight gains. "Freshmen fifteen" is a term often associate with typical weight gain seen during the freshmen year of higher education. Eating in the "all-you-can-eat dining halls, snacking, eating high-fat, convenient junk food, alcohol consumption, and a more sedentary lifestyle all contribute to the significant weight gain typically seen as students adjust to college. Although every student transitions through this freshman year of balancing their diet, only six percent of the student sample from CSU was classified as obese compared with 14.6 percent of the students who completed the NCHA. Possible explanations for this difference including ethnicity and living in an environment that is contusive to active lifestyles.

Differences in BMI among ethnic groups. The prevalence of overweight and obesity have been studies among ethnic groups. According to Hlaing (2007), the lowest prevalence of overweight and obesity was seen in White students, followed by Hispanic, which was followed by African Americans. The CSU student demographics show the student body to be a combination of 70.71 percent White students, 10.53 percent Hispanic/Latino students, and 2.27 percent African Americans. Therefore, ethnicity may be a contributing factor in explaining the lower incidence of obesity among the CSU student sample compared with the findings form national data collected by the NCHA.

Components of weight management. Weight management requires a balance between energy intake and energy expenditure. While all college students adjust to new and easily accessible food environments, differences in weight gain can be explained with the amount of energy expended in planned exercise sessions and overall daily activity patterns. As previously discussed, the state of Colorado and Colorado State University offers plenty of exercise and activity options, creating an environment conducive to an active lifestyle. Therefore, the CSU student sample may have been more successful in weight management by balancing caloric consumption with an appropriate amount of energy expenditure through exercise and daily activity.

Achieving and maintaining an ideal body weight is an important public health priority and a serious challenge for many Americans. The state of Colorado and CSU offer numerous activities and recreational opportunities. Programming efforts designed to promote active lifestyles will be beneficial in the short-term as students continue their education at CSU and in the long-term, as students' transition from the university and into a professional adult life.

Research Question #4: What correlations exist among the risk factors for cardiovascular disease (CVD)?

Numerous correlations were identified from the CSU research student sample investigating CVD risk factors. See tables 4.9 – 4.19. From these correlations, simultaneous multiple regression was completed to predict a dependent variable from a combination of predictor variables. The following six dependent variables will be reviewed; tobacco use, hookah use, systolic hypertension, diastolic hypertension BMI, and elevated total cholesterol.

Tobacco use as a dependent variable. Four predictor variables were identified as males, marijuana edibles, amphetamines, and lack of exercise. These variables significantly predict tobacco use when all four are included in the model and account for 21 percent of the variance in tobacco use among the CSU undergraduate sample set.

Males association with tobacco use. Numerous research studies have found tobacco use to be higher among male students than female students (Cobb et al., 2010; Grekin & Ayna, 2012; Jarrett et al., 2012). The association between males and tobacco use in this study was 0.31.

Motives for male smoking include looking cool, looking masculine, habitual or automatic response during periods of stress, social enhancement, at risk personalities, peer influence, relaxation, coping mechanism for negative emotions, and invincibility (Braun et al., 2012; Heinz et al., 2013; Jarrett et al., 2012; Saddleson et al., 2015). Male students use tobacco in higher quantities compared to females especially with cigars and smokeless tobacco. Males in this study were more likely to use tobacco in the form of cigarettes, e-cigarettes, hookah use, cigars, and smokeless tobacco compared to females.

The addictive nature of nicotine. The nicotine found in tobacco products is highly addictive. Addiction is a chronic disease that alters brain chemistry and function related to reward, pleasure, motivation, and memory. An addiction often begins with a voluntary "yes or no" choice that often spirals out of control (Insel, 2014). Often, individuals experiments with substances to create pleasure and or avoid pain. Eventually, tolerance develops and more of the substance is needed to experience the desired effect. In addition to consuming more of a single drug, some individuals experiment with multiple drugs when tolerance develops in an attempt to capture the same altered effect. Both large dosages and multiple drug use per student were found in this study and are discussed in research question five.

Marijuana edibles associate with tobacco use. Tobacco and illicit drug use remains common practice among college students. Tobacco use has been positively correlated with drug use including marijuana (Heinz et al., 2013) and amphetamines (Saddleson et al., 2015). Nicotine, marijuana, and amphetamines are psychoactive drugs. A psychoactive drug alters the experience or consciousness of an individual and may lead to unpredictable physical and emotional changes and reactions, some of which may be unsafe. Like nicotine, psychoactive drugs are highly addictive.

Marijuana is the most widely used drug in the U.S. Currently, 25 states within the U.S. and the District of Columbia have legalized medical marijuana. Colorado, Washington, Alaska, Oregon, and the District of Columbia have also legalized the use of recreational marijuana (Insel, 2014). Nationally, 39.7 percent of college students smoke marijuana (ACHA, 2016) compared to 59.21 percent of students in this study. Although national data was not available for edibles, it was discovered that 48.03 percent of the research sample consumed marijuana edibles in the past 30 days. Edibles are becoming a popular alternative to smoking cannabis due to convenience, and a more intense and longer lasting effect than smoking marijuana. Governmental officials need to be aware of the rise in edible use and potential consequences associated with legalizing this drug well before these decisions are made. In addition, according to Mohler-Kuo (2003), more than 98 percent of marijuana and other illicit drug users also ingest additional substances including nicotine or binge drinking during college. In this study, in addition to tobacco use, edibles were also associated with increases in SBP, DBP, total cholesterol, and LDLs. The pattern of edibles and tobacco use is an extreme health concern for college students and their future cardiovascular health and well-being.

Amphetamines associated with tobacco use. Amphetamines are potent central nervous system (CNS) stimulant. Examples include dextroamphetamines and crystal methamphetamines, also known as ice (Heinz, 2015, Insel, 2014). A small dosage of amphetamines alters consciousness and typically makes people feel more alert by an increase in heart rate, blood pressure, and sense of awareness. Amphetamine use is 0.1 percent among high school students and the 0.3 percent seen in the general adult population (Insel, 2014). According to the National College Health Assessment (2016), college student amphetamine use 4.9 percent, significantly higher than any other age group. Amphetamine use in the current study was 19.87 percent and the association with use tobacco use was 0.38. Both products are stimulants, therefore college students may use one drug for effect and then couple it with another drug to enhance the effect.

This extreme use of amphetamines combined with high tobacco use is a dangerous combination. Examples of amphetamines commonly used in college include Adderall and weight loss aids. These drugs are stimulants and accelerate heart rates and blood pressures. Nicotine found in tobacco products is a stimulant and results in constricted blood vessels with long-term use. Students that ingest amphetamines while using tobacco products produce a cardiovascular system that is both stimulated and constricted at the same time, which is extremely dangerous.

Exercise habits associated with tobacco use. A regular, sustained exercise routine was negatively correlated with tobacco use in this study (-.80). According to Halperin (2009), those that partake in nicotine use of any form exercise less than non-smokers. This relationship is logical since those involved in activity and exercise typically do so to improve their fitness and health. Additionally, students that include exercise into their lifestyle usually seek out additional ways to achieve health goals such as balanced nutrition, stress management technique, etc. Tobacco use does not enhance health, rather according to the Surgeon General; tobacco use is the single most preventable cause of premature disease and death in the U.S. (Insel, 2014). Tobacco use is counterproductive to a healthy lifestyle, therefore it was not surprising to find a negative correlation between tobacco use and exercise habits in the CSU student sample.

Hookah use as a dependent variable. Four predictor variables were identified as cigarettes, e-cigarettes, smokeless tobacco, and liquor. All four variables significantly predict hookah use when all four are included in the model and account for 41 percent of the variance in hookah use among the CSU undergraduate sample set.

Cigarette use associated with hookah use. Over the last decade much research has been done on hookah smoking. Nationally, cigarette smoking is the most common form of tobacco use at 21.60 percent and hookah is second with a use rate of 19.30 percent (ACHA, 2017). In the current study, hookah smoking was the most popular form of tobacco with a use rate of 35.00 percent compared to cigarette smoking at 24.68 percent. Regardless, cigarette and hookah smoking are the most popular forms of tobacco use among college students. The association rate between cigarette and hookah use was extremely high at 0.55. The dangers of cigarette smoking are well published. Users may mistakenly switch or add hookah to their smoking routine as a safer alternative. The reality is hookah smoking is much more harmful due to deeper inhalations and greater concentrations of toxins and nicotine.

Research has looked at the association of cigarette smoking and hookah smoking. A consistent and significant association exists between cigarette and hookah smoking. Eissenberg (2008) found that hookah users were associated with a greater cigarette use and Gerkin and Ayna (2012) found cigarette users were twice as likely as non-users to smoke hookah. In addition, those satisfied with hookah smoking reported the likelihood of trying a cigarette in the near future. In addition, according to Heinz (2013), hookah smokers were more likely to use greater and more frequent quantities of marijuana and alcohol.

E-Cigarette use associate with hookah use. The use of e-cigarettes and hookahs has increased dramatically in the U.S. The number of hookah bars and lounges has increased significantly during the past two decades and e-cigarettes have rapidly increased in popularity, especially among the younger smoker. Many college students are dual-users with nicotine (Heinz, 2013).

E-cigarettes are very small and portable. It is common for a hookah smoker to take e-cigarettes into hookah bars and smoke from the device while waiting their turn at the hookah. E-cigarette and hookah users often consider these methods a safer alternative to regular cigarette smoking. Some also believe these methods may be helpful for someone trying to quit smoking. However, nicotine and toxins are in all tobacco products. Nicotine is addictive, regardless of the source. According to the Surgeon General's report, "There is no safe level of nicotine." Therefore, e-cigarettes and hookah smoking have addictive properties and should be avoided to prevent long-term adult use.

Smokeless tobacco associate with hookah use. This current CSU research study showed the majority, 84 percent of nicotine users to smoke or use multiple forms of tobacco products. Interestingly, 96 percent of these dual users showed hookah use coupled to another form of tobacco use, reinforcing the popularity of hookah smoking among college students enrolled at CSU.

With respect to smokeless tobacco and hookah use, the current study also showed 92 percent smokeless tobacco users also smoke hookah. The two subjects that used smokeless tobacco and did not smoke hookah, did smoke cigarettes. One reason for the high dual use between smokeless tobacco and hookah could be the result of students using smokeless tobacco throughout their day at school or work, and then participate in hookah smoking in the evenings with their friends. The high prevalence of smokeless tobacco use at CSU may be attributed to the university's agricultural beginnings.

Liquor consumption associated with hookah use. Hookah smoking is a very social event as the typical session takes place in a comfortable bar or lounge with friends. Many hookah bars also serve alcohol to enhance the social setting. This study showed the association of liquor and hookah to be 0.31. Heinz (2013) found hookah users admit to drinking alcohol with hookah as a coping mechanism, or for social enhancement purposes.

Young smokers commonly identify themselves as “social smokers” and are identified as smokers that predominantly smoke in social settings rather than alone. Social smoking typically includes a pattern of tobacco use coupled with drinking. National efforts should be directed towards education and reduction of various forms of tobacco and alcohol use for undergraduate college students.

Systolic hypertension as a dependent variable. Four predictor variables were identified as class status, gender, DBP, and exercise. All four variables significantly predict SBP when all four are included in the model and account for 41 percent of the variance in SBP among the CSU undergraduate research sample.

Class status associated with elevated systolic blood pressure. Blood pressure tends to increase with age. Although the age span between freshman and senior years in college is relatively small, statistically significant differences were found with SBP were identified in this study and should be investigated. The mean rank for senior’s SBP was 55.62, which was statistically significantly higher than that of the freshman value of 34.92.

Although no research studies have measured SBP throughout the college years, there are many influencing factors that may contribute to the higher SPB found in seniors. Typical factors that are common in college that can influence SBP include less physical activity seen in seniors, multiple years of college life and additive weight fluctuations, and sustained academic stress. In addition, although not statistically significant, the CSU seniors in this study were found to have a high drug use including marijuana, edibles, cocaine, methamphetamines, amphetamines, sedatives, hallucinogens, inhalants, and ecstasy. Alcohol consumption was also higher for seniors compared to freshman. The totality and accumulative effect of these multiple variables explains the increase in SBP seen with seniors compared to freshman.

The male gender associated with elevated systolic blood pressure. Hypertension affects both men and women; however, notable patterns have been revealed through the literature. It has been shown that men tend to have a higher prevalence of high blood pressure until age 45. During middle age 45 to 64, the prevalence of hypertension is similar between men and women. Beyond the age of 65, a higher prevalence of women tend to have high blood pressure (Gerald S. Berenson, 2001; Huang et al., 2003). This pattern is important for male students enrolled in college as several studies have associated the male gender with an elevated blood pressure.

Results from the CSU student sample are in agreement with the referenced research above. It was discovered that male research participants had unfavorable results in 15 out of the 16 CVD risk factors. When compared to female participants, males were less likely to exercise and had lower HDLs. In addition, males had higher LDLs, glucose, TCHOL/HDL, BMI, SBP, DBP, and family history of CVD. With respect to nicotine use, males had a higher use of cigarettes, e-cigarettes, hookah, cigars, and smokeless tobacco compared to females. Each of these variables is associated with an elevated SBP. Therefore, it was not surprising to see the combination of variables also led to a statistically significant difference in SBP between males and females.

Diastolic blood pressure (DBP) associated with elevated systolic blood pressure (SBP).

The cardiovascular system includes that the blood, heart, arteries, and veins throughout the body. Blood pressure is a measurement that represents the amount of force exerted by blood volume on the walls of the blood vessels and the resistance within the arterial system.

Risk factors associated with high blood pressure include obesity, excessive alcohol, smoking, age, high sodium intake, and family history. The result of these risk factors typically has an effect on both the SBP and DBP. Therefore, as SBP increases so does DBP. The reverse is also true. As lifestyles improve and risk factors are not increasing blood pressure, decreases are typically seen in both SBP and DBP. Therefore, it was not surprising to find an association between SBP and DBP to be 0.52. See table 4.17 for a representation of corresponding or matching increases and decreases in SBP and DBP that was discovered in this study.

Exercise associated with elevated systolic blood pressure (SBP). Exercise is typically associated with decreases in both SBP and DBP. Inactive individuals are nearly twice as likely to develop CVD as those who are physically active. A lack of physical activity can exacerbate other CVD risk factors, such as high blood cholesterol, triglycerides, high blood pressure, prediabetes, diabetes, overweight and obesity (Gibbons et al., 2013). Regular exercise has been shown to improve health, weight management, mental concentration, and energy levels, while reducing stress and anxiety (Blair et al., 2004). The association between exercise and elevated SBP in the study was 0.16. Although not a typical training adaptation of exercise, there are instances where this occurs.

Occurrences when exercise might increase systolic hypertension. Although the benefits of moderate exercise have been well documented, there may be occurrences when SBP may rise with exercise, or not follow the usually pattern of improvement. One example includes intensive weight lifting. Extreme weight lifting has been associated with increases in blood pressure. This is especially true with the individuals performs a Valsalva maneuver or holds their breath while lifting the weight. The mechanical compression of blood vessels combined with a Valsalva response produces extreme elevations in blood pressure. Therefore, students lifting large amounts of weight multiple days per week may show an increase in resting SBP.

A positive family history for hypertension is another explanation of when exercise might be associated with elevated SBP. Genetics play an important role in risk factor development. A college student with a positive history of hypertension may have a higher than typical blood SBP at rest and with exercise. Therefore, what might appear to be an association between exercise and hypertension for this individual is more likely a stronger association between family history and hypertension.

The third reason why exercise may lead to an elevated SBP is existing plaque in the arterial system. Arteriolosclerosis (or plaque accumulation in the arterial system) requires a higher amount of pressure to push the blood through the reduced vessel diameter, resulting in an elevated SBP and DBP

Diastolic hypertension as a dependent variable. Four predictor variables were dentified as class status, SBP, diabetes, and exercise. All four variables significantly predict DBP when all four are included in the model and account for 28 percent of the variance in DBP among the CSU undergraduate sample set.

Class status associated with elevated diastolic blood pressure (DBP). As already discussed, blood pressure tends to increase with age. The age span between freshman and senior years in college is relatively small. Although not statistically significant (p = .193), differences in DBP were seen between freshmen and seniors. The mean rank for senior's DBP was 86.56, which was higher than that of the freshman value of 66.11.

No research studies were found that measured DBP throughout the college years. However, with the CSU student sample that was used for this research, there are influencing factors that may have contributed to the higher DPB found in seniors. Risk factors for CVD naturally will have an effect on both the SBP and DBP; therefore, the same factors discussed previously for elevations in SBP, also explain increases seen in DBP. These factors include less physical activity seen in seniors, multiple years of weight fluctuations throughout college, and sustained academic stress. In addition, although not statistically significant, the CSU seniors in this study were found to have a high drug use including marijuana, edibles, cocaine, methamphetamines, amphetamines, sedatives, hallucinogens, inhalants, and ecstasy. Alcohol consumption was also higher for seniors compared to freshman. The totality of the multiple variables explains the increase in DBP, just as it did for SBP seen with seniors compared to freshman.

Systolic blood pressure (SBP) associated with elevated diastolic blood pressure (DBP). As previously discussed, risk factors for CVD typically have an effect on both the SBP and DBP. Typically, as DBP increases so does SBP. The association between SBP and DBP in this study was 0.52. High blood pressure results from an increased output of blood by the heart or from increased resistance to blood flow in the arteries (Insel, 2014). Risk factors associated with high blood pressure include obesity, excessive alcohol, smoking, age, high sodium intake, and family history. As lifestyles improve and risk factors are not increasing blood pressure, decreases are typically seen in both DBP and SBP. Table 4.17 provides a representation of corresponding or matching increases and decreases usually seen with DBP and SBP.

Diabetes associated with elevated diastolic blood pressure (DBP). Over the past two decades, the prevalence of diabetes has increased substantially (Selvin et al., 2014). Diabetes is an autoimmune disease where the insulin-producing cells on the pancreas cease functioning.

Diabetes is diagnosed by an elevated blood glucose found in the blood. Diabetes doubles the risk for CVD in men and triples the risk for CVD in women (Insel, 2014).

Diabetes is a major risk factor for cardiovascular disease (CVD). Cardiovascular disease is a multi-faceted chronic disease associated with both diabetes and elevated DBP. Diabetics have been shown to have multiple CVD risk factors including hypertension, obesity, inactivity, and elevated cholesterol and triglyceride levels. Many risk factors for diabetes and CVD are influenced by other associated risk factors, so it is not surprising that diabetes is part of the prediction equation for DBP. Although diabetes was an important variable in predicting DBP, the association between the two in this study was only 0.01, which is most likely due to the low prevalence of both diabetes (12.35 percent, $N = 20$) and DBP (14.81 percent, $N = 24$).

Diabetes continues to rise in the U.S. and is closely linked to hypertension and obesity. It is estimated that for every 2.2 pounds increase in weight, the risk for diabetes increases approximately nine percent (Insel, 2014). Researchers are also studying metabolic syndrome which is identified as a clustering of three of the five following risk factors; elevated blood pressure, excess abdominal adipose tissue, high blood glucose, high triglycerides, and low HDL or good cholesterol. Metabolic syndrome and associate risk factors are predictors for future cardiovascular disease and diabetes, and are more prevalent in males (Nilsson & Cederholm, 2011). Again, male subjects in this study had abnormalities in 15 of the 16 CVD risk factors including blood glucose, hypertension and higher rates of being overweight and obese.

Diabetic plaque composition and association with elevated DBP. Diabetes is a disease that affects primarily the arteries in the body. Elevated blood glucose levels have been correlated with endothelial dysfunction in which the inner lining of the blood vessels are not functioning normally. There is also evidence that shows the plaque built up by a diabetic contains more lipids and macrophages (inflammatory cells) than non-diabetics (Resnick, 2002, Nilsson, et al., 2010). These changes in plaque composition from diabetics may further cause elevations in SBP and DBP. Lastly, diabetics are less likely to be active(Resnick & Howard, 2002) which can also contribute to hypertension.

Exercise associated with elevated diastolic blood pressure (DBP). As previously discussed, exercise is typically associated with decreases in both SBP and DBP. The association with exercise and DBP was -0.05. This inverse relationship means that active subjects had a lower DBP compared to inactive. The small association is likely due to the small range in numbers from DBPs in the study (42-98 mmHg). The researcher was happy to see the negative correlation, but would hope to see a more significant negative correlation in future studies with college students enrolled at CSU.

Inactive individuals are nearly twice as likely to develop CVD as those who are physically active. A lack of physical activity can exacerbate other CVD risk factors, such as high blood cholesterol, triglycerides, high blood pressure, prediabetes, diabetes, overweight and obesity (Gibbons et al., 2013). Regular exercise has been shown to improve health, weight management, mental concentration, and energy levels, while reducing stress and anxiety (Blair et al., 2004). Therefore, including activity into a college student's routine is highly recommended.

Occurrences when exercise might increase diastolic hypertension. Although the benefits of moderate exercise have been well documented, there may be occurrences when DBP may rise with exercise, or not follow the usually pattern of improvement. The three examples previously reviewed for potential elevations in SBP with exercise are also valid for DBP. These examples include extreme weight lifting with the Valsalva maneuver, a positive family history of hypertension , and existing plaque in the arterial system.

Body Mass Index (BMI) as a dependent variable. Four predictor variables were identified as LDL, DBP, waist circumference, and gender. All four variables significantly predict BMI when all four are included in the model and account for 72 percent of the variance in BMI among the CSU undergraduate sample set.

Low density lipoproteins (LDLs) associated with BMI. Low density lipoproteins (LDLs) are protein molecules produced by the liver and contain a larger concentration of cholesterol and triglycerides than protein. Huang (2004), found 11.7 percent of college students had high total cholesterol levels, 13.5 percent had low HDL cholesterol, and 5.5 percent had high LDL cholesterol levels. By comparison, this study found 12.35 percent of college students had high total cholesterol levels, 32.20 percent had males and 14.56 percent of females had low HDL cholesterol, and 30.25 percent had high LDL cholesterol levels. Additionally, 30.66 percent of students were overweight as assessed by BMI.

The association between LDL and BMI in this study was 0.24 and not surprising considering LDLs are the result of genetics, excessive body fat, dietary habits, and inactivity. LDLs can be reduced by minimizing the saturated fat and cholesterol in the diet and increases in physical activity. According to Sacheck (2010), 60% of college student have body fat percentages above desirable levels. This phenomenon was associated with increased cholesterol and LDL in both men and women, as well as increased triglycerides and decreased HDL in women ($p < 0.05$). It is important to note that males in this study were found to have elevated LDLs and BMIs compared to female students.

Diastolic blood pressure (DBP) associated with BMI. Multiple studies have associate elevated blood pressure with BMI. Early data from the Muscatine Heart Study in 1975 showed obese children had higher blood pressures than lean children (Lauer et al., 1975). The

Framingham Study found hypertension to be twice as prevalent in obese when compared to non-obese for both males and females (Hubert et al., 1983). Additionally, the Nurses' Health Study found a 2-to 6-fold greater prevalence of hypertension among obese women (Manson et al., 1995).

Additional data from the Framingham Study further supports the relationship between overweight and elevated blood pressure. According to Higgins (1998), those with the highest body mass index (BMI) exhibited 16 mmHg higher systolic and 9 mmHg higher diastolic blood pressures than those with lower BMIs. It is interesting to note that male students in this study were found to have higher DBP and BMI than females attending the same university. Additionally, males had a lower rate of weekly exercise than females which can increase both DBP and BMI.

Waist circumference associated with BMI. BMI is based on the concept that weight should be proportional to height (Insel, 2014). Therefore, individuals weighing more than the average for their height will have a higher BMI. It is no surprise that waist circumference was associate with BMI. In this study the association between waist circumference and BMI was the strongest correlation of the entire study (r = 90), and an intercorrelation of 0.83 when combined with LDL, DBP, and waist circumference to predict BMI. Students with the largest waist circumference had the highest BMI.

Those that are overweight or obese tend to have more CVD risk factors than normal weight individuals, regardless of gender (Fernandes & Lofgren, 2011; Huang et al., 2007). It is interesting to note that males in this research study had a decreased physical activity pattern when compared to females, and increased measurements in both waist circumference and BMI.

Gender associated with BMI. Both men and women are at risk for developing CVD, however, significant differences exist between the two genders. Middle aged men suffer from CVD 2 to 5 times more than women (Go et al., 2014). Part of the gender difference is explained with research. Multiple studies have found males to have more CVD risk factors when compared to females. For instance, Huang (2007) showed males in college to be more obese, hypertensive, and had higher triglycerides than females (Huang et al., 2007). Males have also been shown to have higher total cholesterol, LDL-C, and triglycerides when compared to females and multiple risk factors accelerated the CVD process (Kuklina et al., 2010).

The Adult Health Risk Screening Initiative project revealed 77 percent of men and 54 percent of women had at least one risk factor for metabolic syndrome and 9.9 percent of men and 3.0 percent of women had meet all the criteria for metabolic syndrome (Morrell, Lofgren, Burke, & Reilly, 2012). Fernandes (2011), found that obese college students were more likely to have three or more risk factors for metabolic syndrome and males had more risk factors than females As previously noted, males in this study had 15 out of 16 abnormal risk factors for CVD, including a higher BMI and waist circumference than females. It appears that college age males have a higher prevalence of CVD risk factors and metabolic syndrome than females.

Elevated total cholesterol as a dependent variable. Five predictor variables were identified as LDL, triglycerides, waist circumference, cigars, and wine consumption. All four variables significantly predict elevated total cholesterol when all five are included in the model and account for 77 percent of the variance in elevated total cholesterol among the CSU undergraduate sample set.

Low density lipoproteins (LDL) associated with elevated total cholesterol.

Total cholesterol is a combination of HDLs, LDLs, and 20 percent of ones triglyceride level (Go et al., 2014). According to the calculation, as LDLs rise, so will total cholesterol. Therefore, it is logical that a strong association exists between LDLs and total cholesterol. In the current study 70 percent (N = 14) of students with an elevated total cholesterol also had an elevated LDL, resulting in a correlation coefficient of .770.

For many years, the American Heart Association has recommended an adult's cholesterol level to be at or below 200 mg/dL. Health care providers and still attentive to ones' total cholesterol level, but are now evaluating this value in context with the entire lipid panel and other existing CVD risk factors. A low total cholesterol level is somewhat dependent on a low LDL cholesterol level and both are necessary for heart health.

Triglycerides associated with elevated total cholesterol.

Total cholesterol is a combination of HDLs, LDLs, and 20 percent of ones' triglyceride level (Go et al., 2014). Therefore, it is logical that an association exists for triglycerides and total cholesterol. As triglycerides rise so will total cholesterol. In the current study, 14 of the 21 students that had an elevated triglyceride level also had an elevated total cholesterol level. The correlation coefficient for the two variables was .347 and was statistically significant (p = <.001).

Elevated triglyceride levels can be the result of several factors. Triglycerides can vary by age, gender, and body weight, inactivity, cigarette smoking, excessive alcohol consumption, tobacco use, and a diet high in carbohydrates. In addition to an elevated total cholesterol level, those with high triglycerides tend to have an elevated LDL and a low HDL. High triglyceride levels are often seen in those with heart disease or diabetes (Go et al., 2014), or underlying disease or genetic disorders.

Waist circumference associated with elevated total cholesterol. Total cholesterol is dependent on several variables with body mass being one of them. A large waist circumference is an unfavorable risk factor for CVD. According to Seidell (2001), a large waist circumference is associated with significantly low HDLs, large increases in body fat, and elevated total cholesterol, LDLs, triglycerides, and blood pressure. According to Brenner (2010), waist circumference is a strong predictor of cardiometaboic health, especially in men.

Risk factors profiles are now including overweight and obese status in combination with blood lipids (Fernandes & Lofgren, 2011; Huang et al., 2007). According to Janiszeski, et al (2007), subject groups with a medium and high measurement for waist circumference were more likely to have diabetes than those with normal or low waist circumference measurements. This is important since diabetes is recognized as a major risk factor for CVD (Go, 2014). Therefore, findings correlated with known diabetes also contribute to the progression of arteriosclerosis.

It is interesting to note that in the CSU student sample, females had a higher total cholesterol level than males. However, as previously noted, health care providers are evaluating the entire lipid panel and other risk factors more so than focusing on only one isolated number. When looking at all risk factors, males in this research study had a higher waist circumference, LDLs, triglycerides, combined with lower HDL cholesterol, and physical activity pattern when compared to females putting them at greater risk for CVD.

Cigars associated with elevated total cholesterol. In the current study, a correlation of -.203 was found between cigar smoking and total cholesterol levels. Therefore, students who smoke cigars have a lower total cholesterol level than those that abstained from cigar use. This study found that of the 40 students that smoke cigars, 65 percent (N = 26) were males and males were found have a lower total cholesterol level than females.

Lifestyles habits may be slightly different for tobacco users versus non-tobacco users and may contribute to this negative correlation found with cigar use and elevated total cholesterol levels. Nicotine is a stimulant. Stimulants tend to decrease appetite, so one might conclude that cigar users do not consume as many calories per day as non-tobacco users. This caloric restriction may be associated with a decrease in protein intake coming from animal products resulting in a lower total cholesterol level.

In addition, some tobacco users admit to using various forms of nicotine, including cigars as a method for control weight. In the early 1990s, younger men and women started smoking cigars and currently is a common practice with college students. Rigotti, et al., (2005) found cigar use more common with freshman and sophomores than juniors and seniors, suggesting that cigar smoking is a new phenomenon entering the college population. One might conclude that these students are smoking cigars to help with the stress involved in transitioning into college life and to help in weight control. Although stimulants are often used for weight control, nicotine is a major risk factor for CVD and should be avoided. Weight control is best achieved with moderate exercise, a balanced diet, and a commitment to avoid tobacco products.

Wine associated with elevated total cholesterol. Wine consumption in this study was positively correlated with elevated total cholesterol (0.15). Although a relatively small correlation, it represents important information.

It has been discovered that individuals tend to overconsume calories when alcohol is served with a meal. Tremblay (2016), studied college student's eating habits during meals without alcohol and meals with alcohol. Alcohol represents extra calories at these meals and has the potential to result in overfeeding, and therefore weight gain. Additionally, participants ate more protein and fewer carbohydrates when alcohol was served, suggesting that alcohol may modify the body's preference for different nutrients. Protein sources tend to have a higher fat and cholesterol content when compared to carbohydrates. Therefore, a higher percentage of calories coming from protein sources are likely to elevate total cholesterol levels.

Research Question #5: Do students cluster together based on CVD risk factors? If so, how many clusters emerged from the data and what combinations of risk factors make each cluster unique?

Cardiovascular disease (CVD) is a complex, multivariable, chronic disease. It is important for health care providers to evaluate the complete health profile of an individual, rather than a single variable, and to track changes in risk factors and health over time. The researcher was interesting in understanding the complete data set as well as identifying clusters or trends occurring with students and clusters or groupings of risk factors in the study. The k-means cluster analysis was selected to perform this function because of the program's ability to produces statistically significant differences between clusters. Six clusters were produced based on the scree plot and are plotted by z-scores. With respect to the bell shaped curve, one standard deviation (SD) away from the mean represents 68.26 percent of the data, two SDs away from the mean represent 95.44 percent of the data, and three SDs away from the mean represent 99.72 percent of the data.

The following cluster analyses were completed; family history of cardiovascular disease and related risk factors, blood lipids, blood pressure, and tobacco use. Although not identified by the American Heart Association as a risk factors for CVD, cluster analysis were also completed for alcohol consumption and drug use since these behaviors tend to be prevalent among college students and may be helpful in a full interpretation of the data.

Cluster analysis for family history of cardiovascular disease.

Cluster 1 represented 5.26 percent (*N* = 6) of the study participants. This group of students had negative family histories for hypertension, diabetes, high cholesterol, and overweight issues. This cluster of students did have slight increase prevalence if heart disease, stroke, and a higher prevalence of high triglycerides, but all positive histories were close to, if not below one SD. For those with a positive family history of high triglycerides, it is recommended to be mindful of total calories consumed, calories from simple sugars, and regular activity to help maintain an ideal body weight. Overall, cluster 1 is a very healthy group with respect to family history of CVD.

C*luster 2* was the largest cluster with 34.21 percent (*N* = 39) of students in the study. This group of students had negative family histories for CVD, hypertension, diabetes, and overweight. There was a very slight positive influx seen for CVD and high cholesterol, but still very close to the mean. Cluster 2 is also a very healthy group with respect to family history of CVD.

Cluster 3 was the second largest cluster with 25.44 percent (*N* = 29) participants. This cluster was found to have all family history information to very close to the mean with no significant positive or negative family history for CVD or related risk factors. What makes this cluster unique is the slight rise in diabetes compared to all other variables close to the mean. These students are fortunate to not have much of a positive history of disease in their background. Although this does not make them immune to CVD development, one risk factor does not need immediate attention. Overall, cluster number three is a very healthy group with respect to family history of CVD.

Cluster 4 was the third largest cluster with18.42 percent (*N* = 21) participants. What makes this cluster unique is the positive family history for heart disease, stroke, diabetes, high triglycerides, and overweight. This group had a negative family history for hypertension and high cholesterol. The significant prevalence of the positive family history for CVD and stroke, along with diabetes, elevated triglycerides, and overweight is noteworthy. These students should be educated on all risk factors for CVD and encouraged to be active in preventive health habits. It is also suggested that this group of students have regular check-up with a health care provider to monitor behavioral and physiological changes during college.

Cluster 5 was the smallest cluster with 0.87 percent (*N* = 1) participant. What makes this cluster unique is the extreme negative family history for CVD and stroke. Diabetes was slightly positive; however, all other family histories were very close to the mean. It is suggested that this student become educated in diabetes and follow a preventive lifestyle to avoid developing diabetes.

Cluster 6 represented 15.79 percent (*N* = 18) of participants. What makes this cluster unique is the positive family history for all variables including heart disease, stroke, hypertension, diabetes, elevated triglycerides and overweight. These students have a significant positive family history for CVD and should be educated on related risk factors and be followed annually by a health care provider to monitor behavioral and physiological changes during college.

Cluster analysis for blood lipids, general health, and exercise.

Cluster 1 represented 5.15 percent (*N* = 7) of participants. Collectively, this cluster of students does not represent an ideal cardiac profile. This cluster showed the highest levels for total cholesterol, LDLs, and triglycerides and corresponding decreases are found in HDLs. This group does less than the average for exercise (which is evident by blood lipids), and rates their general health less as well. Favorable results for this group include a lower than average glucose levels and low ratio of total cholesterol divided by HDLs (TCHOL/HDL). This is surprising given the elevated total cholesterol level and now HDLs, but the adverse results were not significant enough to elevate the ratio of cholesterol and HDLs. The recommendation for this cluster is to begin a regular exercise program in an effort to decrease total cholesterol, LDLs, and triglycerides and corresponding increase HDLs. This result would improve the cardiovascular risk profile and more than likely allow these students to more positively rate their general health.

Cluster 2 represented the largest cluster with 33.82 percent (*N* = 46) participants. Collectively, this cluster has the ideal profile with respect to blood lipids. This group had the highest response with exercise habits that produced a cascade of positive reactions in the blood. Lower than average results were found in total cholesterol, HDLs (most likely due to low total cholesterol) LDLs, triglycerides, and glucose. The ratio of TCHOL/HDL was slight higher than average reinforcing the fact that the lower HDLs are not a concern at this point. It is interesting to note that this cluster of students rated their overall health as lower than average, despite exercise routines and ideal blood lipids. Although this group is doing well, maybe they believe they can do more with respect to their exercise and lifestyle.

Cluster 3 represented the second largest cluster with 23.53 percent (*N* = 32) participants and is a healthy cluster with respect to blood lipids. Total cholesterol, HDLs, LDLs, TCHOL/HDL, and blood glucose were all found to be close to the mean. It is interesting to note that cluster 3 had the lowest rating for exercise habits, yet rated their overall health the highest. Without a routine exercise habit, the researcher is suspicious that this cluster of students has a very low family history of these risk factors and is enjoying the benefits of good genetics.

Establishing an exercise program is still important for this group to help maintain their blood lipids while in college and throughout adult life.

Cluster 4 represented 19.85 percent (*N* = 27) participants. This cluster had the second highest levels for cholesterol and LDLs. Despite having lower than average exercise habits, this cluster rated their health favorably. This group had several positive findings in their lipids including lower than average triglycerides and glucose levels, higher than average TCHOL/HDL ratio, and the highest HDL level of all the clusters. The researcher is suspicious that this cluster of students is also benefitting from a family history with low prevalence of these risk factors and is enjoying the benefits of good genetics. Establishing an exercise program is still important for this group to maintain these levels while in college and throughout adult life.

Cluster 5 represented the smallest group of students at 2.20 percent (*N* = 3). This cluster had a higher than average cholesterol level, LDLs, TCHOL/HDL, and glucose levels. The cluster also had the lowest collective HDL finding in the entire study. Exercise habits for this cluster were average and overall health was below average. It is highly recommended that these three students seek nutritional education to better balance their diet and begin an exercise routine. Together these changes should help balance out blood lipids and allow them to have a greater refection on overall health.

Cluster 6 represented 15.44 percent (*N* = 21) of study participants. This cluster, like cluster 2 had all of their variables very close to the mean. Total cholesterol, LDLs, triglycerides, and the TCHOL/HDL ratio was slightly lower than average. Variables slightly higher than average include HDLs and glucose, however neither had a Z-score above 0.5. This cluster of students was below average for exercise habits, yet rated their overall health slightly above average. Although blood lipids are very favorable for this group of students, regular exercise may prove to be beneficial in maintaining blood lipids and overall general health.

Cluster analysis for blood pressure.

Cluster 1 represented 16.15 percent (*N* = 26) of participants. Collectively, this cluster had the second highest averages for both systolic blood pressure (SBP) and diastolic blood pressure (DBP). The Z-scores for SBP were 1.46 and 0.85 for DBP. Lifestyle modifications to help reduce blood pressure are strongly recommended for this group of students. Behavior modification is easier in college than in the working adult life, therefore immediate attention to lifestyles and blood pressure measurements is recommended. Suggestions include reducing sodium in the diet, regular aerobic activity, limiting alcohol consumption, abstaining from drug use, and stress management techniques.

Cluster 2 represented 5.59 percent (*N* = 9) participants. This cluster of students had both SBP and DBP below the average. The Z-scores for SBP were -0.40 and -2.12 for DBP. These reductions in blood pressure tend to be the result of good genetics, a well-balanced diet, and aerobic activity. A continuation of current lifestyles with respect to blood pressure is suggested.

Cluster 3 represented 2.48 percent (*N* = 4) participants. This small group of students had the highest SBP and DBP of the entire study. The Z-scores for SBP were 2.44 and 2.37 for DBP. Although below 3 SDs, or within 99.72 percent of the population, this group did have the highest values compared to their peers. Lifestyle modifications to help reduce blood pressure are strongly recommended for this group of students. With values this high in college, one might suspect these blood pressure to become more elevated with age. Behavior modifications is easier in college than in the working adult life, therefore immediate attention to lifestyles and blood pressure measurements is strongly recommended. Suggestions include reducing sodium in the diet, regular aerobic activity, limiting alcohol consumption, abstaining from drug use, and stress management techniques.

Cluster 4 represented 29.81 percent (*N* = 48) participants. This cluster had SBP and DBP slightly below the average. The Z-scores for SBP and DBP were -0.21 and -1.01 respectively. These low blood pressures tend to be the result of good genetics, a well-balanced diet, and aerobic activity. A continuation of current lifestyle habits with respect to blood pressure is suggested.

Cluster 5 represented the largest group of students at 32.92 percent (*N* = 53). This cluster had both SBP and DBP very slightly above the mean. The Z-scores for SBP were 0.07 and 0.54 for DBP. The SBP measurements were average and the DBP measurements were only slightly elevated. It is recommended that this group of student's double check the DBP measurement through a series of repeated measures. This may help identify a false positive result in the screening. If the DBP remains elevated, following a well-balanced, low sodium diet, aerobic activity, refraining from tobacco and drugs, and alcohol in moderation (if at all) is suggested.

Cluster 6 represented 13.04 percent (*N* = 21) of study participants. This cluster recorded the lowest measurements for both SBP and DBP. The Z-scores for SBP were -1.29 and -1.03 for DBP. These reductions in blood pressure tend to be the result of good genetics, a well-balanced diet, and aerobic activity. A continuation of current lifestyles with respect to blood pressure is suggested.

Cluster analysis for tobacco and marijuana use.

Cluster 1 represented 5.36 percent (*N* = 6) of participants. This cluster had a very high prevalence of tobacco and marijuana use. Although smoking marijuana and smokeless tobacco were slightly less than average, five other variables were significantly above the mean. This group was slightly above the mean for marijuana edibles and hookah smoking, but significantly above the mean and had the highest Z-scores for cigarettes, e-cigarettes, and cigar use for the entire study. This trend of multiple forms of tobacco use is consistent with the literature and should be evaluated carefully. Nicotine is the most difficult addition to overcome. However, it is highly recommended for this cluster of students to help improve cardiovascular health.

Cluster 2 represented the largest cluster with 34.82 percent (*N* = 39) participants. What makes this cluster unique is the negative association with marijuana, edibles, and cigarettes, yet extremely high level of e-cigarettes and smokeless tobacco. The e-cigarette smoking is more than six standard deviations (SDs) away from the mean (6.82) and smokeless tobacco is over 7 SDs away from the mean (7.32). This cluster also shows positive use for hookah smoking and cigar smoking. This cluster had the highest smokeless tobacco and as previously mentioned, that may stem back to the agricultural beginnings of CSU. In addition, smokeless tobacco is typically used through the school day and or workday. This constant influx of nicotine in the body is extremely harmful to the cardiovascular system and increases the likelihood for moth and gum cancers. This trend of multiple forms of tobacco use is consistent with the literature and should be evaluated carefully. Nicotine is the most difficult addition to overcome. However, it is highly recommended for this cluster of students to help improve cardiovascular health and reduce the risk of cancer.

Cluster 3 represented the second largest cluster with 25.00 percent (*N* = 28) participants. This cluster of students is choosing to not participate in marijuana use, but does participate in multiple forms of nicotine studied. Cigarettes, e-cigarettes, cigars, and smokeless tobacco are all slightly above the mean; however, the unique characteristic of this cluster is the high hookah-smoking rate. For this cluster, hookah smoking is the primary form of tobacco use with a Z-score significantly above the mean (5.20). Nationally, hookah smoking is a popular trend among college students. The same popularity was seen with this CSU sample, as this cluster was the second largest in the study. Hookah tobacco is inexpensive and easy to obtain, however, produces the most harmful of effects with the deep inhalations and holding pattern prior to exhalation. Many smoke hookah for the social aspect and the false pretense that it is safer than cigarette smoking. Programs targeting tobacco awareness are highly recommended for the college student population.

Cluster 4 represented 18.75 percent (*N* = 21) participants. The uniqueness in this cluster is in the high marijuana use and relatively low tobacco use. Although both scores were within 3 SDs from the mean, this group of students had the highest scores for both marijuana use and edibles. Tobacco scores for cigarettes, e-cigarettes, hookah, and cigars were slight above the mean and smokeless tobacco was slightly below the mean.

Cluster 5 represented the smallest group of students at 0.89 percent (*N* = 1). This cluster or student is unique from the other clusters, because this individual was the only student to mark positive activity for all variables. This student smokes marijuana, consumes edibles, smokes cigarettes, e-cigarettes, hookah, cigars, and uses smokeless tobacco. All scores were within one SD, however, the danger comes from multiple forms of both marijuana and tobacco products. Reducing or eliminating these habits is in the best interest for cardiovascular health.

Cluster 6 represented 15.18 percent (*N* = 17) of study participants. This cluster of students have chosen to abstain from marijuana or tobacco products. This decision may be based on personal health habits or religious beliefs. Recommendations for the future…keep it up!

Cluster analysis for alcohol use.

Cluster 1 represented 17.53 percent (*N* = 27) of participants. This cluster was composed of just beer drinkers. The Z-score noted for beer in cluster one was the highest for the entire study. Wine and liquor intake was below the mean for the study indicating little to no consumption.

Cluster 2 represented the largest cluster with 18.18 percent (*N* = 28) participants. This cluster was composed of just wine drinkers. Three of the six clusters indicated a higher than average wine consumption and cluster two had the lowest of the three. Therefore, these individuals only consume wine as an alcoholic beverage, but not in excessive quantities as indicated by the Z-score less than 1.00.

Cluster 3 represented 9.74 percent (*N* = 15) participants. Students in this cluster showed positive results for beer, wine, and liquor. Although the Z-score were less than 1.00 for beer, wine and liquor was between 1.00 – 1.50 SDs .

Cluster 4 represented 2.60 percent (*N* = 4) participants. The uniqueness in this cluster was the high wine consumption. Although still within three SDs of the mean, this cluster showed the highest consumption of wine for the entire study. This group of students also consume liquor, but have less than an average consumption for beer.

Cluster 5 represented the smallest group of students at 13.64 percent (*N* = 21). This cluster or student prefers liquor compared to beer or wine. Liquor was slightly above one SD while beer was less than .5 SD and wine was below average for the study.

Cluster 6 represented the largest group of students with 38.31 percent (*N* = 59. This cluster of students has chosen to abstain from alcohol. Scores for beer, wine, and liquor were well below average for the study. Again, this decision may be based on personal health habits or religious beliefs. This cluster of students is making a conscious decision to not consume alcohol and risk potential negative effects associated with this drug.

Cluster analysis for drug use.

Cluster 1 represented 10.53 percent (*N* = 16) of participants. This cluster showed the second highest scores for multiple drug use. This group was above the mean for six drugs including marijuana, edibles, cocaine, amphetamines, hallucinogens, and MDMA or ecstasy. This group was slightly below the mean for methamphetamines, anabolic steroids, and other drugs. It is important to note that although six drugs were above the mean, cocaine, amphetamines, hallucinogens, and MDMA or ecstasy were significantly above the mean with Z-scores around 2.00.

Cluster 2 represented 0.66 percent (*N* = 1) participant. This individual showed all drug use to be below the mean, except for anabolic steroids. The graph shows this individuals score for anabolic steroids to be above 12 SDs (Z-score = 12.23), the highest Z-score in the entire study. Without knowing the identity of this subject, the researcher is confident that this individual is abstaining from all other drugs except anabolic steroids as an aid in bodybuilding. Athletes to enhance muscle hypertrophy with have used anabolic steroids combined with a vigorous resistance-training program. Although numerous side effects, including death have been associated with this practice, some college students believe their invincible and nothing harmful could ever happen to them. The good news is this cluster only contained one student. The bad news is this cluster contained one student, rather than none. It is in the student's best interest to continue training to meet athletic goals, but do to so drug-free.

Cluster 3 represented 1.97 percent (*N* = 3) participants. Although small is size, this cluster had above average drug use in marijuana, edibles, cocaine, amphetamines, methamphetamines, sedatives, hallucinogens, and MDMA or ecstasy, and other illegal drugs. The only drug that scored below the mean was anabolic steroids. The use of other drugs not recognized in the study was 7 SDs away from the mean, hallucinogens were 2.81 away from the mean, MDMA or ecstasy was 2.43 SDs, and methamphetamines was 1.73 SDs away from the mean. The totality of drug use with these three individuals is extremely high. Drug education programs are highly suggested for this cluster of students.

Cluster 4 represented the largest cluster of students at 51.32 percent ($N = 78$). The uniqueness in this cluster is less than average drug use for all stated drugs, except sedative that was very slightly above the mean. Although sedatives were above the mean, melatonin is a natural sleep aid that some college students occasionally take to help with sleep patterns. It is possible that subjects categorized as a sedative in this study. It was reassuring to see a lack of drug use in this large of a cluster. College is a time to develop independence and establish adult behaviors. It is the hope that these individuals will remain drug free and not have to endure the trial of withdrawal that others may face. A drug free lifestyle is ideal for optimal health and well-being.

Cluster 5 represented 0.66 percent ($N = 1$). The uniqueness of this cluster or individual is the excessively high use of methamphetamines, recorded at 10.95 SDs away from the mean. In addition, this individual also has an excessive use of hallucinogens at 2.81 SDs away from the mean, and MDMA or ecstasy at 2.43 SDs away from the mean. Edibles and sedatives were also slightly above the mean for this student. This cluster represents a significant amount of drug use, especially for one student. Drug education and behavior modification are highly recommended for this individual.

Cluster 6 represented 34.87 percent ($N = 53$) of study participants. The uniqueness of this cluster was the above mean scores for marijuana and edibles, but below mean values for all other drugs. CSU is located in a state where recreational marijuana use is legal. These students may be experimenting with marijuana for that very reason. Marijuana is the most widely used drug in the U.S., and referred to as a "gateway" drug. With time, some individuals develop confidence in themselves and their ability to handle marijuana and begin experimenting with other more dangerous substances.

Research Implications

Research scientists, administrators, and health educators might gain additional knowledge on the prevalence and clustering of risk factors for cardiovascular disease (CVD) in the undergraduate college student. The major strength of the study was identifying 706 CVD risk factors to demonstrate the value of preventive screening in an apparently healthy, asymptomatic, and young group of college students. Second, the research revealed statistically significant differences in gender, ethnicity, class status, and data from other institutions of higher education throughout the nation. Correlations between CVD risk factors were completed which supported the identification of predictive variables for dependent variables. Finally, clusters of risk factors were presented in visual displays, which aid in data interpretation and may prove to be helpful in comparing health trends over time.

Research on the prevalence of CVD risk factors in college students is very rare, although abundant for grade school children and older adults. Simply assuming that college students are in good health is irresponsible. These young adults are transitioning from a high school home life where many decisions were made for them, to an independent adult life where they are now responsible for taking the lead on many decisions that have potential to influence their health and well-being. Researcher scientists, college administrators, health educators, health care providers, and students themselves should gain an understanding into the prevalence and clustering of CVD risk factors in undergraduate college students and the potential impact on future health.

Additionally, the study provided learning opportunities for undergraduate students interested in the research process. Students assisted with anthropometric data and were exposed to the health care beliefs, practices, and attitudes from both the RNs and the undergraduate college students that participated in the study.

Practical Implications of the Findings

This investigation contributed and furthered the comprehension of the prevalence and clustering of CVD risk factors with college students. The results from this study provide significant evidence for supporting CVD risk factor preventive screening to begin during the college years, if not before. The old saying of "never judge a book by its cover" is a perfect analogy for what transpired throughout this study. A total of 706 CVD risk factors were identified in an apparently healthy group of college students attending CSU in the spring semester of 2017. Therefore, the number of CVD risk factors present in college students cannot be predicted by outward appearance, but must be directly measured to reveal biological and physiological changes in the body. In addition to the totality of CVD risk factors and differences between gender, ethnicity, class status, and national comparisons was most startling.

The gender differences for CVD risk factors in this study were unexpected. Females had a higher total cholesterol level and HDL level than males. By comparison, males were found to have a higher glucose, TCHOL/HDL, SBP and DBP. Additionally, males had a higher rate of cigarette, e-cigarette, cigar, and smokeless tobacco use. Additionally, the ethnic differences showed that White students had a significantly significant difference in higher rate of use for hookah and smokeless tobacco.

An unanticipated, yet very interesting and important discovery was made when studying the comparison data between the CSU sample and the student's data from NCHA. Both groups had very similar data on their perception or awareness of having an elevated total cholesterol level, fasting blood glucose, SBP, and DBP. However, it is noteworthy that statistical significant differences were seen in all four CVD risk factors when perception data was compared to clinically measured data. An individual may be asymptomatic for years before problems develop because of elevated risk factors for CVD. Preventive screening for CVD risk factors is a proactive approach to health care. It is wiser and less costly to modify risk factors prior to CVD development.

Limitations

As with all research, this study was not without limitations. The findings from the study may be the result of noted limitations.

Demographic limitations. One of the limitations of this study was the demographics of the sample. The majority of the subjects were White, 81.88 percent (N = 131), female, 62.80 percent (N = 113), senior 53.75 percent (N = 86), and from the department of Health and Exercise Science, 78.62 percent (N = 114). The sample did not represent the totality of undergraduate students enrolled at CSU during the spring semester, 2017 for age, gender, class status, and major but did for ethnicity. Therefore, generalizability is limited.

A second demographic limitation was not collecting data on a student's home or original state of origin. In the spring of 2017, 70 percent of all enrolled students were in-state students and 30 percent were out-of-state students. Typical diets, activity patterns, prevalence of diabetes, hypertension, tobacco use, and alcohol consumption vary by regional location. Therefore, knowing the home state for each study participant may be helpful for interpretation and to study national differences in CVD risk factors.

Self-reporting. A second limitation was the honesty and accuracy of self-reporting section of the questionnaire. Although truthful responses were an assumption of the study, the researcher had no method of confirming intentional or intentional misreporting.

Single data point. A third limitation of the study was this represented one point in time concerning the student's health. Health is dynamic and student development is dynamic. Therefore, the ideal way to evaluate CVD risk factors or any health issue is with multiple measurements done over time. Ideas include an annual screening for the students, showing changes over time, or screening students as they enter the university (freshman or transfer students) and then the semester prior to graduation.

Schedule sensitivity. Finally, future screenings should be well planned according to student life. It is suggested to avoid mid-term and finals weeks, Greek Life Recruitment Week, the week of Homecoming, and other weeks that may cause significant changes in student stress levels, eating habits, drinking and other social behaviors, and exercise routines. The goal is to screening students after a few weeks of normal college life, not after a heightened stress or large campus social activity.

Recommendations for Future Research

Annual screening. Assessing undergraduate college students throughout their college years would produce a clear and robust picture of student's health and wellness over time. Data collection could begin during summer orientation from student and parents in attendance to eliminate "unknowns" in family history and then annual follow-ups until graduation.

Additional screening. With a goal of a complete CVD risk factor assessment, two additions are recommended to the current study. First, the addition of technology (I-phone tracker, pedometers, etc.,) would allow more objective activity recording. There was subjectivity in determining moderate versus vigorous activity and time spent in activity; therefore a more objective recording is suggested. Another recommended addition is including an evaluation for stress levels in the questionnaire.

Longitudinal study. It is also recommended that this study evolve into a longitudinal research study. All assessments are quick, inexpensive, and easy to administer. Following student's graduation, data could be collected every five years. For those in the northern Colorado area, data collection could be offered on-campus or online, whichever is most convenient for participants. For those outside the general area, online questionnaires, and blood profile submission would be possible through a universal website. Incentives for participation should be available.

Longitudinal research will allow the tracking of changes in health behaviors over time, as well as track future health consequences, as a result of college health behaviors. Additionally, longitudinal studies will further define health differences seen age groups, gender, ethnic backgrounds, socioeconomic levels, habitual exercisers, nicotine users, alcohol consumers, and illicit drug users.

Additional statistical analyses. As this study continues to develop, additional statistics will naturally be added for data interpretation. One recommendation is the addition of logistic regression. This addition would allow the researcher to predict a categorical variable from a set of predictor variables. Logistic regression has very few assumptions, but does require large samples to be precise, which would be possible with time. Finally, logistic regression has become a popular measurement, especially in health-related fields of study (Morgan et al., 2012), and therefore, would be ideal this CVD risk factor screening program.

Comparative studies. Replicating this study and comparing acquired data with other universities and colleges in the state of Colorado would be interesting, as well as throughout the nation. It would also be interesting to study differences in student health from conservative states, such as Utah to states in the lower south region of the nation. Does college student health and lifestyles in these states mimic the adult data identified by the CDC?

Conclusion

This study filled a research gap as risk factors for CVD with the college student population is very limited. The assumption is that college students are young, healthy, and do not have health concerns. However, research has shown health behaviors tend to change in college including exercise habits, dietary habits, nicotine use, alcohol use, drug use, and stress management, and time management. Early preventive screenings and interventions are recommended to monitor these behaviors and possibly identify risk factors for CVD.

Several CVD risk factors begin at a young age and continue to adulthood. The American Heart Association (AHA) and the National Health Lung and Blood Institute (NHLBI) emphasize preventive measures beginning in young children and adolescents (Lloyd-Jones et al., 2010). Early identification and modification of CVD risk factors is beneficial in inhibiting or delaying the onset of CVD. Risk factor profiles in young adults have shown to be strong predictors of long-term CVD disease. Therefore, it is important to understand, measure, and monitor the impact that college life has on CVD risk factors.

Identified risk factors for cardiovascular disease (CVD). A total of 706 CVD risk factors were prevalent in this apparently healthy group of college students. The breakdown for

CVD risk factors is as follows: 208 for nicotine use, 238 for family history of CVD, 42 for high LDLs, 32 for elevated SBP, 24 for elevated DBP, 22 for inactivity, 21 for elevated triglycerides, 20 for elevated total cholesterol, 20 for elevated blood glucose, 19 for low HDLs in males, 15 for low HDLs in females, 39 for BMI ≥ 25 kg/m^2), 4 for increase in waist circumference for females, and 2 for an elevated waist circumference in males. Collectively, these results indicate a significant prevalence of CVD risk factors and high alcohol and drug use among the CSU student sample. It is apparent that this undergraduate college student sample may be more at risk for developing subsequent CVD than previously thought and should be screened for CVD beginning at age 20 as recommended by health and medical experts.

The research study showed that male undergraduate students had abnormalities in 15 of the 16 risk factors and females showed abnormalities in one CVD risk factor. White students were more likely to smoke hookah, use smokeless tobacco, consume more wine, liquor, marijuana edibles, drink five drinks in one setting, and drive after drinking alcohol than Non-White students. Differences in class status proved to be interesting with freshmen having statistically significant lower SBP than sophomores and seniors. Seniors were also more likely to consume higher quantities of beer compared to freshmen and sophomores, more likely to drive after drinking alcohol than freshmen, more likely to drive after drinking alcohol than sophomores. Juniors were more likely to consume marijuana edibles than sophomores were.

Increases in blood pressure, hookah smoking, smokeless tobacco, alcohol use, driving after drinking alcohol, and marijuana edibles are areas of growth in the college student population. These increases are also a public health concern. The addictive nature of nicotine, alcohol, and marijuana is noteworthy. Significant use and dependency of these drugs during college has the potential to lead to adult drug addiction and abuse.

The value of preventive health screenings. “Health is something we take for granted…until something goes wrong”. This saying has been around for decades and is still true today. The data strongly implies that we must no longer take college student’s health for granted and assume they are healthy. In fact, to do so is irresponsible. The research findings indicate that undergraduate college students may not be as healthy as once thought.

The literature supports the importance of identifying those at risk for CVD so that steps can be taken to manage, alleviate, and prevent future CVD risk factors (Arts et al., 2014). Preventing the onset of a health risk behavior or intervening before a health risk behavior is established is suggested (Cullen, Koehly, Anderson, Baranowski, Prokhorov, Basen-Engquist, & Hergenroeder, 1999). In addition, research has found that correcting modifiable risk factors in the younger population to be more productive than in the older population, therefore, the college student population is ideal for this type of intervention. Program strategies including health promotion programs, preventive screening, and health education targeted at the leading CVD risk factors, such as hypertension, high cholesterol levels, and tobacco use can significantly reduce the physical, emotional, and financial burden of CVD.

Program development. The University of New Hampshire (UNH), is home to an outstanding CVD prevention program serving college students. This established program could serve as a model for such a program to begin at CSU. Program components should include preventive screening for CVD risk factor identification, fitness assessments, and health education. A complete program would include campus collaboration with the department of Health and Exercise Science, the CSU Health and Medical Center, the Student Recreation Center, and the Kendall Reagan Nutrition Center. The collected data is available for future research studies to monitor popular trends among college students and their health behaviors.

The recommended is that initial screening occur during the first year, or initial year of transfer, and follow-up assessments be done annually.

It is recommended that health care providers, administrator, educators and student representatives come together to create a health and wellness screening program that has two primary goals. The first goal is to screen CSU students to identify risk factors for CVD. The second goal of the program is to educate and inspire students to be more active in their health, well-being, and lifestyle choices. Students should receive education for focusing on eating a well-balanced diet, getting adequate sleep, scheduling time for exercise and activity, and practice healthy stress management techniques while balancing academic demands. Health care professionals can help students protect and enhance their health by performing preventive screening including a blood lipid analysis and blood pressure measurements beginning at the age of 20. In addition, it is important for health care providers to be familiar with medical, community, and campus resources that may be beneficial in assisting students with specific areas of concerns. A preventive screening for CVD risk factors has the potential to educate and enable young adults to become empowered to establish healthy lifestyle patterns throughout college and adulthood.

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APPENDIX A

Nicotine Use Among College Students

Table 4

Prevalence of Nicotine Use Among College Students (Blank indicates not part of the study.

Study	*N*	Age	% Smoking Cigarettes	% Electronic Cigarettes	% Hookah		
					Life	P/Year	P/30 Days
ACHA / NCHA, (2008)	84,760	21.4	--	34-75			
Braun, et al., (2012)	438	18-24	--	--	--	15.4	6.0
Cobb, et al.		18-24	--	--	10-20	--	--
					--	--	20.0
Eissenberg, et al.	744	18-20	--	--			

Grekin, et al.	602	18-24	--	--	15.1	12.4	--
Halperin, et al., (2009)	2,091	18-24	25	--	--	--	--
--							
Heinz, et al., (2013)	--	18-24	--	--	48.0	--	22.0
Huang, et al., (2004)	163	18-24	26	--	--	--	--
Jackson, et al.	937	18-24	--	--	37.9	--	21.1
Jarrett, et al.	82,155	18-24	--	--	--	10.0	22.9
Littlefield, (2015)	599	18-24	--	29	--	--	--
McGill, et al.	2,876	15-34	9	--	--	--	--

Meier, et al., (2015)	1,304	18-24	51	--	38.0	--	--
Primack, et al., (2008)	3,600	18-24	--	--	41.0	30.6	9.5
Primack, et al. (2010)	8,745	18-24	--	--	29.5	--	7.2
Rigotti, et al., (2000)	14,138	18-24	28.5	--	--	--	--
Saddleson, (2015)	1,437	18-23	--	29.9	--	--	--
Smith-Simone, et al.			--	--	28.0	--	15.3
Spangler, et al.	10,520	18-24	--	12	--	--	--
Spencer	226	18-26	40	--	--	--	--
Sutfin, et al., (2013)	4,444	18-24	--	4.9	--	--	--

Wechsler, et al.	15,103	18-24	28.5	--	--	--	--

APPENDIX B

Human Subjects Approval Letter

Knowledge to Go Places

Research Integrity & Compliance Review Office
Office of the Vice President for Research
321 General Services Building - Campus Delivery 2011 eprotocol
TEL: (970) 491-1553
FAX: (970) 491-2293

NOTICE OF APPROVAL FOR HUMAN RESEARCH

DATE:	February 21, 2017
TO:	Kuk, Linda, School of Education
	Gloeckner, Gene, School of Education, Deyoung, Wendy, School of Education
FROM:	Swiss, Evelyn, CSU IRB 2
PROTOCOL TITLE:	The Prevalence and Clustering of Cardiovascular Risk Factors in Undergraduate College Students. The title is consistent for both the protocol and proposal.
FUNDING SOURCE:	NONE
PROTOCOL NUMBER:	17-7071H
APPROVAL PERIOD:	Approval Date: February 21, 2017 Expiration Date: February 20, 2018

The CSU Institutional Review Board (IRB) for the protection of human subjects has reviewed the protocol entitled: The Prevalence and Clustering of Cardiovascular Risk Factors in Undergraduate College Students The title is consistent for both the protocol and proposal.. The project has been approved for the procedures and subjects described in the protocol. This protocol must be reviewed for renewal on a yearly basis for as long as the research remains active. Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.

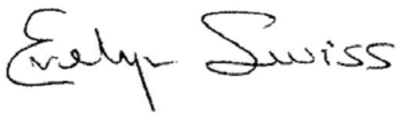
Important Reminder: If you will consent your participants with a signed consent document, it is your responsibility to use the consent form that has been finalized and uploaded into the consent section of eProtocol by the IRB coordinators. Failure to use the finalized consent form available to you in eProtocol is a reportable protocol violation.

If approval did not accompany a proposal when it was submitted to a sponsor, it is the PI's responsibility to provide the sponsor with the approval notice.

This approval is issued under Colorado State University's Federal Wide Assurance 00000647 with the Office for Human Research Protections (OHRP). If you have any questions regarding your obligations under CSU's Assurance, please do not hesitate to contact us.

Please direct any questions about the IRB's actions on this project to:

IRB Office - (970) 491-1553; RICRO_IRB@mail.Colostate.edu
Evelyn Swiss, Senior IRB Coordinator - (970) 491-1381; Evelyn.Swiss@Colostate.edu
Tammy Felton-Noyle, Assistant IRB Coordinator - (970) 491-1655; Tammy.Felton-Noyle@Colostate.edu



Swiss, Evelyn

Approval is to recruit up to 120 participants with the approved verbal script and cover letter consent. Because of the nature of this research, it will not be necessary to obtain a signed consent form. However, all subjects must receive a copy of the approved cover letter printed on department letterhead. The

Page: 1

APPENDIX C

Sample of the Promotional Research Flyer/Poster

APPENDIX D

CSU Flea Market Reservation Conformation

CSU STUDENT ORGANIZATION CONTRACT for FLEA MARKET

All fields must be completed

This agreement is made between the Board of Governors of the Colorado State University System, acting by and through Colorado State University on behalf of the Campus Activities Flea Market, hereinafter termed Flea Market, at Colorado State University, and, hereinafter-termed Vendor.

VENDOR NME-VENDOR FILL IN	TABLE SPACE. FOR OFFICE USE ONLY	DATES.VENDOR FILL IN
Wendy DeYoung	All Tables in the flea	Tuesday, Feb 21st or
Health & Exercise Science	market.	Thursday, Feb. 23rd, 2017
Wellness Club		from 8:00 - 11:00 A.M.

This agreement is valid only for the dates indicated herein.

With Valentine's Day being in February, the month is often called 'Heart Month.' We are promoting Heart Health with this Blood Pressure & Cholesterol screening. The screening is Free & available to all CSU students. Each student Will have a consultation with a Nurse from the Health District.

1. Vendor will be conducting the following business in the Flea Market: (please describe):
2. Vendor will <u>submit a sample of product(s)</u> to be sold for approval from the Flea Market to market such product(s). If in paper form, Vendor may fax a sample with other documents in to the Campus Activities Office.
3. Vendor will remove all vending materials from the campus at the end of each vending day. Vendors leaving the Flea Market area or the campus in any condition requiring CSI-J maintenance will be charged a fee no less than $50 to be paid in full before any subsequent vendor days may be used or scheduled.
4. Vendor will not infringe upon copyrighted or trademarked materials of any entity.
5. On University premises or at any University-sponsored activities, the following acts are prohibited: manufacture, sale, dispensation. possession or use of weapons, and any illegal drug or controlled substance without legal authorization such as a prescription. Vendor agrees that it will not undertake such activities on University premises.
6. Vendor agrees not to engage in free-food giveaways <u>unless arranged</u> through Lory Student Center Food Services.
7. Vendor understands and acknowledges that the University does not guarantee exclusivity, and that there may be other vendors promoting similar products on the same day in the Flea Market.

8. Vendor is solely responsible for collecting and remitting, as required by law, all state sales tax.

I agree to the above terms and certify that I am a duly authorized signatory for:

SIGNATURE Wendy DeYoung DATE 11/18/16

Who is handling this for your company:

NAME Wendy DeYoung, MS.

EMAIL wendy.deyoung@colostate.edu

Campus Activities Flea Market Rep for CSU By:

SIGNATURE ______________ DATE

TERMS OF USE FOR CSU STUDENT ORGANIZATIONS Flea Market,
Lory Student Center, Colorado State University

1 . Vendor scheduling is on a first-come. first-served basis. Reservations begin the first Wednesday after the Fourth of July for fall semester and the Wednesday after Thanksgiving for spring semester. Space reserved is considered confirmed upon receipt of all fees and all documents described in #2 of this document.

2. Any Vendor not arriving by noon on any scheduled day forfeits reserved space in the Flea Market, unless previously arranged with Flea Market staff. Other Vendors reserving space for that same day may request forfeited space through the Flea Market Office.
3. Vendors may utilize the corkboard at the top of the window behind their table, top and front of their table for advertising on their reserved day(s). Please be considerate of other Vendor space. Absolutely no material may be placed anywhere else in or outside of the Lory Student Center.
4. Vendors using electrical outlets must provide and utilize a surge protector for their equipment.
5. Vendors may not solicit customers other than from behind their reserved table. No unreasonable noise, disruptive or abusive behavior will be tolerated. Vendors must remain behind their tables and demonstrate professionalism at all times.
6. Vendor must provide written information about its ability to back its claims and guarantees. During the Vendor's use of the Flea Market, a statement must be made available to purchasers that sets forth the circumstances under which purchasers may return merchandise during and after the sale including the Vendor and Vendor's representative's addresses, and phone numbers. This information must be posted or made available for customers to take at the Flea Market site.
7. Vendor must post a sign at their vending table addressing both the nature of the sale and identifying the sponsoring organization.

8. Colorado State University reserves the right to: a.) reassign tables space if deemed necessary by the university, and b.) remove a Vendor from the Flea Market or restrict Vendor's future use of the Flea Market.

I/we, the undersigned, have read and agree to these Terms of Use.

APPENDIX E

Cover Letter for Consent Form

Colorado State University®

Dear Student;

My name is Wendy DeYoung and I am a doctoral student in the School of Education. I am interested in researching college student health. My research interest and focus is cardiovascular risk factors associated with disease development. I will be looking at the prevalence of cardiovascular risks factors in college age students and if risk factors cluster together.

The title of my study is: "Prevalence and Clustering of Cardiovascular Risk Factors in College Students." Linda Kuk, Ph.D. is the Principal Investigator and advisor for this research. You are being invited to consider taking part in my research to determine the prevalence and clustering of risk factors for cardiovascular disease in college students 18 – 25 years old by completing a short health survey and having your height/weight/waist measured. Completing the survey should take no more than 15 minutes, and the total time for your participation in this research will be no more than 25 minutes.

If you consent to participate in this research, after the registered nurses from the Health District check your cholesterol levels and your blood pressure, you will have the opportunity to complete a health measures survey for this research. I will also measure your height, weight, and waist measurement.

For this research, the research team will not be able to link you to your data. The Health District nursing staff will provide the researchers your blood pressure and cholesterol information, but will remove your name and replace your name with a coded label. A label with the same code will be put on your survey to link the two sets of data.

Participating in this research is voluntary and will have no impact on the information that you will receive from the Health District. There are no known risks or direct benefits associated with this research, but we hope that this research may help college students develop healthy behaviors and lifestyles to reduce the possibility of an increased adult risk for cardiovascular disease.

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about this study, you can contact the investigator, Linda Kuk, Ph.D. at linda.kuk@colostate.edu or 970 491 – 7243. If you have any questions about your rights as a volunteer in this research, contact the CSU IRB at: RICRO_IRB@mail.colostate.edu; 970-491-1553. Please keep this cover letter for your records.

If you would like to receive a summary of this research, please provide your email address on the attached page.

Thank you for your consideration!

Linda Kuk, Ph.D., Associate Professor
School of Education
Principal Investigator
(970) 491 – 7243
Linda.kuk@colostate.edu

Wendy DeYoung, M.S.
Co-Principal Investigator
Doctoral Student
(970) 491-3768
wendy.deyoung@colostate.edu

REQUEST FOR STUDY RESULTS

Study Title: *Prevalence and Clustering of Cardiovascular Risk Factors in College Students*

Please provide me the summary of this research. I understand that the study results will be in aggregate form only.

Email:____

Thank you for your participation!

Linda Kuk, Ph.D., Associate Professor
School of Education
Principal Investigator
(970) 491 – 7243
Linda.kuk@colostate.edu

Wendy DeYoung, M.S.
Co-Principal Investigator
Doctoral Student
(970) 491-3768
wendy.deyoung@colostate.edu

APPENDIX F

Consent to Participate in a Research Study
Colorado State University

Title of Study: Prevalence and Clustering of Cardiovascular Risk Factors in College Students
Principle Investigator: Linda Kuk, Ph.D.
Associate Professor
Coordinator for Higher Education Leadership Program
School of Education
(970) 491 – 7243
Linda.kuk@colostate.edu

Co-Principle Investigator: Wendy DeYoung, M.S.
Doctoral Student in the School of Education
(970) 491 – 3768
Wendy.deyoung@colostate.edu

You are invited to participate in this research study because you are a college student between the ages of 18 – 25 years old.

Linda Kuk, Ph.D. is the Principle Investigator for this research team. Wendy DeYoung will be involved as a doctoral student in the School of Education. She will be present on screening days and will be working closely with the research team. The team is collaborating with four Register Nurses (RNs) from the Health District of Northern Larimer County who have agreed to complete the blood pressure assessments and blood analysis for this research.

The purpose of the research study is to determine the prevalence and clustering of risk factors for cardiovascular disease in college students 18 – 25 years old. The study will take place in the Moby Complex on February 21, 2017 and the Lory Student Center on February 22, 2017. Your time commitment as a participant will be 30 minutes.

The procedures for the study are as follows:

- You will be asked to complete a Cholesterol Screening Intake Form that provides demographic and health history information.

- A RN will review your responses and ask you general questions to determine if any conditions exist that may prevent you from participating in this research study.
- Once complete, you will sit quietly in a chair for 5 minutes.
- Your blood pressure will be taken twice by a RN with two to three minutes between assessments. The assessments will be averaged and record on the Cholesterol Screening Result Form.
- You will then be asked to wash your hands with warm soapy water and towel dry.
- Your finger will be lanced by a RN to collect a drop of blood for the blood analysis.

Page 1 of 3 Participant's initials _______ Date_______

- Once analyzed, the RN will record your results on the Cholesterol Screening Result Form. She will then review your blood pressure and blood lipids and compare your values to average values for your sex and age group.
- You will then have your height and weight taken and recorded by the doctoral student.
- The doctoral student will then measure and record your waist circumference by using an inelastic tape measure.
- When all measurements are finished, you will be asked to complete a health history and lifestyle activity form. You can complete this electronically on the provided laptop computers, or manually with paper and pen.

Volunteers younger than 18, older than 25, or not enrolled in college are excluded from this study.

The only risk to participants is a potential for infection to develop at the lanced site. However, a sterile procedure will be followed and it is very rare that an infection will develop. It is not possible to identify all potential risks in research procedures, but the researcher has taken reasonable safeguards to minimize any known and potential, but unknown risks.

The anticipated benefits from volunteering for this study include your new knowledge regarding personal risk factors associate with cardiovascular disease. Additionally, you will learn how these risk factors can be reduced or managed through lifestyle behaviors and or medical management. Finally, you will be informed of your risk appraisal score from both the American Diabetes Association and the Framingham 10-year risk of having a heart attack in the next 10 years. These anticipated benefits may help college students develop healthy behaviors and lifestyles to reduce the possibility of an increased adult risk for cardiovascular disease.

Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

We will keep private all research records that identify you, to the extent allowed by law. For this study, we will assign a code to your data. Your code will be your last name followed by the last four digits of your cell phone number (for example, D-1131). The only place that your name will appear in our records is on the consent form and in our data spreadsheet, which links you to your code. Only the research team will have access to the link between you, your code, and your data. The only exceptions to this are if we are asked to share the research files for audit purposes and the CSU Institutional Review Board ethics committee, if necessary. In addition, for funded studies, the CSU financial management team may also request an audit of research expenditures. For financial audits, only the fact that you participated would be shared, not any research data. When we write about the study to share with other researchers, we will only write about the combined information gathered. You will not be identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

Monetary compensated is not included in this study.

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about this study, you can contact the investigator, Linda Kuk, Ph.D. at linda.kuk@colostate.edu or 970 491 – 7243. If you have any questions about your rights as a volunteer in this research, contact the CSU IRB at: RICRO_IRB@mail.colostate.edu; 970-491-1553. We will give you a copy of this consent form to take with you.

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing three pages.

____ ____________
Signature of person agreeing to take part in the study Date

____
Printed name of person agreeing to take part in the study

____ ____________
Name of person providing information to participant Date

____
Signature of Research Staff

Page 3 of 3 Participant's initials _______ Date_______

APPENDIX G

Health History and Lifestyle Questionnaire

Health and Lifestyle Survey

Description:

Date Created: 11/3/2016 6:20:37 PM

Date Range: 11/11/2016 12:00:00 AM - 12/30/2017 11:59:00 PM

Word PDF

Page - 1

Q1 Identification Code: (Middle Initial - Last 4 digits of your cell phone number)

[Code = 1] [Textbox]

Required answers: 0 *Allowed answers: 1*

Demographics

	Required answers: 0	*Allowed answers: 0*

Q2 What is your gender?		
Female*[Code = 1]*		
Male*[Code = 2]*		
Transgender*[Code = 3]*		
	Required answers: 1	*Allowed answers: 1*

Q3 What is your date of birth? (mm/dd/yyyy)		
[Code = 1] [Textbox]		
	Required answers: 0	*Allowed answers: 1*

Q4 What is your age?
18*[Code = 1]*
19*[Code = 2]*
20*[Code = 3]*
21*[Code = 4]*
22*[Code = 5]*

23*[Code = 6]*
24*[Code = 7]*
25*[Code = 8]*
Other*[Code = 9]*
Required answers: 1 *Allowed answers: 1*

Q5 Where do you currently live?
Campus residence hall*[Code = 1]*
Fraternity or sorority house*[Code = 2]*
Other college/university housing*[Code = 3]*
Parent/Guardian home*[Code = 4]*
Other off-campus housing*[Code = 5]*
Other (please specify)*[Code = 6] [Textbox]*
Required answers: 1 *Allowed answers: 1*

Q6 Are you Hispanic or Latino?
Yes*[Code = 1]*
No*[Code = 2]*
Required answers: 1 *Allowed answers: 1*

Q7 What is your race? (select one or more responses)
American Indian or Alaska Native*[Code = 1]*
Asian*[Code = 2]*
Black or African American*[Code = 3]*
Native Hawaiian or Other Pacific Islander*[Code = 4]*
White *[Code = 5]*
Other (please specify)*[Code = 6] [Textbox]*
Required answers: 1 *Allowed answers: 5*

Q8 Which department are you in?
Animal Science*[Code = 1]*
Apparel and Merchandising*[Code = 2]*
Biology*[Code = 3]*
Biochemistry*[Code = 4]*
Biomedical Sciences*[Code = 5]*
Business*[Code = 6]*
Chemistry*[Code = 7]*
Communication Studies*[Code = 8]*

Construction Management*[Code = 9]*
Early Childhood Education*[Code = 10]*
Economics*[Code = 11]*
Engineering*[Code = 12]*
English*[Code = 13]*
Environmental and Natural Resources Economics*[Code = 14]*
Food Science and Human Nutrition*[Code = 15]*
Health and Exercise Science *[Code = 16]*
Horticultural*[Code = 17]*
Human Development and Family Studies*[Code = 18]*
Mathematics*[Code = 19]*
Music*[Code = 20]*
Natural Resource Recreation and Tourism*[Code = 21]*
Natural Sciences*[Code = 22]*
Political Sciences*[Code = 23]*
Psychology*[Code = 24]*
Social Work*[Code = 25]*
Sociology*[Code = 26]*
Other:*[Code = 27] [Textbox]*

Required answers: 1 *Allowed answers: 1*

Q9 Are you a
Freshman*[Code = 1]*
Sophomore*[Code = 2]*
Junior*[Code = 3]*
Senior*[Code = 4]*
Required answers: 1 *Allowed answers: 1*

Q10 What is your current GPA?
4.00*[Code = 1]*
3.99 - 3.50*[Code = 2]*
3.49 - 3.00*[Code = 3]*
2.99 - 2.50*[Code = 4]*

2.49 - 2.00*[Code = 5]*

On academic probation*[Code = 6]*

Required answers: 1 *Allowed answers: 1*

Q11 Are you in the CSU Honor's Program?

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q12 Are you a member of a social fraternity or sorority?

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q13 How many hours a week do you work for pay?

0 hours*[Code = 1]*

1-9 hours*[Code = 2]*

10 - 19 hours*[Code = 3]*

20 - 29 hours*[Code = 4]*

30 - 39 hours*[Code = 5]*

40 or more hours*[Code = 6]*

Required answers: 1 *Allowed answers: 1*

Next Page: Sequential

Page - 2

Health Information

Required answers: 0 *Allowed answers: 0*

Q14 How would you describe your general health?

Excellent*[Code = 1]*

Very Good*[Code = 2]*

Good *[Code = 3]*

Fair*[Code = 4]*

Poor*[Code = 5]*

Don't know*[Code = 6]*

Required answers: 1 *Allowed answers: 1*

Do **you** have a history of:

Q15 Heart disease

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q16 Stroke

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q17 Hypertension (high blood pressure)

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q18 Diabetes

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q19 High Cholesterol

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q20 High Triglycerides

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Q21 Overweight/Obesity

Yes*[Code = 1]*

No*[Code = 2]*

Required answers: 1 *Allowed answers: 1*

Do you have a **family history** of:

Q22 Heart disease

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Q23 Stroke

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Q24 Hypertension (high blood pressure)

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Q25 Diabetes

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Q26 High Cholesterol

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Q27 High Triglycerides

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Q28 Overweight/Obesity

Yes*[Code = 1]*

No*[Code = 2]*

Do not know*[Code = 3]*

Required answers: 1 *Allowed answers: 1*

Tobacco Use

Within the last 30 days, on how many days did you use:

Q29 Cigarettes

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q30 Tobacco from a water pipe (Hookah)

Never used*[Code = 1]*
Have used, but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*

Q31 Cigars, little cigars, clove cigarettes
Never used*[Code = 1]*
Have used, but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*

all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*

Q32 Smokeless tobacco
Never used*[Code = 1]*
Have used, but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*

Q33 Marijuana
Never used*[Code = 1]*
Have used, but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Alcohol Use

Within the last 30 days, on how many days did you use:

Q34 Beer

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q35 Wine

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q36 Liquor

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q37 Vaporized alcohol

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Within the last 30 days, on how many days did you:

Q38 Have you consumed more than 5 alcoholic beverages in one setting?

No, never*[Code = 1]*

Have done, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Display if Q2='Male'

Q39 Have you consumed more than 4 alcoholic beverages in one setting?

No, never*[Code = 1]*

Have done, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Display if Q2='Female' OR Q2='Transgender'

Within the last 30 days, on how many days did you:

Q40 Drive after drinking any alcohol at all

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q41 Drive after consuming 5 or more drinks
Never used*[Code = 1]*
Have used, but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*
Display if Q2='Male'

Q42 Drive after consuming 4 or more drinks in a setting
Never used*[Code = 1]*
Have used, but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Display if Q2='Female' OR Q2='Transgender'

Q43 Drive after smoking marijuana

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q44 Drive after using any illegal drug(s)

Never used*[Code = 1]*

Have used, but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q45 The last time you "partied"/socialized, how many alcoholic drinks did you have?

1*[Code = 1]*

2*[Code = 2]*

3*[Code = 3]*

4*[Code = 4]*

5*[Code = 5]*

6*[Code = 6]*

7*[Code = 7]*

8*[Code = 8]*

9*[Code = 9]*
10*[Code = 10]*
11*[Code = 11]*
More than 11*[Code = 12]*
Required answers: 1 *Allowed answers: 1*

Q46 The last time you "partied"/socialized, how many hours did you drink alcohol?
1*[Code = 1]*
2*[Code = 2]*
3*[Code = 3]*
4*[Code = 4]*
5*[Code = 5]*
6*[Code = 6]*
7*[Code = 7]*
8*[Code = 8]*
9*[Code = 9]*
10*[Code = 10]*
11*[Code = 11]*
Required answers: 1 *Allowed answers: 1*

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Drug Use

Within the last 30 days, on how many days did you use:

Q47 Marijuana (pot, weed, hashish, hash oil)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q48 Cocaine (crack, rock, freebase)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*

Q49 Methamphetamines (crystal meth, ice, crank)
Never used*[Code = 1]*
Have used but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q50 Other amphetamines (adderall, diet pills, bennies)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q51 Sedatives (sleeping aids, downers, ludes)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q52 Hallucinogens (LSD, PCP)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q53 Anabolic Steroids (Testosterone)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*

Q54 Opiates (heroin, smack)
Never used*[Code = 1]*
Have used but not in the last 30 days*[Code = 2]*
1-2 days*[Code = 3]*
3-5 days*[Code = 4]*
6-9 days*[Code = 5]*
10-19 days*[Code = 6]*
20-29 days*[Code = 7]*
all 30 days*[Code = 8]*
Required answers: 1 *Allowed answers: 1*

Q55 Inhalants (glue, solvents, gas)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q56 MDMA (Ecstasy)

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Q57 Other illegal drugs

Never used*[Code = 1]*

Have used but not in the last 30 days*[Code = 2]*

1-2 days*[Code = 3]*

3-5 days*[Code = 4]*

6-9 days*[Code = 5]*

10-19 days*[Code = 6]*

20-29 days*[Code = 7]*

all 30 days*[Code = 8]*

Required answers: 1 *Allowed answers: 1*

Exercise and Physical Activity

Required answers: 0 *Allowed answers: 0*

Q58 Do you exercise or participate in physical activity regularly (3 days/week or more)?

Yes*[Code = 1]*

No*[Code = 2] (Go To End)*

Required answers: 1 *Allowed answers: 1*

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Within the last 7 days, how many days

Q59 per week did you participate in exercise or physical activity?

1*[Code = 1] [Numeric Value = 1]*

2*[Code = 2] [Numeric Value = 2]*

3*[Code = 3] [Numeric Value = 3]*

4*[Code = 4] [Numeric Value = 4]*

5*[Code = 5] [Numeric Value = 5]*

6*[Code = 6] [Numeric Value = 6]*

7*[Code = 7] [Numeric Value = 7]*

Required answers: 1 *Allowed answers: 1*

Q60 do you walk for at least 10 minutes at a time in your leisure time?

1*[Code = 1] [Numeric Value = 1]*
2*[Code = 2] [Numeric Value = 2]*
3*[Code = 3] [Numeric Value = 3]*
4*[Code = 4] [Numeric Value = 4]*
5*[Code = 5] [Numeric Value = 5]*
6*[Code = 6] [Numeric Value = 6]*
7*[Code = 7] [Numeric Value = 7]*
Required answers: 1 *Allowed answers: 1*

Q61 do you do moderate physical activity (bicycling, swimming, jogging, or brisk walking at a regular pace) for at least 10 minutes?
1*[Code = 1] [Numeric Value = 1]*
2*[Code = 2] [Numeric Value = 2]*
3*[Code = 3] [Numeric Value = 3]*
4*[Code = 4] [Numeric Value = 4]*
5*[Code = 5] [Numeric Value = 5]*
6*[Code = 6] [Numeric Value = 6]*
7*[Code = 7] [Numeric Value = 7]*
Required answers: 1 *Allowed answers: 1*

Q62 do you do vigorous physical activity (aerobics, fast cycling, swimming or running) for at least 10 minutes?

1*[Code = 1] [Numeric Value = 1]*

2*[Code = 2] [Numeric Value = 2]*

3*[Code = 3] [Numeric Value = 3]*

4*[Code = 4] [Numeric Value = 4]*

5*[Code = 5] [Numeric Value = 5]*

6*[Code = 6] [Numeric Value = 6]*

7*[Code = 7] [Numeric Value = 7]*

Required answers: 1 *Allowed answers: 1*

Q63 On a typical day, how much time did you spend walking in your leisure time?

Hours per day*[Code = 1] [Textbox]*

and Minutes per day*[Code = 2] [Textbox]*

Required answers: 1 *Allowed answers: 2*

Q64 On a typical day, how much time did you spend doing moderate activity in your leisure time?

Hours per day*[Code = 1] [Textbox]*

and Minutes per day*[Code = 2] [Textbox]*

Required answers: 1 *Allowed answers: 2*

Q65 On a typical day, how much time did you spend doing vigorous activity in your leisure time?

Hours per day*[Code = 1] [Textbox]*

and Minutes per day*[Code = 2] [Textbox]*

Required answers: 1 *Allowed answers: 2*

Time Spent Sitting

Required answers: 0 *Allowed answers: 0*

Q66 During the last 7 days, how much time did you usually spend **sitting** on a **weekday**?

Hours per day*[Code = 1] [Textbox]*

and Minutes per day*[Code = 2] [Textbox]*

Required answers: 1 *Allowed answers: 2*

Q67 During the last 7 days, how much time did you usually spend **sitting** on a **weekend**?

Hours per day*[Code = 1] [Textbox]*

and Minutes per day*[Code = 2] [Textbox]*

Required answers: 1 *Allowed answers: 2*