PolyHeart
Cardiovascular Disease Risk Assessment

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Chapter 1

Introduction

Obesity has reached epidemic proportions in the United States, with the vase majority of adults being overweight or obese(>65%)[1]. In general, cardiovascular disease (CVD) tracks obesity, and being obese greatly increases the risk for CVD. CVD is a disease that encompasses all diseases of the heart and/or blood vessels, including coronary artery disease, arrhythmias and congenital heart defects. Conditions or episodes caused by narrowed blood vessels also fall under the umbrella of cardiovascular diseases, these include heart attack, angina, and high blood pressure. CVD has been a public health concern since 1925[2], and CVD was the leading cause of death for both men and women in 2006, and accounted for about 34% of all deaths that year[3,4]. In 2010 it is estimated that CVD will cost the United States approximately $316.4 billion, which includes the cost of health care services, medications, and lost work productivity[5].

There are seven risk factors of CVD, as defined by the American College of Sports Medicine[6]. Obesity is also linked to three of the seven other factors including type-2 diabetes, high blood pressure, and elevated total cholesterol measurements. A sedentary lifestyle is another risk factor that goes hand in hand with obesity; it is also a strong indication of the presence of other controllable risk factors. Therefore leading a sedentary lifestyle greatly increases the risk of CVD.

An academic setting, which conducts a large portion of obesity and CVD research, exposes students and faculty to the positive benefits of a healthy lifestyle. However, it remains unclear whether there is a relationship between exposure to a healthy environment and low risk stratification for CVD, among faculty. Positive health behaviors are associated with lack of smoking, and low BMI[7]. A healthy lifestyle includes following ACSM physical activity protocols, not smoking, and eating a balanced diet, as specified by the USDA myPyramid[8]. Additionally knowledge of family history is important in assessing risk for heart disease. Healthy behavior also includes regular visits to the doctor not only to assess general health status, but also to measure blood lipid and glucose profiles. Leading a healthy lifestyle can prevent as well as manage six of the seven risk factors proposed by the American College of Sports Medicine[6]. Genetics is the only un-modifiable risk factor. Because CVD is largely preventable, Americans need to be educated on their risk factors in order to eradicate this disease.

Purpose/Hypothesis

The purpose of this study was to assess Cal Poly's faculty members' cardiovascular health status, as specified by the American College of Sports Medicine's (ACSM) seven cardiovascular disease risk factors. These include: family history of early heart disease, cigarette smoking, hypertension, dyslipidemia, impaired fasting glucose, obesity, and sedentary lifestyle[6]. The results of this study are relevant from both a basic science (effects of "lifestyle" on CVD risk factors) and practical (participants' awareness of CVD) perspective. Awareness of CVD risk factors may help prevent progression of more risk factors and may improve quality of life.

Additionally, it may be important to know an individual's perception of their cardiovascular health and longevity versus how many risk factors the individual actually possesses. Data will be assessed to determine whether a person thinks they are at high risk or low risk for cardiovascular disease. This research benefits participants because awareness of their own personal risk factors can help improve their quality of life.

Cardiovascular disease is the number one killer in America, and it is largely preventable; six of the seven risk factors are escapable[1]. By giving people the information of which risk factors they possess, they can learn to manage and control the risk factors of cardiovascular disease.

It was hypothesized that 1) Cal Poly faculty and staff are at a low risk for CVD mainly due to their exposure to a healthy lifestyle in an academic setting and, 2) faculty will lead an active lifestyle and be non-smokers. We expected that, based on the studies mentioned above, Cal Poly faculty and staff would have a low risk for cardiovascular disease using the ACSM 7 risk factor assessment.

Chapter 2

Literature Analysis

The increase in obesity rates and host of medical problems associated with obesity impacts all areas of an individuals' life. The obesity trend is rising in the United States, and the risk for cardiovascular disease tracks this increased rate. The following literature outlines trends, causes, and solutions to the rising epidemic of obesity and cardiovascular disease.

Obesity

Fegall and Carroll, et al.[9] conducted the National Health and Nutrition Examination Survey (NHANES), a study to examine prevalence and trends of obesity in adults from 1999-2008. Additionally the study examined current obesity prevalence in 2007-2008. The NHANES is a survey that cycles continuously in which data is released every two years. Participants included 8082 men and women, and height and weight measurements were assessed. The data was used to calculate BMI and used to assess prevalence of overweight and obesity; 25.0-29.0, and above 30.0 were the ranges for determining overweight and obesity, respectively. Overall, the prevalence of obesity in men for 2007-2008 was 32.2%, and in women was 35.5%. Combined data of overweight and obesity showed a prevalence of approximately 68%. Researchers concluded that there were only small increases of obesity since the previous study, thus the trend in obesity is relatively stable. However future trends are difficult to predict because of the causes of variability in earlier trends. It must be noted that obesity is a precursor to many chronic conditions including, but not limited to, CVD.

Freedman, et al.[10] conducted the Bogulsa Heart Study, a longitudinal study to track childhood obesity and the impact on adult obesity and subsequent coronary heart disease risk factors. There were 2617 individuals who participated in the study. BMI was assessed in the children aged 2 to 17 years, then 17 years later lipid profile, glucose levels and blood pressure were measured, when participants were 18 to 37 years old. Data analysis showed that childhood obesity is a strong indicator and predictor of obesity later in life, morbidity (including CVD) and mortality. All adults who were classified as obese did not differ in their level of risk factors depending on whether they were overweight or not as a child. But, adults who became obese earlier in life showed increased risk factor levels. Future studies follow age of obesity compared to prevalence of coronary artery disease risk factors.

Perception of Risk for CVD

Barnhart and Wright, et al.[11] conducted a study to evaluate the perception of an individual's risk for CVD in comparison to their actual risk for CVD, and subsequent health behaviors. Researchers surveyed 250 individuals with at least one CVD risk factor, in outpatient medical clinic waiting rooms in the Bronx, New York. Perceived risk was measured using the Coronary Risk, Individual Perception (CRIP) scale, and summarized scores from self-reported diet and exercise behaviors. Many respondents who reportedly perceived that they were at low risk for CVD were actually at high risk for CVD (more than three risk factors). These findings highlight the importance of addressing an individual's perception of risk when consulting on prevention and/or treatment of CVD.

Power, et al.[12] conducted a study to determine the association of childhood cognition and adulthood CVD risk factors, and whether this could be explained by common causes, adult social position or health behavior. At age 11 participants were given age-appropriate math, reading, and general ability tests, nurses followed up with participants 34 years later to do clinical examinations in addition to assessment of health behaviors and class based on current occupation, at individuals' homes. The data showed that improved cardiovascular risk profile in midlife was determined by adult health behavior and social destinations. Higher childhood socioeconomic status led to higher education levels which in turn mediated cognition of CVD risk factors. Adult health behaviors were also indicative of cognition of CVD risk factors, and social circumstances had a strong influence on behavior. The role of education in cognition is substantial and may have to do with health literacy, and access to healthcare treatment and compliance, as well as health outcome associations.

Hall and Saukko, et al.[13] conducted a study to examine how clinicians communicate and patients understand family history in the context of coronary heart disease (CHD) in risk assessment. Twenty-one volunteers were recruited when they requested a cholesterol test when seeing the doctor. Each patient completed a family history questionnaire and interview with a physician. The outcomes highlighted three concerns in terms of family history. First, the patient's explanations family history were not further explored; the physicians did not take the time to fully explore family history for CHD. Second, the relationship between family history and other risk factors was not discussed with the patient. Finally, family history and its relation to overall risk for CHD was not fully explained to the patient. This study highlights the need for greater patient-physician communication of risk and relationship between risk factors. A better understanding of risk factors and their relation to each other is important information for individuals who are at low to moderate risk for CHD, to comprehend.

CVD correlates/lifestyle factors

Lakka et al.[14] conducted a study with the purpose of investigating the relationship between metabolic syndrome and its correlation with cardiovascular disease and mortality, among middle-aged men. Participants in the study were Finnish men between the ages of 42-60, (1984-1989) who were followed through December of 1998; they had no existing signs of CVD, diabetes or cancer. Risk factors for metabolic syndrome both at the beginning and end of the time frame of the study to determine developed disease were assessed. The cause of death was determined for participants who passed away during the study (109 participants). There was a positive association between metabolic syndrome with cardiovascular and overall mortality. These data suggest that modest lifestyle changes favorably affect metabolic and cardiovascular risk factors. However, it was noted that change in lifestyle did not prevent diagnosis of metabolic syndrome from occurring.

Meng et al.[7] conducted a study to determine if positive health behavior is associated with chronic disease, cancer and mortality. A chronic disease risk index (CDRI) was used as a tool to assess impact of lifestyle practices and behaviors. The total population of the study was 31,700 participants; subjects completed a survey designed by the Hawaii Department of Health, from 1974 to 1980. Another survey and round of interviews were administered in 1994. The CDRI included five modifiable lifestyle risk factors. The data showed that risk factors were cumulated, that individual risk factors were clustered. BMI and smoking were highly correlated to chronic disease and mortality. These data showed a relationship between BMI and fat intake on risk for chronic disease. A potential confound was that physical activity was not accounted for in the analyses. However, these data showed that adverse lifestyle factors are synergistic, not simply additive, to chronic disease risk.

Lutsey, et al.[15] conducted a study to determine whether birthplace, number of US generations, and socioeconomic status are associated with subclinical CVD risk factors. Data was collected from the Multi-Ethnic Study of Atherosclerosis (MESA) which included 6717 participants aged 45 to 84 years old, as well as binomial regression models to compute prevalence ratios of the data collected. Additionally other risk factors were assessed; the participants filled out a questionnaire and then an ultrasound machine was used to obtain images of the internal carotid artery, finally a urine sample was taken to determine albumin and creatinine concentrations. There was greater acculturation associated with a greater prevalence of carotid plaque. The prevalence of albumania (precursor to microvascular atherosclerosis) and education in Whites was inversely related to socioeconomic status. Data also showed that Blacks born in Africa had a lower prevalence of carotid plaque than Blacks born in the United States. There was an inverse relationship between socioeconomic status and prevalence of carotid plaque. Overall, these data suggest that across all racial/ethnic groups increased prevalence of carotid plaque and intima-media thickness was associated with lower socioeconomic status and greater US acculturation, highlighting the association between low socioeconomic status and CVD prevalence.

Randall et al.[16] conducted a study regarding impaired heart rate variability, (HRV) and how it correlates to CVD morbidity and mortality. It has been shown that married individuals are at decreased risk for CVD morbidity and mortality as compared to individuals in social isolation. Marital status is the most objective measure of social support structure. Eighty-eight volunteers from three London hospital-based rapid access chest pain clinics participated in the study. Demographic, health behavior, psychological, anthropometric, and clinical data were assessed. Unmarried martial status is associated with lower HRV than the married martial status group. A lower HRV is a predictor of coronary heart disease incidence and prognosis. There was also an observed beneficial impact of marriage on HRV. These data suggest that it is important for health care practitioners to take into account marital status and the underlying mechanisms of the health status differentials therein, when assessing a patient at risk for cardiovascular disease.

<u>Academia</u>

Dr. Leslie Spencer[17] conducted a study to determine the cardiovascular disease risk factors among college students. The primary purpose of this study was to provide normative data on CVD risk factors of traditional college students, as previous research has shown that college students do not have the most desirable health habits despite their indication of extensive knowledge of risk factors. 226 students participated in the study aging from 18 to 26, from a university in New Jersey. Participants filled out a survey regarding gender, ethnicity, age, heredity, tobacco use, diet, perceived stress level, alcohol consumption, then measures of blood pressure and cholesterol readings were taken. Overall, college students possessed several risk factors for heart disease.

Additionally, the students' unhealthy lifestyles were predictors of adverse cholesterol readings, which is a risk factor for CVD. Future studies should use a more random sampling technique to incorporate a more representative sample of the university.

Siegel et al.[18] conducted a worksite health promotion study to follow the effect of an obesity intervention program in elementary schools. There were a total of 16 schools that participated, 8 control and 8 for the intervention. Participants of the two-year study filled out a survey and were assessed for anthropometric data before and after the intervention. Researchers hypothesized that after the intervention group would have lower BMI and be more likely to significantly change diet and physical activity behaviors, than the control group. Data analysis showed that BMI was reduced over the two years in the intervention schools, and BMI of the individuals in the control group were slightly higher over the same two-year span. However there was no significant difference in fruit and vegetable consumption or physical activity, as evidence by data analysis from the IPAQ data. Overall there were moderate changes in health status. Future interventions should determine exactly which activities promoted the most change and focus on calorie intake adjustment rather than tracking diet using fruit and vegetable consumption.

Obesity has been steadily increasing, and the data tracking the occurrence of which is used as a method to track CVD prevalence in America. The aforementioned studies have detailed causes and solutions to decreasing this epidemic. It is important to educate patients on their risk factors as well as look holistically at all components of an individual's lifestyle and history to fully determine the interrelatedness of risk factors. Obesity is one of the risk factors for CVD as defined by the ACSM. Most notably, childhood obesity is predictive of adult obesity and subsequent coronary heart disease risk factors. Higher socioeconomic status in childhood is correlated with higher education of CVD risk factors. Research cites more interlinking variables to cardiovascular risk than just the seven factors outlined by the ACSM. Studies have shown that lifestyle components such as marital status, heart rate variability, number of generations in the United States and socioeconomic status, are all underlying causes to the more prevalent risk factors.

Not only has education and prevention of CVD risk factors been shown to be more effective starting at a young age, but clinician education and communication of risk is essential. When health care professionals can more clearly explain risk factors and their interrelatedness to patients, risk can be addressed and decreased more effectively with better understanding. The underlying causes of risk factors are an important point for clinicians to address if lifestyle change is the prescription for decreasing risk.

Living or spending considerable time on a university campus, there is lots of exposure and education about what a healthy lifestyle entails. But, research has shown that despite exposure to a healthy lifestyle, university students are at a potentially high risk for CVD. Students have shown knowledge of risk factors, but do not seem to practice the healthy behaviors they claim to know are beneficial. No specific studies have been conducted thus far to determine faculty perceptions of risk, and actual risk for CVD as they are exposed to the same healthy lifestyle as the university students. But there have been walking program interventions conducted for faculty at elementary schools. Based on these programs, it is clear that there is a known problem in the increasing obesity rates/CVD risk in the teaching as well as work force population.

Chapter 3

Methods

The purpose of the study was to determine cardiovascular disease risk factors in faculty at Cal Poly. The participants in the study made one appointment to come in for testing and evaluation to assess these potential risk factors (Figure 1). Subjects completed a questionnaire and CVD risk assessments were completed followed by a debriefing. The study was approved by the Cal Poly Human Subjects Review Board.

Participants were recruited via email at Cal Poly. Individuals who expressed interest in participating set up their one time appointment. In addition to the blanket faculty email, research assistants went door to door in the faculty office building to recruit and encourage participation using face-to-face interaction. Exclusion criteria was, based on the Physical Activity Readiness Questionnaire (PAR-Q), high risk for or from a heart condition. Participants who were not able to participate in the exercise assessment but were permitted to participate in the other assessments in the study.

Figure 1. Schedule of Activities

8:00am							9:00am
Consent forms, PAR-Q	Blood Pressure/ Heart Rate	Height/ Weight	Lipid Profile/ Glucose	Waist Circumference	Body Fat Analysis	Tread-walk Test	Debriefing

Participants came one time to the Human Performance Lab after having fasted for at least two hours prior to testing. Participants first completed a consent form, PAR-Q, and verbal health history questionnaire. Questions on the health history questionnaire included age, sex, activity level, and whether they were a smoker or not. At the conclusion of the verbal questionnaire, resting blood pressure and heart rate were assessed, followed by body weight and height measurements. A fasting blood sample (i.e. no food for 2 hours prior to blood draw) was then taken to assess a lipid profile (total cholesterol, HDL) and glucose concentrations. Quantitative assessment of glucose and lipids were determined using a Cholestech LDX Analyzer System. A finger stick blood sample was used for analyses, a specific testing cassette was used to for the desired lipid profile and glucose concentrations in the Cholestech machine. Results were available within five minutes after input into the machine. While the Cholestech Analyzer was reading the results of the lipid profiles, the participants' waist circumference was assessed, using a spring loaded tape measure. The measurement was taken two times, at the smallest circumference of the waist. To assess body fat percentage, a bioelectrical impedance analysis machine was used. A sub-maximal treadmill test (Treadwalk Test) was the final assessment. This test was conducted using three successive speeds and grades to achieve steady state heart rate to estimate maximal oxygen uptake (VO2 peak). At the conclusion of the test, participants were debriefed on their results. The primary researcher explained to the participant the significance of the outcomes of each of the assessments, additionally each of the seven risk factors for CVD were outlined and participants were shown which ones they were positive or at risk for according to the calculations. Participants were sent home with a copy of their results and a flyer detailing the risk factors for CVD.

Statistics could not be run on this study because there was no control or comparison group. The participants of the study were instead compared to the risk stratification guidelines outlined by the ACSM[6]. Participants were classified as low, medium or high risk for CVD both according to their individual data. The mean values of the group were also classified into one of the risk stratifications.

Chapter 4

Results

Twelve participants completed the study, seven males and five females (Table 1). Mean data showed that overall Cal Poly faculty are at a low risk for CVD. Mean data was below the risk threshold for CVD in all of the seven categories, and therefore put them at an overall low risk threshold for CVD.

The first risk factor, obesity, is defined as a body mass index (BMI) $\geq$30 or a waist circumference for women above 88cm or for men above 102cm. BMI and waist circumference are predictors of obesity. A BMI measurement above 30 constitutes obesity and therefore a high risk for CVD. A waist circumference for women above 102cm or above 88cm for men constitutes obesity. The mean BMI of the Cal Poly faculty was 24.3, which is low risk for CVD. However, the BMI ranged from 19.9 to 41, and individual data showed that 3 participants fell outside of the low risk stratification.

The other classification of obesity, waist circumference, is a measurement of the smallest point of the waist, in centimeters. The mean waist circumference of the Cal Poly faculty was 79.3 (low risk for CVD). However, the range was 64 to 101cm, and 3 subjects were at high risk for CVD.

	Mean	Range	Risk Stratification	Risk Threshold
n	12 (7M/5F)			
BMI (kg/m2)	24.344	19.9-41	Low	>30
Waist Circumference (cm)	79.33	64-101	Low	(M) >102cm (W) >88cm
BIA (% Body Fat)	24.7	5.8-40		

Table 1 – Subject Characteristics

This table indicates the breakdown of subjects (male and female). The following measurements, Body Mass Index (BMI), Waist circumference (WC) and bioelectrical impedance analysis (BIA) are indicated showing the group's mean, range of values, risk stratification of mean data, and threshold for high risk stratification for CVD.

Systolic blood pressure above 120 mmHg is considered a high risk for CVD. The pre-hypertensive classification is 120-129mmHg for systolic BP. Mean systolic blood pressure for Cal Poly faculty was 119mmHg. However, six individuals' systolic blood pressure qualified them to be in the high-risk stratification, above 120mmHg (Figure 2).

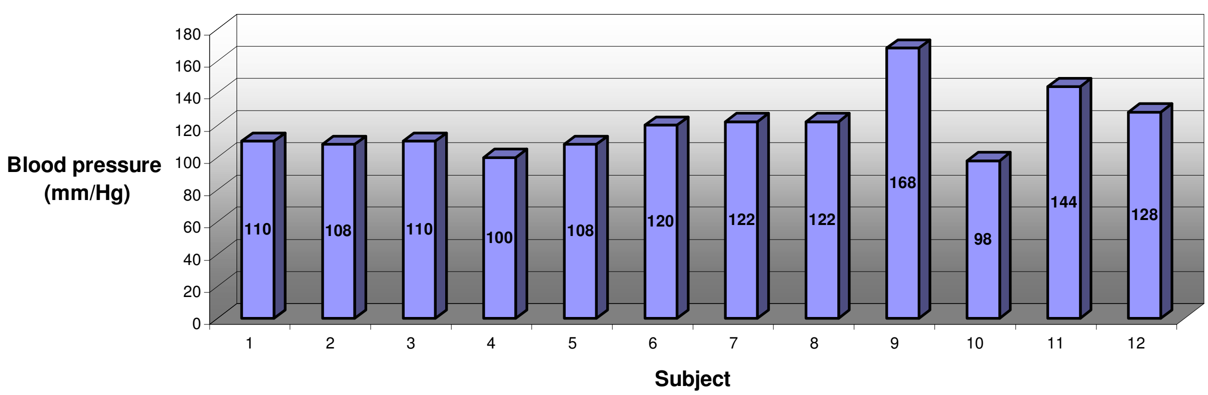

Figure 2 – Blood Pressure data
The X axis is individual data and the Y axis is systolic blood pressure. The green line indicates the mean of the group. The red line indicated the threshold above which individuals are considered at risk for CVD.

High-risk stratification for total cholesterol (TC) is defined as TC above 200mg/dL. Mean total cholesterol was 173mg/dL, with a range of 140-224mg/dL. Two individuals had cholesterol readings at or above 200mg/dL, putting their individual data at high risk for CVD. But, overall the Cal Poly faculty were at low risk for CVD.

High density lipoprotein (HDL) was another measurement that the Cholestech System Analyzer measured; it is a component of total cholesterol. But, having a high HDL measurement is desirable, and therefore a negative risk factor for CVD. Individuals possessing high HDL, above 60mg/dL, negate one of the positive risk factors for CVD.

Mean HDL was 51mg/dL, ranging from 35 to 69mg/dL. Two of the participants had HDL levels at or above 60mg/dL; those are the only two individuals who negate one of their positive risk factors.

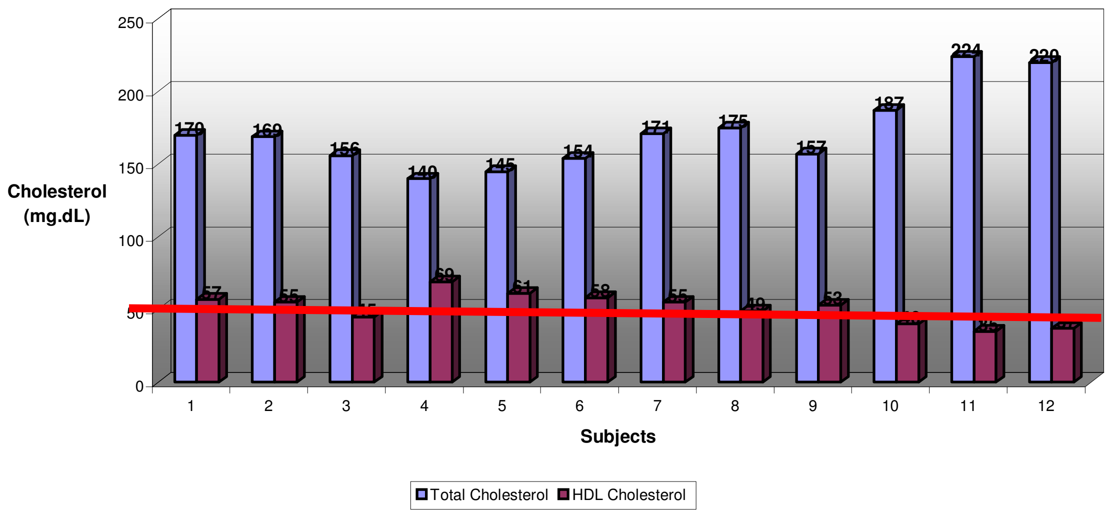

Figure 3– Total Cholesterol and HDL Cholesterol Data

This graph indicates individual participants' total cholesterol (TC) in blue, as well as their high density lipoprotein cholesterol (HDL) in maroon. The green lines indicate the mean TC and HDL for the group. The top red line indicates the point above which individuals are considered at high risk for CVD. The bottom red line indicates the point above which individuals are considered as having a negative risk factor for CVD.

Glucose concentration greater than or equal to 90mg/dL is a high risk factor for CVD. Mean fasting glucose concentrations were 103mg/dL, with data ranging from 84 to 152mg/dL. Ten of the participants had glucose concentrations above 90mg/dL.

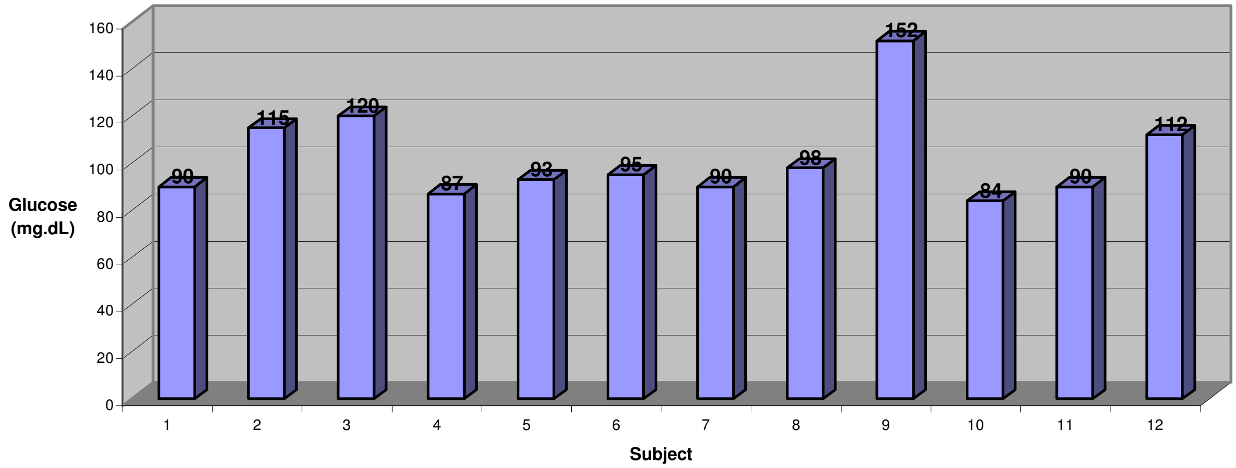

Figure 4 – Individual Glucose Data

This figure indicates individual glucose measurements for each participant. The green line indicates the mean glucose of the group of participants. The red line indicates the point above which individuals are considered at high risk for CVD.

Questionnaire results showed that two of the individuals had a family history of CVD. This is defined as having a first-degree relative die of a heart related condition, males before the age of 55, and females before the age of 65. As a group Cal Poly faculty are at low risk stratification for the risk factor of family history for CVD; two of the participants had a first-degree male or female relative die before the age of 55 or 65, respectively. None of the participants were current or previous cigarette smokers, therefore the faculty group as a whole is at low risk for that CVD factor.

Sedentary lifestyle is a risk factor for CVD[6]. The American College of Sports Medicine (ASCM) defines guidelines that everyone should meet in order to decrease their risk of disease and disability, most namely CVD. In 2007 the updated guidelines recommended that adults exercise at a moderate intensity (50-80% of max HR) 30 minutes a day, five days per week or exercise at a vigorous intensity (greater than 80% of max HR) for 20 minutes a day, three days per week in addition to strength training 2 days a week and flexibility exercises daily. Eight participants met the criteria for an active lifestyle, and four participants met the criteria for a sedentary lifestyle. The four individuals who led a sedentary lifestyle qualified to be at high risk for this particular risk factor. Overall, the mean of the group is at low risk for CVD for the physical activity risk factor.

	Mean	Range	Risk Stratification	Risk Threshold
Smoker (Yes/No)	No	0Y/12N	Low	Yes
Family History (Yes/No)	No	2Y/10N	Low	Yes
Activity (≥5 days/wk, ≥35min)	Yes	8Y/4N	Low	No

Table 2 – Questionnaire Data

Three CVD risk factors are concluded in this table, smoking, family history, and physical activity. For each the mean, range of answers, risk stratification of the group and high-risk threshold are indicated. Each of the questions required a yes or no answer.

Chapter 5

Discussion/Conclusion

The purpose of the study was to assess cardiovascular disease risk factors and health status in faculty and staff at Cal Poly. It was hypothesized that participants would be at a low risk for CVD based on their exposure to an academic setting and healthy lifestyle. The main findings were, in general, Cal Poly faculty were at low risk for CVD. However, individual data showed that some participants were at moderate to high risk for CVD. Despite the setting of high exposure to positive health benefits, faculty and staff were still at risk.

Other studies have not specifically researched cardiovascular health status of faculty and staff in a university setting. Additionally no studies have been conducted to compare university student versus faculty risk for CVD. There have been school-based worksite health promotion studies conducted with the goal of improving health status of the faculty[18]. But, no studies of that nature have assessed specific risk factors for CVD, just overall wellness. Studies have been conducted to determine the CVD risk factors of college students, as they claim extensive health knowledge, but show poor health habits[17].

A limitation in this study was that participants did not adhere to a true fasting glucose protocol; participants only fasted for a minimum of two hours prior to testing. Because glucose concentrations are sensitive to recent food (carbohydrate) intake, the high fasting glucose concentration in this study may have been an artifact of recent food intake and may not be indicative of a 'clinical' condition. A true fasting glucose would have participants fast for 8-10 hours before testing glucose levels, which will yield more accurate and conclusive data [19]. Also, future research should have a comparison group to compare this data too. In the current study, statistics could not be evaluated on the data collected because there was no comparison group, for example Cal Poly students.

As more and more individuals are going back to school for a degree in higher education, universities are a prime target for students and faculty to be educated, and learn to prevent the risk for CVD. Potential researchers interested in studying CVD risk factors should employ health promotion tactics and procedures to incorporate key decision leaders into the program to stimulate other faculties' interest and participation in the program. Future directions from this study include collection of more data to facilitate an intervention and subsequent health promotion program for all university faculty and staff, with the idea of decreasing or preventing the risk for CVD.

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