



Original Research

Lifestyle Choices and Risk of Developing Cardiovascular Disease in College Students

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ABSTRACT

International Journal of Exercise Science 15(2): 808-819, 2022. The purpose of the study was to examine and evaluate the cardiovascular risk factors in college students including their nutritional and social choices and how those choices related to their cardiovascular health. A descriptive, cross-sectional study of 148 college students, obtaining their blood pressure, body mass index, fasting lipid panel, fasting glucose, hemoglobin A1c, serum cotinine levels, physical activity, alcohol consumption, and dietary habits. A high prevalence of cardiovascular disease risk factors was found: 23.8% were current or past smokers with more male than female smokers ($p = .009$); 65.5% consumed alcoholic beverages; 13.5% had elevated blood pressure; 25.7% had hypertension stage I; 3.4% had hypertension stage II; 36.5% were overweight while 19.9% were obese; 14.2% had prediabetes and 2% had diabetes; and 40.5% had borderline high cholesterol levels while 3.4% had hyperlipidemia. Elevated blood pressure and hypertension were most prevalent between the ages of 18 and 23 years and among males ($p = .001$). The top three risk factor co-occurrences were overweight and drinking alcohol (33.78%), followed by family history of heart disease and drinks alcohol (27.70%), and overweight and history of heart disease (25.68%). Of the 148 participants, 108 of them had at least two cardiovascular risk factors. The results of this study indicate that college students participate in risky behaviors that predispose them to develop CVD in the future.

KEY WORDS: Risk factors, cardiovascular risk factors, young adult, blood pressure, obesity

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in both men and women in the United States of America (USA) (5). Between 2011 and 2012, it was estimated that CVD cost the USA an average of \$317 billion (5). Despite the cost, an estimated 610,000 American adults die of CVD every year; 1 in 4 deaths are caused by CVD (5). Most studies focus on reducing the incidence of CVD in adults in general while the risk of CVD in college students ages 18-24 years is underestimated despite a high prevalence of risk factors in this age group (1, 3, 30). As they gain their independence and establish adult identities and behaviors, college students may participate in unhealthy behaviors including poor dietary habits, excessive weight gain, alcohol consumption and tobacco use, poor sleeping pattern, and lack of exercise (3, 12).

For this population, these behaviors may be considered benign, a rite of passage, and transitional, nonetheless increasing the college students' lifetime risk for developing CVD (1, 3, 30). Navigating through the "rite of passage" of college life can result in many lifestyle changes that may have a long-lasting impact on their future health (28). Furthermore, over 50% of college students in the USA have at least one CVD risk factor (3). Unfortunately, these college students are generally unaware that their behaviors predispose them to developing CVD in the future (3, 17). According to Fernandes et al. (2011), there was a significant difference in trends of increased calorie intake and physical inactivity among college students, especially first-year students, compared to non-college young adults (7). Specifically, Nair et al. (2016) studied 970 college students and found that 40% smoked tobacco regularly, 37.8% participated in binge drinking, 71% ate fried foods regularly, and 45.8% led a sedentary lifestyle (22). These findings aligns with Oppenheimer (2010), which identified risk factors for CVD to include smoking, obesity, physical inactivity, hyperlipidemia, hypertension, and diabetes (25). Several studies have shown that approximately 33% of college students were overweight or obese (7), 47% had elevated blood pressure (BP) (15), 18% had high triglycerides (7), 53% had elevated low-density lipoprotein cholesterol (LDL-C) (7), 20% had low high-density lipoprotein cholesterol (HDL-C) (7), and 27% had at least one component of metabolic syndrome (15).

Studies have found that young adults in college have significantly higher risk for developing CVD than they are unaware of (3, 6, 17, 28). Sarpong et al. (2017) found that over a period of 10 years, awareness of CVD risks increased in adults over the age of 40 but was lower in college students (28). Fortunately, Sarpong et al. (2017) indicated that multiple years in college and a career in the health profession improved the level of awareness (28). Tran et al. (2017) found that despite access to information, resources, and knowledge of CVD risks, college students continued to underestimate their CVD risks (30). The literature supported that college students have high CVD risks and that the prevailing CVD risk factors among this group of young adults are being overweight and physically inactive (4, 12, 30). Despite this understanding, there is a scarcity of information on mitigating CVD risks factors in college students. Therefore, it was worthwhile to examine and evaluate the cardiovascular risk factors in a small sample of college students including their nutritional and social choices and the choices related to their cardiovascular health. This will create awareness with this population and influence the development of interventions to mitigate their CVD risks.

METHODS

Participants

We examined CVD effects on college students' social choices using a cross-sectional, descriptive study. We recruited college students between ages 18 to 39 years old using a convenience sample at a Southwestern university. We recruited from March 2017 to September 2017 at the University Health Center using research flyers around the campus and media platforms. The study inclusion criteria were students at the recruited university who were between the ages of 18 to 39 with no known history of CVD or events, and not currently pregnant or lactating. We excluded students who were diagnosed with CVD such as myocardial infarction, stroke, or

coronary heart disease and women who were pregnant or think they might be pregnant. We recruited 195 students; however, only 148 students met all the inclusion criteria. Institutional Review Board approval was obtained from the recruited university (#953581) and all the participants signed the informed consent prior to participating in the study. This work adheres to the ethical practices relating to the responsible conduct of research (23).

Protocol

The following questionnaires were completed by all participants: socio-demographic, physical activity, and alcohol consumption. The socio-demographic questionnaire consisted of past and present medical history, smoking status, and three brief questions regarding their dietary habits. The Physical Activity Questionnaire contained seven open-ended questions on physical activity. The Alcohol Intake Questionnaire (AIQ) included information about alcohol consumption such as quantity, frequency, and binge drinking. The AIQ is a 20-item tool with 6-items on binge drinking and has good psychometric properties to detect high-risk or binge drinking (25).

We collected height and weight to calculate body mass index (BMI), fasting lipid panel (total cholesterol, LDL-C, HDL-C, and triglycerides), fasting glucose, hemoglobin A1c, serum cotinine levels, and resting BP. The participants rested for at least five minutes before two BP readings were taken and averaged.

Statistical Analysis

Analyses were performed using IBM SPSS version 24 (IBM Corp, Armonk, NY). All data were reported as mean \pm SD, with $p < .05$ considered significant. A test of normality was performed on continuous variables and all the variables deviated from normal distribution except the systolic BP and total cholesterol. All the variables had at least 95% of the completed data. Cross tabulations (contingency table) and chi-square tests were performed to examine relationships on sex and the risk factors. Mann-Whitney U tests were performed on nonparametric variables to determine the significant differences between sample means. Additionally, co-occurrence of cardiovascular risk factors was evaluated using frequencies of each unique pattern of risk factors. We used the G*Power 3.1.5 to estimated that the required sample size of a total of 150 college students was needed to achieve power. This sample size had sufficient power to answer the research purpose with 0.08 in power and 0.23 effect size.

RESULTS

A total of 195 participants were recruited; however, only 148 participants completed the study for this analysis. As indicated in Table 1, the participants' race and sex were fairly distributed, 36.5% white and 59.5% female. The mean age for the participants was 24.39 ± 4.58 , and most of the participants were between ages 18 and 23 years (62.8%), working on their bachelor's degree (53.4%), single (77.7%), and had insurance coverage (91.9%; Table 1).

Table 1. Sample demographic characteristics ($N = 148$).

Variables	Freq (%)
Age	
18-23	91 (62.8)
24-29	44 (30.3)
30-36	10 (6.9)
Female	88 (59.5)
Race/Ethnicity	
White	54 (36.5)
Asian/Pacific Islander	46 (31.1)
Hispanic/Latino	15 (10.1)
Black or African-American	12 (8.1)
More than one race	18 (12.2)
Other	3 (0.2)
Marital status (Single)	115 (77.7)
Educational level (Bachelor's)	79 (53.4)
Insurance coverage (Yes)	136 (91.9)

Data related to cardiovascular risk factors including smoking status, BP, overweight or obesity, glucose and hemoglobin A1c, lipid panels, alcohol consumption, physical activity, and dietary habits were collected for analysis. Information on alcohol consumption, physical activity, and dietary habits were collected based on self-report, and the remaining cardiovascular risk factors were measured. We found that 44.6% of participants reported having a family history of heart disease (Table 2), and no statistical significance was found between males versus females.

Participants' smoking status was obtained through self-report from the socio-demographic questionnaire in addition to collecting their serum cotinine level. Through self-report, 76.2% of participants reported having never smoked and 23.8% reported being a current or past smoker. Among the participants that reported being a current smoker (6.1%), 90% reported smoking less than one pack per day, and the main forms of smoking were cigarettes, Hookah, e-cigarettes, and marijuana. We found that 5.4% of participants' serum contained a cotinine level of more than 2 ng/mL, indicating their smoking status as current. There was a significant difference between males vs. females smoking status ($p = .009$), there were more male smokers (13.6%) compared to females (9.5%).

Two BP readings were taken and the average of the two BP readings was used to evaluate their BP levels. The mean systolic BP was 116 mm Hg and diastolic BP was 73 mm Hg. The systolic BP ranged from 85 to 150 mm Hg and diastolic BP from 54 to 111 mm Hg. According to the Blood Pressure Clinical Guidelines (31), 13.5% of participants had elevated BP (systolic BP 120-129 mm Hg and diastolic BP < 80 mm Hg), 25.7% had hypertension stage I (systolic BP 130-139 mm Hg or diastolic BP 80-89 mm Hg), and 3.4% had hypertension stage II (systolic BP \geq 140 mm Hg or diastolic BP \geq 90 mm Hg). When we performed a cross-tabulation of the participants' age and BP levels, we found the majority of participants that had elevated BP (20.63%) and hypertension (27%) were between the ages of 18 and 23 years. A Mann-Whitney U test demonstrated that there was a significant difference between males and females in regards to

the systolic and diastolic BP ($p = .001$); males had a higher mean rank compared to females (systolic BP 96.77 vs. 58.73; diastolic BP 88.25 vs. 64.44).

Table 2. Descriptive statistics of CVD risk factors.

CVD Risk Factors	Freq (%)	Males Freq (%)	Females Freq (%)
Family history of heart disease	66 (44.6)	28 (18.9)	38 (25.7)
Smoking status*			
Current/past smoker	35 (22.6)	20 (13.6)	14 (9.5)
Never smoked	112 (75.7)		
Weight status (BMI)			
Underweight	3 (2.0)		
Normal	63 (42.6)	39 (26.5)	73 (49.7)
Overweight	54 (36.5)		
Obese I	12 (8.1)	0	3 (2.0)
Obese II	16 (10.8)	21 (14.2)	42 (28.4)
Hypertensive status*		24 (16.2)	29 (19.6)
Normal	85 (57.4)	6 (4.1)	6 (4.1)
Elevated BP	20 (13.5)	8 (5.4)	8 (5.4)
Hypertensive stage I	38 (25.7)		
Hypertensive stage II	5 (3.4)	21 (14.2)	63 (42.6)
Diabetes status ^a		14 (9.5)	6 (4.1)
Normal	124 (83.8)	20 (13.5)	18 (12.2)
Prediabetic	21 (14.2)	4 (2.7)	1 (0.7)
Diabetic	3 (2.0)		
Hyperlipidemia		50 (33.8)	73 (49.3)
Normal	83 (56.1)	8 (5.4)	13 (8.8)
Borderline high lipid.	60 (40.5)	1 (0.7)	2 (1.4)
High lipid	5 (3.4)		
Alcohol status		28 (18.9)	55 (37.2)
Non-drinkers	51 (34.5)	29 (19.6)	30 (20.3)
Alcohol drinkers	97 (65.5)	2 (1.4)	3 (2)
Binge drinkers	31 (32.0)		
Dietary status		21 (14.2)	30 (20.3)
Eat out daily	20 (13.5)	38 (25.7)	58 (39.2)
Drink sugary drinks daily	17 (11.6)	12 (31.6)	19 (32.8)
Eat red meat daily	15 (10.1)		
Physical activity status			
Moderate physical activity	101 (68.2)		
Sedentary	68 (46.0)		

Note: BMI - body mass index; BP blood pressure, ^aHemoglobin A1c & Fasting glucose

*Significant differences between males vs females

Height and weight were measured using a stadiometer. The mean height (inches) was 66.35 ± 3.82 , ranging from 59 to 77 inches. The mean weight (pounds) was 165.87 ± 42.60 , ranging from 110 to 315 lbs. Using the height and weight to calculate BMI, the mean BMI was 26.27 ± 5.29 , ranging from 17.70 to 41.40. When categorizing the participants' BMI, 2.0% of the participants were underweight (BMI < 18.5), 42.6% were within normal weight (BMI 18.5-24.9), 36.5% were

overweight (BMI 25-29.9), and 19.9% were obese (BMI \geq 30). A chi-square test demonstrated that there was no significant difference between sex and BMI.

We evaluated diabetes status by collecting fasting glucose level (fasting for at least nine hours) and hemoglobin A1c. The mean fasting glucose was 88.72 ± 17.15 , ranging from 60 to 214. Mean hemoglobin A1c was 5.33 ± 0.47 , ranging from 4.4 to 9.0. Using the fasting glucose and hemoglobin A1c levels, we found that 14.2% of participants had prediabetes and 2% had diabetes. There were no significant differences between males and females on diabetes status.

Fasting lipid panel was collected for all participants. Mean total cholesterol was 166.55 ± 31.20 , ranging from 98 to 284; mean LDL-C was 93.83 ± 26.86 , ranging from 35 to 215; mean HDL-C was 54.84 ± 14.68 , ranging from 22 to 100; and mean triglycerides was 89.15 ± 56.98 , ranging from 11 to 541. We were unable to calculate the LDL-C in one of the participants because they had the highest triglycerides level at 541. All the participants mean cholesterol levels were within normal limits; however, 40.5% of the participants had borderline high cholesterol levels while 3.4% of the participants had hyperlipidemia. There were no differences between lipid panels and sex among this sample.

We used the AIQ to detect high-risk or binge drinking related to cardiovascular risk factors (24, 26). We found that 65.5% of participants reported drinking alcoholic beverages 1-2 days per week. Of these drinkers, 35.1% of them reported having a history of alcohol abuse in their family and 37.1% reported having previously blacked out after drinking. Participants reported that when they drank, they would typically consume about three drinks, and on average, the largest number of drinks consumed on any occasion during the past 30 days was four and as high as 25 drinks. On average, those that reported drinking alcohol had been drinkers for approximately two years. According to Piano and colleagues (24, 26), binge drinkers are defined as having four or more drinks for females and five or more drinks for males at least twice within the past 30 days. From our sample of college students that drank alcohol (97 participants), 32.8% females and 31.6% males drank 4-5 drinks on more than two occasions in the last 30 days, making them binge drinkers. However, based on the chi-square test, there was no significant difference found between males and females in regard to binge drinking.

We used the Physical Activity Questionnaire to assess and evaluate each participant's physical activity level. Seven questions pertained to the type and frequency of the physical activity. We found that 76% of participants reported participating in some form of physical activity and on average spent around two days per week with an average of 48 minutes per day. Approximately 68.2% of participants reported performing some form of moderate level physical activity, spending around two days per week with an average of 36 minutes spent per day. During the last seven days, 48.8% of participants reported walking at least 10 minutes and 16.2% of them reported walking at least 10 minutes per day, five days per week.

The socio-demographic questionnaire contained three questions about dietary habits: frequency of eating out, drinking sugary beverages, and eating red meat. We found that 55.8% of

participants reported eating out at least two to three times per week and 13.6% reported eating out daily. Nearly half of participants (41.1%) reported drinking sugary beverages at least once per week while 11.6% reported drinking sugary beverages daily. Similarly, 41.9% of participants reported eating red meat at least once a week and 10.1% reported eating red meat daily.

All the cardiovascular risk factors (except for physical activity and dietary habits) were examined for co-occurrence and the top three co-occurrences were overweight and drink alcohol (33.78%), followed by family history of heart disease and drink alcohol (27.70%), and overweight and history of heart disease (25.68%). Of the 148 participants, 108 of them had at least two cardiovascular risk factors (Table 3).

Table 3. Co-occurrence of cardiovascular risk factors.

Risk Factors	<i>n</i>	% of sample
Overweight & Drink Alcohol	50	33.78%
Drink Alcohol & Hx Heart Disease	41	27.70%
Overweight & Hx Heart Disease	38	25.68%
Overweight & Hypertension	33	22.30%
Smoking & Drink Alcohol	31	20.95%
Hypertension & Drink Alcohol	25	16.89%
Hypertension & Hx Heart Disease	20	13.51%
Overweight & Smoking	19	12.84%
Smoking & Hx Heart Disease	15	10.14%
Hypertension & Smoking	11	7.43%
Hypertension & Hyperlipidemia	4	2.70%
Overweight & Hyperlipidemia	4	2.70%
Hyperlipidemia & Drink Alcohol	3	2.03%
Hyperlipidemia & Hx Heart Disease	3	2.03%
Diabetes & Overweight	3	2.03%
Diabetes & Hx Heart Disease	3	2.03%
Hypertension & Diabetes	3	2.03%
Smoking & Hyperlipidemia	2	1.35%
Smoking & Diabetes	2	1.35%
Diabetes & Drink Alcohol	2	1.35%
Hyperlipidemia & Diabetes	1	0.68%

Note: *n* = 108 had two or more risk factors; overweight includes overweight and obese; Hx Heart Disease, family history of heart disease

DISCUSSION

There is growing concern regarding the incidence of CVD in the USA. Risk factors among college students in the USA can predispose them to developing CVD later in life. Identifying those risk factors can guide the development of preventive measures that can reduce the incidence of at-risk college students developing CVD in the future. The results of this study contribute to the literature on the prevalence of CVD risk factors amongst college students.

Among the college students that participated in this study, less than half were within normal weight. A significant number were either obese (19.9%) or overweight (36.5%). It is concerning that more than 50% of these students are overweight or obese because it places them at a higher risk for CVD (1, 7, 8). A possible explanation for weight problems in college students can be attributed to alcohol consumption, poor dietary habits, and a sedentary lifestyle. The results from this study are similar to others (1, 7, 8, 16).

Additionally, this study found that most participants reported that they had never smoked, while 6.1% reported being current smokers. However, serum cotinine levels indicated that only 5.4% were current smokers. This discrepancy between self-reported smoking status and measured serum cotinine levels may be because some of the students participate in smoking substances (like marijuana) that do not have cotinine levels as a precursor. Nonetheless, studies show that smoking (tobacco, electronic cigarettes, and marijuana) place individuals at risk for developing CVD in the future (9, 14, 20, 28).

Using the recently published Blood Pressure Clinical Guidelines (31) 25.7% of the participants were categorized as having hypertension stage 1, 3.4% hypertension stage 2, and 13.5% had elevated BP. Surprisingly the college students that were identified by the new guidelines (31) as hypertensive or having elevated BP were between the ages of 18 and 23. This is contrary to what is hypothesized for this population. Several studies support that hypertension prevalence increases with age (2, 31), yet our study found a higher prevalence of hypertension in the younger group. This finding may be an indication that younger people are developing CVD risks sooner than believed. Of note, our study also demonstrated that there are statistically significant differences between males versus females in regards to blood pressure and smoking status, males are at increased risk for elevated blood pressure and more often smoking than females. This is not surprising given there is supporting literature that demonstrates males are at increased risk during young adulthood because females have hormonal protective characteristics (18).

For diabetes status, we found that 14.2% of participants had prediabetes and 2% had diabetes. This is not surprising as one would expect from this population because of their unhealthy dietary practices, being overweight or obese, and lack of physical activity (29). Even though the average fasting glucose and hemoglobin A1c levels categorized the participants at low risk for diabetes, having prediabetes is a precursor for the development of diabetes, which can increase the risk of developing CVD by 13% (13).

The lipid panel results showed that 40.5% of participants had borderline high cholesterol levels, while only 3.4% had hyperlipidemia. Despite the mean cholesterol levels of all the participants being within a normal range, it is still concerning that almost half of the participants had borderline high cholesterol levels. Having borderline high cholesterol levels predisposes these students to develop hyperlipidemia, which is a risk for developing CVD, especially when combined with hypertension and smoking (10, 11).

This study also found that the participant's personal habits placed them at a higher risk of developing CVD. The AIQ demonstrated that 33.3% of the female college students and 29.7% of male college students were binge drinkers (26). This is consistent with other study findings (16, 19, 21). Specifically, it was found that approximately 75% college students identified as alcohol drinkers (17), while 61% were binge drinkers (19). Whereas, another study (21) found that 25% of college students participated in heavy episodic drinking at least once a month. This is staggering, yet, given this population, this may also be under reported.

A good number of participants in our study reported physical inactivity and poor dietary choices. Surprisingly, we expected this number to be higher. Previous studies documented a prevalence of poor eating habits, alcohol use, and physical inactivity among college students (1, 7, 15). For example, one study found that 39.6% of college students mainly consumed a fatty diet (1) while another found that first-year college students gained weight 11 times faster than other adults due to physical inactivity and increased caloric intake (7). Another study found that 37.8% of students admitted to binge drinking (22). The lower incidence in our study could be explained by the lack of sophistication of the questionnaire tool used in this study to avoid participant burden. Nonetheless, binge drinking, inactivity, and poor eating habits are precursors for developing risk factors for CVD (5).

Overall, our study showed that many college students participate in activities and behaviors that put them at risk for developing CVD in the future. Many of the participants lead a sedentary lifestyle, have poor dietary habits, smoke, and consume alcohol excessively. Particularly, the three common cardiovascular risk factors that co-occurred were overweight/obese, drink alcohol, and family history of heart disease. The risk factors have been identified as contributing to the development of CVD (7, 24). Consequently, if students are educated on CVD risks, encouraged to make healthy choices, and are routinely screened for CVD risks, their risk of developing CVD in the future may be decreased or potentially eliminated.

The following limitations were identified in this study. First, we used a convenience sample from one university; therefore, generalizability is limited. Nonetheless, this is one of the most ethnically diverse universities to recruit. Secondly, some variables of the study relied on a self-reported survey tool, which lacks reliability and validity testing in college students; however, it still provided valuable data. Thirdly, we did not assess stimulant medications or beverages that may potentially increase students' blood pressure that are commonly consumed in this population. This study does not consider the role of stress on the college students' CVD risks. We did not perform a 24-hour dietary recall, and did not use a validated tool when asking about physical activity; therefore, we recognize limitations in interpreting data related to these variables. Future research is necessary to examine the role of stress on college students' behaviors and social choices and consequently CVD risks.

Despite the limitations, this study contributes to the establishment of the prevalence of risk factors for the development of CVD amongst college students. However, some college students may not be cognizant of the health implications from their social behaviors. Knowledge and

awareness are important components in the prevention of CVD. This study aims to increase awareness for CVD risk factors among college students and the need for health screening and education programs to identify risks, promote healthy behaviors, and prevent future development of CVD. Health care providers especially nurses in college health care centers should be aware of CVD risk factors in college students, implement risk assessment, and therefore, be able to provide education to minimize or potentially eliminate high risk behaviors in this population. If CVD risks are mitigated early in college students, it may decrease the incidence of CVD in the future. Importantly, further research in the prevention of risk factors and improving risk awareness in college students may have impactful health outcomes.

This study indicates the prevalence of risky behaviors that college students participate in such as smoking, alcohol consumption, poor dietary habits, and physical inactivity; and these behaviors have been identified as risk factors for developing CVD. Unfortunately, most college students are unaware of the health sequelae of these CVD risk behaviors. To prevent the future development of CVD in college students and decrease the overall incidence of CVD in the USA, it is imperative to establish CVD risk awareness and prevention during this important adulthood transition. Colleges and universities health centers play a vital role in the promotion of prevention of CVD for this particular population. Outside healthcare practices have limited opportunity to see these students compared to college and university health centers. Action such as implementing education programs and cardiovascular risk factors assessment specific to preventing CVD risks may be effective in this population. Additionally, college campuses should consider eliminating poor nutrition foods in college cafeterias, providing creative exercise programs to attract students, and incentivize healthy habits, to encourage students to participate in healthy behaviors.

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