Coronary Heart Disease Risk Factors Among Tri-Ethnic College Students
S Koutoubi, F Huffman

Abstract
Objectives: The present study identified and compared Coronary Heart Disease (CHD) risk factors quantified as "CHD risk point standards" among tri-ethnic (White non-Hispanic [WNH], Hispanic [H], and Black non-Hispanic [BNH]) college students.

Methods: Three ethnic groups of college students completed the Cardiovascular Risk Assessment Instruments, and had blood pressure readings recorded. Blood sample was collected and blood lipids were measured. Data were analyzed by gender and ethnicity using one-way Analysis of Variance (ANOVA).

Results: On the average, college students were below-average risk of developing CHD. Males scored significantly (p >0.013) higher than females and BNHs scored significantly (p > 0.033) higher than WNHs. A significant ethnic difference (χ² = 10.74, p > 0.030) was found with 38.4% of the BNHs being in the "fair" to "very poor" categories as compared 23.3% of the Hs and 20.0% of WNHs.

Conclusions: Our findings indicate strong gender and ethnic differences in CHD risk factors among college-age population.

INTRODUCTION
Coronary heart disease (CHD) is the leading cause of death in the United States. Among American adults ages 20 and older, the estimated age-adjusted prevalence of CHD is higher for Blacks, followed by Hispanics and Whites. Strong ethnic differences in CHD risk factors have been shown among young adults in a large national sample. Clinical studies on cardiovascular diseases are rare before the third decade of life. Autopsies performed on young men killed in the Korean and Vietnam Wars indicated grossly visible lesions in the coronary arteries. The Bogalusa Heart Study demonstrated the presence of aortic fatty streaks in teens autopsied after non-cardiac related deaths. New evidence from the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group, revealed dramatic and early differences in atherosclerosis between those with good and bad risk factor profiles. The differences appeared by age 15. This evidence indicated that atherosclerosis begins in early adulthood, and plaques, an advanced form of fatty streak, can be found in the arteries and coronary vessels of children and adolescents. Coronary heart disease risk factors can be quantified as "CHD risk point standards," which can provide a quantitative interpretation. Coronary heart disease risk increases with age and with a positive family history of premature CHD; furthermore, premature CHD is a very important risk factor. Some studies found that African-Americans were more likely to suffer and die of CHD than any other minority groups or Whites. Smokers' CHD risks are two to four times higher than those of nonsmokers. Nationwide, 74.8% of college students had tried cigarette smoking. White students were significantly more likely to report such behavior than Black and Hispanic students. Individuals with higher cholesterol levels die at an early age, while those with lower cholesterol levels lived longer. Lack of physical activity is another risk factor for...
CHD. Only 37.6% of college students had participated in a vigorous physical activity at least three of seven days preceding their survey. Obesity is a significant risk factor linked to CHD. Approximately 21% of college students are classified as being overweight. Black students were more likely to be overweight than Whites and Hispanics (11). Obesity at the age of 18 was positively correlated with the risk of CHD in middle age. 

An observational review of 14 studies in Medline found that both life stress and social support have an influence on CHD, with social support being a more significant factor than life stresses. In the United States, approximately 50 million or one in four adults have high blood pressure. In 1997, Blacks and Whites in the Southeastern United States had a greater prevalence of HBP and higher death rates from stroke than did those in other regions of the country. When HBP exists with high blood cholesterol, diabetes, inactivity, smoking, and obesity, the risk of CHD increases several-fold. Healthy People 2010 recognizes the need to investigate CHD risk factors because studies of CHD in young men and women are lacking. Healthy People 2010 targets for CHD were not met, and the disparities between African-Americans and Whites were not reduced. Data are needed to determine ethnic variations in the risk factors for CHD among college students. The college years are important, since many students develop eating habits that become long-term lifestyle patterns and beliefs that help explain these habits. Therefore, it is important to learn when ethnic differences for CHD risk factors are first apparent so that preventive interventions can be initiated before unhealthy lifestyles are established. The main objective of the study was to identify, determine and compare CHD risk factors, quantified as “CHD risk point standards” for a tri-ethnic (White non-Hispanic, Hispanic, and Black non-Hispanic) college population. The specific objectives of the study were to (1) Identify the prevalence of CHD risk factors and quantify “CHD risk point standards” and (2) Compare and contrast CHD risk factors and total “CHD risk point standards” by gender, ethnicity, and gender-ethnicity subgroup.

METHODS
SUBJECT RECRUITMENT AND SELECTION
Three hundred college students at Florida International University (FIU) were recruited to participate in the study. Subjects were recruited to represent six groups based on their gender and ethnicity. Two methods of subject recruitment were used: 1) Flyers with the study outline with inclusion and exclusion criteria, benefits, and investigator's phone number were distributed and posted by the investigators at FIU campuses in areas where students congregated. 2) Students in large classrooms with diverse majors and backgrounds were also approached. Subjects who met the inclusion criteria and agreed to participate in the study were asked to report to the investigator's laboratory on campus to take part in the study. Only one visit was necessary to collect all of the required data; and the entire process took approximately 60 minutes.

Subjects who were interested in participating in the study signed an informed consent form, approved by the FIU Institutional Review Board (IRB), before all tests were performed. Subjects' recruitment continued until the required number of subjects was reached. According to Cohen (Statistical Power Analysis for the Behavioral Sciences, 2nd Edition, 1988, Lawrence Erlbaum Associates, Hillsdale, NJ), an Analysis of Variance (ANOVA) using an alpha = 0.05 sample size of 50 for each of the six gender/ethnic groups would detect a “medium” effect size of 0.25 for the main effects of gender, ethnicity, and the interaction effect with a power of 98% or more.

Based on the assumption above, the total sample size was determined to be n=300 students. Subjects who volunteered to participate in the study and met the following criteria included College students at FIU during 1999-2000, had age less than 40 years, males and females, any major (except nutrition major), and originate from one of the targeted tri-ethnic groups, that is, Hispanic, Black non-Hispanic, and White non-Hispanic origin.

DATA COLLECTION
All subjects were required to complete the Cardiovascular Risk Assessment Instruments (CRAIs) when they reported to the Human Nutrition Laboratory on campus. The CRAIs contained a socio-demographic questionnaire which included information regarding age, gender, weight, height, race and ethnic background, the student's class level and major, how long the student has lived in the United States, and if the student took any college nutrition classes prior to the study.

The Cardiac Risk Evaluation Questionnaire (CREQ) was used to measure CHD risk factors. Measured risk factors were quantified as “CHD risk point standards,” which provided a quantitative interpretation of the risk factors of age, race, gender, diabetes, smoking, high blood pressure,
Coronary Heart Disease Risk Factors Among Tri-Ethnic College Students

high blood cholesterol, physical inactivity, obesity, and high stress level. The questionnaire also included the participant’s family history of heart disease, personal history of heart disease, personal and family histories of diabetes, smoking habits, behavioral style and activity levels. A fasting blood sample was drawn from the antecubital vein, using sterile, standard techniques, with the subject in the sitting position.

A 15 ml fasting blood sample was collected by venipuncture by the investigator, a trained phlebotomist. The blood sample used for the preparation of serum was collected into a vacutainer tube. After the blood in the Serum Separator Tube (SST) had been completely coagulated, that is after a 30-minute waiting period, yet no later than 45 minutes after venipuncture, blood was centrifuged at full speed (1100 RCF) for 15 minutes. The serum was then transferred from the spun SST into three labeled plastic tubes. The first tube was used immediately for lipid analysis, the second was frozen and shipped for tHcy analysis, and the third was stored in the freezer at -70 C. for reserve.

Blood pressures were measured and recorded by the investigator, who was trained in taking blood pressure. Three blood pressure readings were recorded for each subject. The first reading was taken at the beginning of the study when the subject reported to the laboratory. The second and third readings were obtained at the end of the study before the subject left the laboratory. The mean of the three readings was calculated and recorded as the blood pressure. Blood pressure was assessed using a sphygmomanometer and a stethoscope.

DATA ANALYSIS

BLOOD LIPIDS ANALYSIS

The serum total cholesterol (TC), high-density (HDL) and low-density lipoprotein (LDL) cholesterols, and triglyceride (TG) levels were measured using the BECKMAN Synchron CX System. Blood lipid analyses were done by Quest Diagnostics Laboratory, West Palm Beach, Florida.

CARDIOVASCULAR RISK FACTORS ANALYSIS

A risk-point standard system based on nine CHD risk factors was developed by the American Heart Association. For each CHD risk factor, a zero or eight-risk level was assigned. The most significant risk factors for developing CHD were given the highest numeric point. Based on the CREQ, the blood pressure results and the blood lipid levels, subjects received a score anywhere from zero to eight, the maximum number of points for each factor. The risk points from all of the risk factors were totaled. The Risk category was determined using the following category list:

**Figure 1**

<table>
<thead>
<tr>
<th>Risk Point Standards</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-below average (Low CHD risk)</td>
<td>5-15</td>
</tr>
<tr>
<td>Below average, good</td>
<td>16-23</td>
</tr>
<tr>
<td>Borderline, fair</td>
<td>24-35</td>
</tr>
<tr>
<td>Above average, poor</td>
<td>36-44</td>
</tr>
<tr>
<td>Very high, very poor</td>
<td>45-60</td>
</tr>
<tr>
<td>Dangerously high (High CHD risk)</td>
<td>Above 60</td>
</tr>
</tbody>
</table>

STATISTICAL ANALYSIS

Data from the CHD Risk Evaluation Questionnaire (CREQ) and the Food Frequency Questionnaire (FFQ) were analyzed by gender and ethnicity using the SPSS Computer Program. The results were expressed as mean ± standard deviation, or frequencies and percentages. One-way Analysis of Variance (ANOVA) was used to determine the mean differences in CHD risk point standards by gender, by ethnicity, and by gender-ethnicity subgroup with Bonferroni’s pairwise mean comparison procedure. Pearson’s correlations were used to associate various independent variables (IVs) to “CHD risk point standard” values. The Chi-square test was used for categorical variables with follow-up Bonferroni’s Chi-square tests. Differences were considered significant at a P-value less than 0.05.

RESULTS

We were able to recruit 300 subjects, 50% (n=150) males and 50% (n=150) females. One-third (n=100) were White, not of Hispanic origin (WNH), Hispanic (H), and Black, not of Hispanic origin (BNH). There were 50 subjects in each of the gender-ethnicity subgroups. Only 27.7% (n=83) of the subjects have taken a college nutrition course (Table 1).
Sixty percent (n=180) of subjects were between the ages of 19 to 20 years. The mean age was 20.8 ± 3.9 years (mean ± SD). More than 74% (n=224) of the subjects were 61 to 70 inches in height with a mean of 67.0 ± 4.0 inches. Fifty-two percent (n=156) weighed between 101-150 pounds (Lbs). The mean weight was 150.6 ± 30.2 Lbs. According to the Body Mass Index (BMI) classification, 7.7% (n=23) of the subjects were underweight, 66.0% (n=198) were within the normal range, 23% (n=69) were overweight, and 3.3% (n=10) were obese. The mean BMI was 23.2 ± 3.5 Kg/m² (Table 2). There was a significant gender difference in the distribution of the subjects (38% female, 17% male) who had taken a college nutrition class (χ² =16.00, p<0.001).

CARDIAC RISK EVALUATION QUESTIONNAIRE (CREQ)

A five-category physical activity index was computed for each subject to calculate the CREQ. A significant gender difference were found with regard to the activity index (χ² =9.55, p<0.049) with 20.0% (n=18) of males had more vigorous activity as compared with only 7.8% (n=7) of females. Statistically significant ethnic differences were found (χ² =15.71, p<0.047) with 20% (n=12) of the BNHs being inactive as compared with 3.3% (n=2) of WNHs and 5.0% (n=3) of Hs (Table 3).
Significant differences were found among ethnicities with regard to behavioral styles ($\chi^2 = 20.57, p < 0.008$). Thirty-percent ($n=18$) of the WNHs reported being sometimes calm as compared to only 13.3% ($n=8$) of the Hs and 8.3% ($n=5$) of the BNHs. Significant differences were found in gender-ethnic groups ($\chi^2 = 20.55, p < 0.002$) with 40.0% ($n=12$) of WNH males reported being sometimes calm as compared to none ($n=0$) of H males and 10.0% ($n=3$) of BNH males. Significant differences were also found in females ($\chi^2 = 9.02, p < 0.029$) with 26.0% ($n=8$) of BNH females reported being never calm as compared with 3.3% ($n=1$) of H females (Table 4).

**Figure 5**

Table 4: Behavioral style of subjects by gender, by ethnicity, and by gender-ethnicity subgroup

<table>
<thead>
<tr>
<th>Behavioral Style</th>
<th>WNH</th>
<th>H</th>
<th>BNH</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm</td>
<td>23</td>
<td>14</td>
<td>12</td>
<td>20.55</td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>Occ.</td>
<td>20</td>
<td>12</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>16</td>
<td>24</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>13</td>
<td>18</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>10</td>
<td>18</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall, on average 32.8% of college students fell in the “excellent” category, that is, well-below the average risk of developing CHD, and 40% fell in the “good” category, that is, below-average risk of developing CHD. A significant difference was found among ethnicities by CHD risk category ($\chi^2 = 10.74, p < 0.030$) with 38.4% ($n=23$) of the BNHs being in the “fair” to “very poor” categories as compared to 23.3% of the Hs and 20.0% of WNHs. Therefore, BNHs have borderline and above-average risk of developing CHD compared to the other two groups (Table 6).

**“CHD RISK POINT STANDARDS” SCORE AND CHD RISK CATEGORY**

The “CHD risk point standards” were calculated for all subjects ($n=180$). The mean and standard deviation (SD) were determined and six-risk categories were assigned by gender, by ethnicity and by gender-ethnicity subgroup.

Overall, the total “CHD risk point standards” mean score for all subjects was 19.15 ± 6.79. Assigned to the CHD risk category, this indicates that on average, college students were in the “good” category, or below-average risk of developing CHD. Statistically significant gender differences were observed ($p<0.013$), with males scoring higher (20.41 ± 7.36) than females (17.90 ± 5.93). Therefore, males have a higher risk of developing CHD than female.

Statistically significant differences were also found among ethnic groups, with BNHs scoring significantly higher (21.00 ± 8.77) than WNHs (18.00 ± 5.86), thus, BNHs have a higher risk of developing CHD (Table 5).

**Figure 6**

Table 5: Means of coronary heart disease risk point standard score by gender, by ethnicity, and by gender-ethnicity subgroup

No significant differences were found by gender across ethnic groups with regard to smoking, family history of heart disease, personal and family histories of diabetes, and personal history of heart disease.
SERUM LIPIDS AND LIPOPROTEINS

Serum lipids and lipoproteins were determined for 180 subjects. Subjects were of equal numbers by gender, ethnicity and gender-ethnicity subgroups. Statistically significant differences between males and females were observed, with males having a higher mean concentration of TG (p<0.002) 108.8 ± 71.0 mg/dl compared to 81.7 ± 40.0 mg/dl for females, higher cholesterol/HDL ratio (p<0.001) 4.0 ± 1.7 mg/dl compared to 3.3 ± 0.9 mg/dl for females, higher glucose (p<0.026) 90.5 ± 13.7 mg/dl compared to 86.9 ± 6.7 mg/dl for females, and lower HDL (p<0.001) 44.2 ± 9.5 mg/dl compared to 52.8 ± 11.0 mg/dl for females (Table 7). Statistically significant differences between males and females were observed, with males having a higher SBP (p<0.001) (118.8 ± 7.4 mmHg) and a higher DBP (p<0.002) (76.3 ± 6.8 mmHg) than females (112.7 ± 9.9 mmHg and 72.8 ± 8.0 mmHg, respectively).

DISCUSSION

This study presented baseline data of a college-aged population for CHD risk factors by gender, ethnicity, and by gender-ethnicity subgroup. It addresses the question whether there are ethnic differences in CHD risk factors. We hypothesized that there would be gender and ethnic differences in the activity levels, behavioral lifestyles, and smoking. The results support the hypothesis by demonstrating statistically significant differences between males and females, with males reporting more vigorous physical activity than female. More Black non-Hispanics were inactive as compared to WNHs and Hs.

Epidemiological research has demonstrated protective effects of physical activity on the risk for CHD. Other studies support our findings that males are more likely than females to engage in regular activity and in vigorous exercise. Black non-Hispanics were less active than WNHs and this disparity was more pronounced for females. The Youth Risk Behavior Surveillance also indicated that male college students were significantly more likely than female college students to engage in vigorous exercise. Furthermore, according to the 1996 Surgeon General's Report on Physical Activity and Health, the percentage of people who say they engage in no leisure activity is higher among females than males. A greater percentage of White non-Hispanics, especially, males reported being “sometimes calm” as compared to WNHs and Hs. More Black non-Hispanic females reported being “never calm” as compared to H females. Because of the relationship between CHD and a person’s stress, WNHs and BNH females are at a higher risk of developing CHD. Coronary Heart Disease is a phenomenon of modern society.

Acute and chronic stress may affect other CHD risk factors, such as blood pressure, cholesterol levels, smoking, and obesity. Researchers studied the role of psychosocial factors in the incidence of CHD. An observational review of 14 studies in Medline found that life stresses have a negative influence on CHD, and social support has a positive influence on CHD. Our findings are consistent with new evidence, which shows dramatic increases in smoking rates among WNHs and BNH females. Cigarette smoking is the leading preventable cause of CHD in females. Although the prevalence of smoking among US females declined from 34% in 1965 to 24% in 1991, smoking cessation rates have declined more slowly among females than males. On the basis of current trends in 1999, it was estimated that by the year 2000, smoking rates would be higher in women (23%)
than men (20%). These changing demographics of smoking, especially among young females, may contribute to a higher CHD risk.

The hypothesis that gender and ethnic differences in blood pressure, in personal and family histories of heart disease, and in personal history of diabetes would be noted for this population were supported; results demonstrate statistically significant differences between males and females, with males having higher systolic and diastolic blood pressure (BP), which supports our hypothesis. Epidemiological studies document a strong association between high levels of both systolic and diastolic BP and risk of CHD in both males and females. The findings of our study are supported by other findings.

Researchers found that blood pressure measures were higher for BNHs than for WNHs. Although no significant differences were found in the family history of heart disease nor the personal and family histories of diabetes, the lack of knowledge regarding the history of heart disease and personal and family histories of diabetes was evident and common across all gender-ethnic groups. This is an alarming observation, as college students will be put at an even greater risk by not knowing the heart disease and diabetes histories of their respective families.

Results demonstrate statistically significant differences between males and females with males having a higher mean concentration of TG; higher cholesterol/HDL ratio; higher glucose and lower HDL. With regard to lipoproteins, males were significantly more likely than females to be in the “High Risk” category of HDL, while females were statistically more likely than males to be in the “Desirable” category of HDL. White non-Hispanic females were statistically more likely than BNH females to be in the “Desirable” category of HDL. High-density lipoprotein levels were inversely associated with CHD risk. In addition, an increase in HDL level in association with lowering LDL level was associated with reduced incidence of CHD in the Lipid Research Clinics Coronary Primary Prevention Trial (27), and in the Helsinki Heart Study (28). A low level of HDL cholesterol is a risk factor for CHD in younger females and was a stronger predictor of CHD mortality in females than males. The role of TG in CHD is controversial, but observational studies suggest they may be a particularly important risk factor in women. We hypothesized that there would be gender and ethnic differences in “CHD risk point standards” and CHD risk categories.

The results support this hypothesis. Our findings indicate statistically significant differences between males and females, with males having a higher risk of developing CHD. Also, a statistically significant difference was found between BNHs, Hs and WNHs with BNHs being in the “fair” to “very poor” categories as compared to WNHs and Hs.

CONCLUSION

In conclusion, our findings indicate strong ethnic differences in CHD risk factors among the college-age population. On average, these college students fell in the “good” category or below-average risk of developing CHD. Black non-Hispanics fell in the borderline and above-average risk of developing CHD. Males reported more vigorous physical activity while BNHs were more likely to be inactive. A greater percentage of White non-Hispanics, especially males, reported being “sometimes calm,” while more BNH females reported being “never calm.” Males had higher systolic and diastolic blood pressure on average than females. Males had a higher mean concentration of TG; higher cholesterol/HDL ratio; higher glucose and lower HDL, and BNH males had higher cholesterol; LDL; cholesterol/HDL ratio and TG than WNH and H males.

ACKNOWLEDGEMENT

This research was supported by grant 00WM07 from the American Heart Association.

CORRESPONDENCE TO

Samer Koutoubi, MD, PhD Room 309, Nutrition Department Bastyr University Kenmore, WA Email: skoutoub@bastyr.edu

References

Author Information

Samer Koutoubi, MD, PhD.
Nutrition Department, Bastyr University

Fatma G. Huffman, PhD, R.D.
Department of Dietetics and Nutrition, Florida International University