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Lipid Levels in a Cohort of Sedentary University Students

R Bowden, B Lanning, E Doyle, H Johnston, B Slonaker, G Scanes

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Abstract

Most lipid research focuses on people over the age of forty-five, but compelling evidence suggests the need to intervene at a much younger age. Therefore, the purpose of this study was to measure and compare total cholesterol, LDL, HDL, triglyceride and TC/HDL ratio levels in university students enrolled in a personal health class. A secondary purpose was to compare gender differences in lipid levels. One-hundred and eight sedentary participants who had been inactive for the previous three months, had enrolled in a college-level health education class and were non-health and health-related majors volunteered for the study. Male participants were more at-risk than females based on triglyceride, LDL, and HDL levels; and on TC/HDL ratios. For both genders, a number of participants were found to have elevated lipid levels supporting the need for lipid screening among university students.

The Faculty Research Investment Program at Baylor University has provided funding for this study

The Exercise and Sports Nutrition Laboratory at Baylor University provided lipid screening and technicians for this project

INTRODUCTION

Coronary artery disease (CAD) leading cause of death in the United States since early in the twentieth century.[1] Additionally, 45% of people who experience a myocardial infarction will eventually die from it.[2] Researchers have suggested that approximately 25% of the adult population ages twenty and older have blood cholesterol levels that are considered high[3]. Traditionally, research has focused on people over the age of forty-five when heart disease becomes the leading cause of death. However, new compelling evidence suggests that heart disease may actually begin as early as two years of age with interventions needed at a younger age.[4,5,6,7]

In both the Bogalusa Heart[6] study and the Pathobiological Determinants of Atherosclerosis in Youth (PDAY)[7] study, arterial lesions and stenosis were discovered in adolescents and young adults. The authors of the PDAY study found differences in accumulation of fatty streaks and the risk factor profiles of their participants with differences appearing as early as 15 years of age. A number of authors[2,6,7,8,9,10] also have reported that most children and adolescents who have risk factors for heart disease are more likely to have heart disease as adults and that the same risk factors and predictors of heart disease commonly associated with adulthood are now being discovered in youth. The National Cholesterol Education Program (NCEP) has recommended that screening for high cholesterol should begin at the age of twenty.[3] The NCEP also suggests additional screening and physician referral should occur following an abnormal lipid screening.

Intervention programs addressing these risk factors can be implemented on the university campus. Most empirical research findings involving university students isolate specific behaviors for study and attempt to discover their impact on student health.[11] The National College Risk Behavior Survey[12] suggests many university students engage in risky behaviors that increase the likelihood of serious health problems, including those that place them at risk for CAD. Because university students are gaining new independence, they are at a crucial time of life when effective intervention programs could foster healthy decision making skills. The microcosmic atmosphere of the university campus offers a unique setting in which screening for disease can be coupled with health education for significant lifestyle change.

Despite NCEP recommendations for cholesterol screening at age 20, little is known about cholesterol levels among university students and only a few studies have been conducted[4] with no studies to date screening only sedentary participants. Sparling et al.[10] discovered that 11.1% (primarily male) of screened university students had elevated cholesterol levels, all of whom had elevated LDL levels. Spencer[5] reported 29% of 207 university students had undesirable levels of cholesterol and 7.7% were at-risk. Spencer also reported up to 18% were above the NCEP guidelines for HDL and total cholesterol/HDL (TC/DHL) ratio. The authors of an earlier study[13] found 27% of university students had elevated cholesterol levels (>200 mg/dL) with males typically having higher total cholesterol levels. Though the results of these studies provide some information about cholesterol values in college students there has not been enough to create a complete understanding of lipid levels in college students and studies are relatively fragmentary, with no studies to date recruiting sedentary (independent risk factor for lipid levels and CAD) college students. Therefore, the purpose of this study was to assess risk for CAD among sedentary university students using total cholesterol (TC), LDL, HDL, triglyceride and TC/HDL cholesterol levels. A secondary purpose was to compare gender differences in lipid levels of sedentary university students.

METHOD

PARTICIPANTS

One-hundred and eight sedentary participants who self-reported they had been inactive for the previous three months and had enrolled in a college-level health education class and were non-smokers volunteered for the study. Volunteers were not allowed to participate if they had experienced any of the following during the three months prior to study initiation: any metabolic disorder including known electrolyte abnormalities; heart disease, arrhythmias, diabetes, thyroid disease, or hypogonadism; a history of hypertension or hepatorenal disease; were taking thyroid, hyperlipidemic, hypoglycemic, anti-hypertensive, or androgenic medications; or had taken ergogenic levels of nutritional supplements that may affect lipid levels, anabolic/catabolic hormone levels or weight loss. One-hundred and eight volunteers meeting eligibility criteria were informed of the requirements of the study and signed informed consent statements in compliance with the human subjects guidelines of the university.

LIPID ANALYSIS

Each participant donated approximately 20 ml of blood after fasting for 12 hours using standard venipuncture techniques in the antecubital vein in the bend of the elbow. Whole blood samples were sent to Quest Diagnostics (Dallas, TX) for assay of a standard clinical lipid profile (triglyceride, TC, HDL, LDL, and TC/HDL ratio). Lipid analysis was conducted using an AU 5400 clinical chemistry analyzer. The AU 5400 uses spectrophotometry which is employed to measure the amount of light that a sample absorbs to measure lipid levels in blood serum. The instrument operates by passing a beam of light through a sample and measuring the intensity of light reaching a detector. Use of a spectrophotometer makes cholesterol estimations very convenient and reliable, particularly for obtaining rapid results on a relatively small numbers of samples.

STATISTICAL ANALYSIS

The Statistical Package for the Social Sciences software for Windows (version 10.0, SPSS Inc, Chicago, IL) was used to perform the statistical analysis of the raw data. Significant differences between mean lipid levels in males and females were calculated using ANOVA. Significance was set a-priori at .05. Descriptive statistics were used to calculate means and standard deviations for each lipid measure among males and females. Finally, percentiles (25,50,75,90,95) were calculated for each lipid measure in males and females.

RESULTS

A sample of sedentary university students (N=108) from introductory health classes at a southern university were selected to participate. All students were non-health related majors. Females were 65.96% (n=71) of participants and males were 34.04% (n=37) of participants. Males and females averaged 20.32 (SD=1.60) and 19.65 (1.32) years of age respectively. Participants averaged 73.44 kg (SD=30.8) for weight, 66.10 cm (10.62) for height with BMI averaging 25.00 (5.11).

Female participants averaged 173.70 mg/dL (SD=34.79 mg/dL) for total cholesterol, 96.38 mg/dL (29.78 mg/dL) for LDL, 61.12 mg/dL (13.75 mg/dL) for HDL, 2.9 (.67) for TC/HDL ratio, and 81.35 mg/dL (34.18 mg/dL) for triglycerides. Male participants averaged 171.81 mg/dL (SD=33.24 mg/dL) for total cholesterol, 109.44 mg/dL (31.05 mg/dL) for LDL, 46.47 mg/dL (7.94 mg/dL) for HDL, 3.8 (1.0) for TC/HDL ratio, and 79.59 mg/dL (30.67 mg/dL) for triglycerides. Findings are displayed in Table 1.

An ANOVA was calculated to reveal differences in blood lipids between females and males. The ANOVA revealed significant differences in HDL between women (61.12

mg/dL, 13.75 mg/dL) and men (46.47 mg/dL, 7.94 mg/dL, p=.0001), LDL between women (96.38 mg/dL, 29.78 mg/dL) and men (109.44 mg/dL, 31.05 mg/dL, p= .047), and TC/HDL ratio between women (2.9, .67) and men (3.8, 1.0, p= .0001). No significant differences were found in triglyceride levels (p=.806) and TC (p= .799). Results are presented in Table 1.

Figure 1

Table 1: Blood lipid values for participants and gender comparisons

	Females		Males		
	Mean	**SD**	**Mean**	**SD**	**P-value**
Total Cholesterol (mg/dL)	173.70	34.79	171.81	33.24	.799
LDL (mg/dL)	96.38	29.78	109.44	31.05	.047
HDL (mg/dL)	61.62	13.75	46.47	7.94	.0001
TC/HDL (ratio)	2.9	.67	3.8	1.0	.0001
Triglycerides (mg/dL) .806		81.35	34.18	79.59	30.67

Percentiles (25^{th}, 50^{th}, 75^{th}, 90^{th}, and 95^{th}) were calculated and are presented in Table 2. With the exception of TC/HDL ratio all values presented below are recorded in mg/dL. Females TC percentiles were 148.75 (25^{th}), 167 (50^{th}), 194.25 (75^{th}), 214.50 (90^{th}), and 253.30 (95^{th}). LDL percentiles were 78.75, 55.50, 109.50, 131.40, and 165.75. HDL percentiles were 53, 61, 66, 75.3, and 91.9. Triglyceride percentiles were 59.50, 76.0, 96.25, 107.30, and 172.50. Ratio of TC/HDL percentiles were 2.5, 2.7, 3.3, 3.9, and 4.37. Males TC percentiles were 150.25, 162.50, 183.75, 225.50, and 247.95. LDL percentiles were 90.50, 99, 116.50, 153.70, and 187. HDL percentiles were 40.75, 46.50, 50.50, 57.70, and 61.75. Triglyceride percentiles were 53.25, 72.50, 111.75, 123.70, and 136.55.

Figure 2

Table 2: Blood lipid percentiles for participants.

	25^{th}	**50^{th}**	**75^{th}**	**90^{th}**	**95^{th}**
Females					
TC (mg/dL)	148.75	167.00	194.25	214.50	253.30
LDL (mg/dL)	78.75	88.50	109.50	131.40	165.75
HDL (mg/dL)	53.00	61.00	66.00	75.30	91.90
Triglyceride (mg/dL)	59.50	76.00	96.25	107.30	172.50
TC/HDL (ratio)	2.5	2.7	3.3	3.9	4.37
Males					
TC (mg/dL)	150.25	162.50	183.75	225.5	247.95
LDL (mg/dL)	90.50	99.00	116.50	153.70	187.00
HDL (mg/dL)	40.75	46.50	50.50	57.70	61.75
Triglyceride (mg/dL)	53.25	72.50	111.75	123.70	136.55
TC/HDL (ratio)	3.1	3.4	4.4	5.6	6.4

The descriptive statistics presented in Table 3 revealed that a number of participants were at-risk due to elevated lipid levels based on the latest NCEP report[14]. Forty-two (38.8%) of participants had low HDL levels. Thirty-one (28.8%) participants had elevated TC/HDL ratios, twenty-one (19.8%) had elevated TC levels, forty-four (41.3%) had elevated LDL levels, and five (4.8%) had elevated triglyceride levels.

Figure 3

Table 3: Blood Lipid Means and Percentage of Students above National Cholesterol Education Program (NCEP) Guidelines

Variable	**NCEP[14] risk guideline**	**% above NCEP[14] guidelines**
LDL	≥100 mg/dL	41.3%
HDL	<50 mg/dL	38.8%
Risk Ratio	>3.5	28.8%
T. Cholesterol	≥200 mg/dL	19.8%
Triglycerides	≥150 mg/dL	4.8%

COMMENTS

The NCEP recommends lipid screening beginning at age twenty and continuing every five years, with normal levels, and more frequently with abnormal levels throughout adulthood.[3,14] However, very little research has been conducted in the area of traditional aged university students and lipid levels with no studies to date having used only sedentary university students. The literature strongly supports the association of sedentary lifestyles, elevated lipids, and CAD[15]. Therefore, the primary purpose of this study was to ascertain the blood lipid levels of students who had been sedentary for at least three months prior to the study. By recruiting participants who were sedentary, it was hypothesized that they would be more at-risk for elevated blood lipids and, therefore, would represent a more accurate profile of students who would more likely be at-risk. A secondary purpose was to compare gender differences in lipid levels.

A number of university students were identified as high risk based on lipid levels. The greatest number of participants (41.3%) had elevated LDL levels (100 mg/dL and below is considered optimal, with atherogenesis occurring above 100mg/dL[14]). LDL cholesterol accounts for 60-75% of the total serum cholesterol and is the terminal end in the pathway of lipoprotein metabolism called cholesterol transport. High levels of LDL cholesterol are able to penetrate the porous endothelium of arteries and begin to accumulate if plasma concentrations are abnormal. This natural plaque is eventually converted to unstable plaque increasing the likelihood of rupture and possible thrombosis.[14] Additionally, LDL levels have been identified in the NCEP's third report[14] as the primary marker for needed cholesterol therapy and the single greatest lipid predictor of CAD. Based on percentiles, a high number of males and female participants had LDL levels 100 mg/dL and above, but males tended to have higher LDL levels than females and, therefore, a higher risk of CAD. There are several risk factors associated with high LDL levels among adult populations (e.g., diets high in saturated fats, alcohol consumption, gender, etc.) which are present in university students and are crucial targets for intervention.[16] Evidence from this study supports the need for intervention programs that target LDL levels in university students. Accordingly, the greatest absolute diminution of risk for heart disease can be achieved by the reduction of LDL which may directly lower platelet aggregation, vascular reactivity, and lower cytokine release leading to a further reduction in risk for myocardial infarction[17] in university students.

The metabolic balance of lipoproteins which is both vital and dangerous also uses reverse cholesterol transport via HDL to lower cholesterol in the periphery. HDL absorbs cholesterol in peripheral cells which enter the core of the cell through the action of lecithin-cholesterol acyltransferase. Therefore, inclusion of HDL in risk assessment can greatly enhance risk stratification. Low HDL (<50mg/dL) levels (increased risk for heart disease) were detected among 38.8% (n=42) of participants with more males than females represented at lower percentiles (see Table 2). Almost 75% of males in the present study had levels below the new NCEP guidelines[14] of >50 mg/dL, strongly suggesting the need for cholesterol screening on campus. The findings also support the need for health education regarding CAD risk even as early as traditional college-aged years. Though low HDL was primarily a problem in males in this study, enough students had abnormal levels of HDL to warrant screening for at least sedentary university students, if not all students. Research has consistently identified an inverse relationship between HDL levels and CAD incidence.[16] Low HDL levels have been associated with sedentary lifestyles and binge drinking in university students.[4] A health education program that focuses on the importance of exercise and alcohol avoidance may improve HDL levels and lower the risk of CAD.

As would be expected due to elevated LDL and low HDL levels, 28.8% (n=31) of participants experienced elevated TC/HDL ratios (>3.5). Previous research has identified TC/HDL as a risk factor for CAD.[16] The same strategies used to increase HDL levels and lower LDL levels should be used for lowering TC/HDL levels. Programs that address diet, specifically saturated fat in the diet, advocate exercise, and reduce alcohol abuse and binge drinking should be promoted to reduce TC/HDL levels and decrease CAD risk.

Total cholesterol was elevated (>200mg/dL) in 19.8% (n=21) of participants. Though total cholesterol has become less important in the prediction of disease than LDL and HDL, it serves as a valuable screening measure used to recommended further testing.[14] Total cholesterol tends to reflect average dietary habits that affect LDL, and can reasonably provide an assessment of risk between participants. By identifying nearly twenty percent of the participants as at-risk based on TC it is evident that lipid screening, even if only TC, on university campuses may be warranted. By identifying those with elevated TC levels more students may be encouraged to seek further testing. Yet, the differences in risk between individuals can be strongly influenced by many additional lipoproteins.[18,19,20] Therefore the measurement of total cholesterol alone cannot adequately reflect an individual's risk of heart disease[18] and should rarely be used as the sole lipid measure in university cholesterol screenings.

Historically, it has been understood that high triglyceride levels were the result of elevated total cholesterol and lower levels of HDL cholesterol,[19,21] but recent studies have shifted elevated triglyceride levels from an association with heart disease to an independent predictor of the disease.[14,21,22,23] Only 4.8% (n=5) were identified as high risk based on triglyceride levels in this study (?150mg/dL), and when compared to the number of at-risk participants based on lipoprotein levels, the findings suggest that triglyceride may not be a source of risk for university students in this study. Though not measured, it is possible that due to the increasing popularity of low carbohydrate and high protein diets, more students were consuming lower carbohydrate levels, which tends to decrease triglyceride levels and therefore had lower triglyceride levels when tested. Further research that measures dietary habits may help to elucidate this theory.

Females had statistically significant lower LDL and TC/HDL levels and significantly higher HDL levels. Numerous study authors have demonstrated decreased risk for heart disease in women due to improved blood lipid levels.[16] Women tend to have a protective effect by increased HDL levels due to higher estrogen levels.[14] With other possible influences on HDL levels accounted for in this study (e.g., exercise), the findings suggest that a protective estrogen-level effect may occur among women in this study group. However, further research that includes estrogen measures and diet is warranted to confirm this possibility.

Most surprisingly, based on percentiles, a majority (75th percentile) of males in this study were at-risk based on HDL levels. The findings in this study suggest a strong need for education on the importance of daily activity to increase HDL levels. Sedentary male university students may be at more risk than previously believed, revealing the need for cholesterol screening on the university campus, especially among sedentary males.

This research, though it identifies a number of students at-risk, has some limitations. Students were enrolled in a health education class (non-majors) and were sedentary for at least three months prior to screening and therefore, should not be used as normative values for all university students. Secondly, the participants were relatively young (males and females averaged 20.32 and 19.65 years of age respectively).

Despite these limitations, the results of this study can be used to advance lipid profile research and intervention development on university campuses. Institutions of higher education have the unique opportunity to promote positive health behaviors and improve lipid profiles among young adults who have greater risk for CAD than previously believed.[24] Health professionals in university settings can provide suitable and effective health education programs that address diet, exercise, and other important factors that influence lipid levels.[11] A rigorously designed long-range research and health promotion effort that incorporates these factors and their interrelationships could significantly advance nationwide efforts to impact the health and well being of university students.

CORRESPONDENCE TO

Rodney G. Bowden, Ph.D. Assistant Professor of Health Education Department of Health, Human Performance and Recreation Center for Exercise, Nutrition and Preventive Health Research Baylor University, Waco, TX 76798, USA One Bear Place # 97313 254-710-4020 Fax: 254-710-3527 Rodney_Bowden@baylor.edu

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Author Information

Rodney G. Bowden, Ph.D.
Assistant Professor of Health Education, Department of Health, Human Performance and Recreation, Baylor University

Beth A. Lanning, PhD., CHES
Assistant Professor of Health Education, Department of Health, Human Performance and Recreation, Baylor University

Eva I. Doyle, PhD., CHES
Associate Professor of Health Education, Department of Health, Human Performance and Recreation, Baylor University

Holly M. Johnston, MS
Research Assistant, Department of Health, Human Performance and Recreation, Baylor University

Becky Slonaker, MS
Research Assistant, Department of Health, Human Performance and Recreation, Baylor University

Georgene Scanes, BS
Research Assistant, Department of Health, Human Performance and Recreation, Baylor University