Assessing Overweight and Cardiovascular Risks Among College Students

WayWay Hlaing, Subrata D. Nath, and Fatma G. Huffman

ABSTRACT

Although studies regarding health issues and the obesity epidemic have increased in recent years, few of these studies target college-aged students. The primary purpose of this study was to evaluate the differences in race/ethnicity with respect to prevalence of overweight/obesity (defined by body mass index or BMI) among college students attending an urban university. In addition, the demographic characteristics and cardiovascular risks between the overweight and obese group (n=138) were compared to the underweight and normal weight group (n=349). The study included 487 college students under 40 years of age who identified their origin as white (non-Hispanic), black (non-Hispanic), or Hispanic. There were 32.65% white, 33.26% Hispanic, and 34.09% black. The mean and median ages were 21 and 19 years, respectively. The overall prevalence of overweight/obesity was 28.11%, with 23.91% (white), 34.06% (Hispanic), and 42.03% (black). Age-, gender-, and race-/ethnicity-adjusted cardiovascular risk levels (blood pressure, pulse pressure, blood glucose and lipid profiles) significantly varied between two groups. The findings suggest that screening cardiovascular risks among a college-aged population is warranted. Our study further indicates the need for weight management and risk reduction of overweight-related chronic diseases on campus.

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of mortality in the United States (U.S.) and the disease risk often begins early in life.[1–3] Sub-clinical CVD may exist during childhood and adolescence. There are several known modifiable risk factors of CVD, including smoking, physical inactivity, excess body weight, elevated blood pressure, blood glucose and cholesterol levels.[4] In addition, increased stiffness of the arteries has been linked to overweight and CVD.[4–7] The level of arterial stiffness in young individuals can be determined non-invasively using systolic and diastolic blood pressure values.[6] The association of arterial stiffness and overweight has been shown from adolescence until old age,[6] but such assessment among the college-aged population is limited.

Overweight and obesity among college students are indicative of behaviors that place them at risk for serious health consequences later in life.[7] Prevalence of overweight also is rising across all age groups.[8–9] The greatest increase in obesity (body mass index [BMI] $\geq$ 30 kg/m^2) from 1991 to 1997 was reported among the college-aged population.[10] Weight gain during college years is considerably greater than that observed in the general population over the same time frame.[11] The transitional period between adolescence and young adulthood appears to be a period of increased risk for the development of obesity.[12] The college years coincide with tremendous socio-behavioral changes. Students develop patterns of dietary, exercise, and other lifestyle behaviors, any or all of which may contribute to overweight and obesity. Further, these behavioral patterns and excess weight may persist later during adulthood.[7,13–15]

WayWay Hlaing, MBBS, MS, PhD, is with the Department of Epidemiology & Biostatistics, Stempel School of Public Health, Florida International University, 11200 SW 8th Street, HLS II-584, Miami FL 33199; E-mail: hlaingw@fiu.edu. Subrata D. Nath, MBBS, MPH, PhD, is with the Division of Nephrology/ Dept. of Medicine, University of Texas Health Science Center at San Antonio, Mail Code 7882, 7703 Floyd Curl Dr., San Antonio, TX 78229. Fatma G. Huffman, RD, PhD, is with the Department of Dietetics & Nutrition, Stempel School of Public Health, Florida International University, 11200 SW 8th Street, HLS I – 437, Miami, FL 33199.

A study reported that the prevalence of obesity among college students was 21% in 2001.[16] Among national representative sample of undergraduates, 20.5% were overweight[13] and 35% were overweight or obese.[7] In addition to obesity, several studies[17–20] have shown that abnormal lipid profiles and glucose metabolism are the major cardiovascular risks among college-aged students. In another study, computer use played a significant role in the discretionary time of young adults and was negatively associated with physical activity.[21] Physical inactivity is a risk factor for overweight and obesity as well as CVD.[4] Hence, the CVD risk factors in both young and older adults are the same. These risk factors include physical inactivity, smoking, elevated weight, blood pressure, arterial stiffness, dyslipidemia, and abnormal glucose level.[4,6] In addition, there is evidence that most college students are not meeting dietary, physical activity, and other healthy lifestyle guidelines.[3]

Purpose of the study

Studies related to overweight in adolescents and children have grown exponentially in recent years. However, few studies have targeted college-aged students of diverse racial/ethnic backgrounds. While college students and their risk factors have been studied at national level, studies that include Hispanic college students are scant. Hence, college students in a Hispanic-Serving Institution (HSI) were selected to assess the prevalence and variations in cardiovascular risks. The objective of this study was to evaluate the overall and race/ethnicity-specific prevalence of overweight and obesity among white, black, and Hispanic college students. Additionally, the characteristics and cardiovascular risks between the overweight and obese group were compared to the underweight and normal weight group. Self-reported factors included age, gender, race/ethnicity, smoking, physical inactivity, and personal and family history of heart disease and diabetes. Using the standard clinically relevant values, prevalence of cardiovascular risks were also evaluated. Blood pressure (SBP, DBP), arterial pulse pressure (APP), fasting blood glucose, and lipid levels were compared between the groups.

METHODS

Design and Sample

The study utilized cross-sectional data collected from college students attending an urban Hispanic-Serving University during 1999–2001. The study was approved by the Institutional Review Board (IRB) of the Institution.

College students who were under 40 years of age and of white (non-Hispanic), black (non-Hispanic), or Hispanic origin were invited to participate. Students 40 years and older were not recruited for two reasons; first, they do not represent traditional college-aged students, and second, they are more likely to have preexisting health conditions. Recruitment was accomplished by posting flyers where students congregated on campus and announcements in large classes. Eligible and willing participants (n=491) were required to visit the on-campus laboratory once for about 60 minutes. All data were collected during the laboratory visit and all students were provided with a light breakfast and a five-dollar incentive.

Among 491 college students that met the age and race/ethnicity criteria, four students refused weight measurements (n=487). The participants were initially categorized into four groups based on their weight status as defined by their BMI (Table 1). Due to the small number of participants in the underweight and obese categories, the four groups were collapsed to two groups (overweight/obese and normal/underweight).

The gender-ethnic distribution of the university students was as follows: 43.20 % male; 56.80% female; 55.73% Hispanic; 17.80% white non-Hispanic; 12.93% black non-Hispanic; and 13.54% others. The study sample (48.67 % male and 51.33% female) was similar to the gender makeup of the university. The sample composed of 33.26% Hispanic, 32.65% white non-Hispanic, and 34.09% black non-Hispanic. The goal of our study was to recruit an equal proportion of six main gender-ethnic groups. Thus, ethnic distribution of our sample was not similar to the university student profile.

Measures

The variables relating to the current report are briefly described below. They included demographic (age, gender, race/ethnicity), and self-reported CVD risks (smoking, physical activity, family/personal history of heart disease and diabetes). Prevalence of smoking was determined by inclusion of current smokers and those who quit smoking within last year. For family history of heart disease and diabetes, three responses were available: yes, no, or don't know. Physical activity was assessed using the Modifiable Activity Questionnaire (MAQ)[22] which determined the past year's leisure and occupational activities. The leisure and occupational activity estimates were combined to provide overall, average activity level by intensity. Moderate, high, and vigorous intensity levels were considered physically active. Those who did not exercise or exercised with light intensity were grouped as inactive. The MAQ was designed for easy modification to maximize appropriateness and feasibility and has been shown to be reliable (correlation ranged from 0.73 to 0.87) and valid in minority adolescent and adult populations.[22–23]

For CVD risk measurements, fasting venous blood samples of 15 ml were drawn and glucose and lipid profiles were analyzed by Quest Diagnostics Laboratory. A quarter of the students refused blood drawing. Laboratory results included blood glucose, serum total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides in mg/dL and total cholesterol to HDL ratio.

Other measurements included body weight, height, and blood pressure. Height and weight were measured to the nearest inch and pound, respectively. Height and weight was converted metric units (meter and kilogram). Body mass index (BMI) was calculated as weight by height squared (kg/m^2). Three blood pressure (BP in mmHg) readings were taken from each student by a trained researcher using the standardized

method. An average value of three BP readings was used in the analysis. As a measure of arterial stiffness, arterial pulse pressure (or APP) (mmHg) level was derived by subtracting DBP from SBP (APP = SBP – DBP).[6]

Analysis

Data were entered and managed in SPSS Version 11.5J (SPSS Inc., Chicago, IL) for Windows statistical package and analyzed using the SAS Version 10 (SAS Institute Inc., Cary, NC) software. Percentages were computed for demographic characteristics and cardiovascular risks. Differences in proportions of demographic characteristics and self-reported cardiovascular risks between groups were assessed using the chi-square (χ^2) tests. For continuous measures of cardiovascular risks, the means and standard errors (SE) of age, SBP, DBP, APP, blood glucose, and lipid levels were reported. Age was treated as both dichotomous (≤ 19 versus > 19 years) and continuous variables. Self-reported cardiovascular risks were dichotomized: smoking (never versus current and recent smokers), and physical activity (active versus inactive). Measured risk variables of continuous scales were dichotomized based on the reference values.[24] For example, low- and high-risk groups were created using the following cut-off values: ≤ 140 versus > 140 mmHg for SBP and ≤ 90 versus > 90 mmHg for DBP. Normotensive (≤ 140 SBP and ≤ 90 DBP) and hypertensive (> 140 SBP or > 90 DBP) groups were created. As reported in a previous study,[25] the mean (62 mmHg) APP level was used as the cut-off point for arterial stiffness. Clinically relevant references were used to dichotomize fasting blood glucose (< 100 versus ≥ 100 mg/dl) and cholesterol levels.[24] Categorization of the blood lipid profiles were as follows: total cholesterol (< 200 versus ≥ 200 mg/dL); HDL (≥ 40 versus < 40 mg/dL); LDL (< 100 versus ≥ 100 mg/dL); triglycerides (< 150 versus ≥ 150 mg/dL); and total cholesterol to HDL ratio (< 3.5 versus ≥ 3.5).[24] These reference values were summarized in Table 2.

In comparing the mean levels of cardiovascular risks between two groups, unadjusted levels were initially determined.

Table 1. Proportion of Participants in each Weight (Body Mass Index or BMI) Category (n = 491)

Weight status	BMI (kg/m^2) *	n	%
Underweight	< 18.5	21	4.28
Normal weight	18.5 - 24.9	328	66.80
Overweight	25.0 - 29.9	113	23.01
Obese	≥ 30	25	5.09
Missing		4	0.81
		491	100.00

* National Heart, Lung, and Blood Institute (NHLBI)[26] and Centers for Disease Control and Prevention (CDC)[27]

Table 2. Reference Value or Range Used in Clinical, or Population-based Settings

Cardiovascular Risks	Normal or Reference value or range*
Systolic Blood Pressure or SBP(mmHg)	< 140
Diastolic Blood Pressure or DBP (mmHg)	< 90
Arterial Pulse Pressure or APP (mmHg)	< 62
Blood Cholesterol (mg/dl)	< 200
High-density Lipoprotein or HDL (mg/dl)	≥ 40
Low-density Lipoprotein or LDL (mg/dl)	< 100
Triglycerides (mg/dl)	< 150
Cholesterol/HDL Ratio	< 3.5
Fasting Blood Glucose (mg/dl)	65 - 99

* American Heart Association[4]; National Cholesterol Education Program (NCEP)[24]; Health Survey for England[25]

As overweight/obese and under-/normal weight groups varied by age, gender, and race/ethnicity, multiple regression models were fitted to assess appropriately adjusted cardiovascular risk levels.

RESULTS

Based on the National Heart, Lung, and Blood Institute (NHLBI)[26] and the CDC[27] criteria, the majority (66.80%) of the college students displayed ideal body weight for their height (BMI = 18.5 to 24.9 kg/m^2). Overall prevalence of overweight and obesity was 28.11% in this sample (Table 1). Gender distribution was significantly different with preponderance of females in the under-normal weight group and more males in the overweight/obese group ($p < .01$). There were more white (36.10%) and black (42.03%) students in the under-/normal weight and overweight/obese groups, respectively ($p < .05$). Amongst all gender-/ethnic-specific groups, white (non-Hispanic) women were more likely to be under-/normal weight and black (non-Hispanic) men were more likely to be overweight or obese ($p < .05$) compared with other groups. There were no differences in personal or family history of heart disease and diabetes between two groups (Table 3).

Similarly, there were no differences in the level of physical activity or smoking between groups. By using the reference values (Table 2), no statistically significant differences

Table 3. Characteristics of Participants by Weight Status (n = 487)

	Under/Normal Weight BMI ≤ 24.9 kg/m2 (n=349)		Overweight/Obese BMI ≥ 25.0 kg/m2 (n=138)		
	n	%	n	%	χ^2 1 df
Age (years)					
Young (< 19)	187	53.58	60	43.48	3.76
Old (> 19)	162	46.42	77	55.80	
Missing			1	0.72	
Gender					
Male	149	42.69	88	63.77	17.54**
Female	200	57.31	50	36.23	
Ethnicity					
White non-Hispanic (WNH)	126	36.10	33	23.91	8.08 a*
Hispanic (H)	115	32.95	47	34.06	
Black non-Hispanic (BNH)	108	30.95	58	42.03	
Gender-Ethnic Groups					
Male, WNH	55	15.76	25	18.12	26.59 b*
Male, H	49	14.04	29	21.01	
Male, BNH	45	12.89	34	24.64	
Female, WNH	71	20.34	8	5.80	
Female, H	66	18.91	18	13.04	
Female, BNH	63	18.05	24	17.39	
Personal History of Heart Disease					
No	345	98.85	134	97.10	1.87
Yes	4	1.15	4	2.90	
Family History of Heart Disease					
No	95	27.22	44	31.88	0.63
Yes	154	44.13	59	42.75	
Don't know	100	28.65	35	25.36	
Personal History of Diabetes					
No	334	95.70	129	93.48	1.04
Yes	15	4.30	9	6.52	
Family History of Diabetes					
No	117	33.52	39	28.26	1.66
Yes	160	45.85	72	52.17	
Don't know	57	16.33	16	13.04	
Missing	15	4.30	9	6.52	

BMI, body mass index, df, degrees of freedom
[a]df = 2, [b]df = 5
*significant at the .05 level, **significant at the .01 level

in the prevalence of high SBP, APP, blood cholesterol, or fasting glucose levels were detected. Hypertension prevalence was 5.07% and 1.43% among overweight/obese and under-/normal weight students, respectively. Prevalence of undesirable DBP, HDL, LDL, triglycerides, and cholesterol-to-HDL ratio were higher in the overweight/obese group than the under-/normal weight group (Table 4).

In comparing the mean and standard error (SE) of cardiovascular risks between two groups, most *unadjusted* risks except APP and fasting blood glucose levels differed significantly (data not shown). However, *all* appropriately *adjusted* cardiovascular risks were statistically significant between overweight/obese and under-/normal weight groups (Table 5). Overweight/obese individuals were slightly older (21.93 $\pm$ 0.42 years) compared with under-/normal weight (20.86 $\pm$ 0.21 years) students ($p < .01$). As evidenced in older adults, BP and APP levels were significantly higher in overweight/obese students compared with their under-/normal weight counterparts ($p < .01$). Overweight/obese students exhibited higher serum lipid profiles (except HDL) than their under-normal weight peers. However, compared to the reference values indicated in Table 2, total cholesterol, HDL, and triglycerides levels were below the reference values in both groups. In the overweight/obese students, LDL level and total cholesterol to HDL ratio were above the reference values. Below reference values were observed in the under-/normal weight students. Fasting blood glucose levels were within the reference range of 65 to 99 mg/dL in both groups (Table 5).

DISCUSSION

The study indicated that the prevalence of overweight among multi-ethnic college students was 23.01%. The prevalence of overweight and obesity combined was 28.11%. Although the sampling techniques were different, the proportion of overweight in our sample was higher than that of a national sample (20.5%).[13] However, prevalence of combined overweight and obesity in our sample was lower than that of their national peers (35%).[7] Another salient finding was that ethnic minority groups (34.06% Hispanic and 42.03% black, non-Hispanic) were more likely to be overweight or obese compared with their white non-Hispanic (23.91%) peers. In another college health study,[18] black students exhibited higher BMI level than white students. Although this finding[18] was consistent with our study, it did not include Hispanic students due to

Table 4. Prevalence of Cardiovascular Risks by Weight Status (n=487)

	Under/Normal Weight BMI ≤ 24.9 kg/m² (n=349)		Overweight/Obese BMI ≥ 25.0 kg/m² (n=138)		
	n	%	n	%	χ^2 1 df
Smoking (Never vs.) Recent or current smokers	105	30.09	52	37.68	2.6
Physical Activity (Active vs.) Inactive	114	32.66	38	27.54	1.21
Systolic Blood Pressure or SBP (≤ 140 vs.) > 140 mmHg	1	0.29	2	1.45	2.18
Diastolic Blood Pressure or DBP (≤ 90 vs.) > 90 mmHg	4	1.15	6	4.35	5.03*
Hypertension: SBP >140 or DBP > 90 mmHg (No vs.) Yes	5	1.43	7	5.07	5.44*
Arterial Pulse Pressure or APP (≤ 62 vs.) > 62 mmHg	4	1.15	2	1.45	0.07
Blood Cholesterol (< 200 vs.) ^ ≥ 200 mg/dl	37	10.60	22	15.94	2.71
High-density Lipoprotein or HDL (≥ 40 vs.) ^ < 40 mg/dl	49	14.04	32	23.19	6.27**
Low-density Lipoprotein or LDL (< 100 vs.) ^ ≥ 100 mg/dl	108	30.95	60	43.48	8.11**
Triglycerides (< 150 vs.) ^ ≥ 150 mg/dl	24	6.88	17	12.32	3.85*
Cholesterol/HDL Ratio (≥ 3.5 vs.) ^ > 3.5	90	25.79	56	40.58	11.77**
Fasting Blood Glucose (< 100 vs.) ^ ≥ 100 mg/dl	52	14.90	29	21.01	2.78

BMI, body mass index, df, degrees of freedom
^ ratio of missing number in under/normal weight and overweight/obese is 87:34
* significant at the .05 level, ** significant at the .01 level

the small sample size.[18] Although racial/ethnic differences in relation to overweight or obesity have been reported, findings specific to Hispanic college students included in our study would contribute to the health disparity literature. However, findings of this study should be interpreted cautiously, as Hispanic college students may be systematically different from other Hispanic groups in the nation.

Although the findings of higher CVD risks in overweight/obese compared with under-/normal weight group are not new, racially-/ethnically-diverse college student data would be of value to college health literature. For example, several differences were found when comparing findings of our report and another college students study with predominantly white students.[12] Prevalence of hypertension among college students in southern New Jersey ranged from 10.5 to 11.5%.[12] In our study, hypertension prevalence ranged from 1.43% to 5.07%. Prevalence of lipid levels also differed between our and the New Jersey studies. The differences could be attributed to the smaller sample size (n=122) and racial/ethnic distribution (84% white) in the New Jersey study.[14]

It is expected that the adjusted mean levels of cardiovascular risks would be worse among overweight/obese than their under-/normal weight peers. A noteworthy

Table 5. Adjusted Cardiovascular Risks by Weight Status (n=487)

		Under/Normal Weight BMI ≤ 24.9 kg/m² (n=349)		Overweight/Obese BMI ≥ 25.0 kg/m² (n=138)		
	n	Mean	SE	Mean	SE	F
Age (years)	486	20.89	0.23	21.85	0.37	4.71**
Systolic Blood Pressure (mmHg)#	487	113.83	0.52	117.18	0.84	19.45**
Diastolic Blood Pressure (mmHg)#	487	72.93	0.40	76.07	0.64	17.62**
Arterial Pulse Pressure (mmHg)#	487	40.91	0.44	41.11	0.72	4.73**
Blood Cholesterol (mg/dl) ^#	366	164.86	2.35	177.02	3.81	5.74**
HDL (mg/dl) ^#	366	51.08	0.78	47.91	1.27	12.87**
LDL (mg/dl) ^#	366	97.27	1.96	108.88	3.17	5.75**
Triglycerides (mg/dl) ^#	366	84.10	3.18	101.96	5.16	10.22**
Cholesterol/HDL Ratio ^#	366	3.39	0.07	3.95	0.11	16.80**
Fasting Glucose (mg/dl)^#	366	91.61	0.94	92.48	1.52	3.28**

adjusted for age, gender, and race/ethnicity
^ ratio of missing number in under/normal weight and overweight/obese is 87:34
** significant at the .01 level

point of this report was that most of the cardiovascular risk levels (SBP, DBP, APP, blood cholesterol, HDL, triglycerides, and fasting glucose) were below the reference values regardless of the weight status. This may have negative implication in which overweight/obese students may not attempt to lose weight when the clinical indicators seem "*normal*." Due to the lack of similar studies among college students, consistency of our findings with other studies cannot be evaluated.

Despite several methodological differences between our study and the studies with nationally representative samples,[13,28–29] the risk prevalence varied between our and national samples. Compared to the U.S. (32.4%) college students surveyed,[13] students in our sample (157/487 or 32.23%) were equally likely to be current smokers. Nationally, about 33% of college students did not participate in recommended amount of physical activity.[28–29] In our sample, 31.21% (152/487) of students were physically inactive. These findings suggest that health education regarding these modifiable risk factors may be beneficial to college students across the nation.

The strengths of our study were the racial/ethnic diversity of the participants and adequate sample size in each race/ethnic group. There were, however, several limitations. First, despite the fact that about a quarter of the students refused blood drawing, there were no differences in the demographic and cardiovascular risks between those who refused (n=121) and did not refuse blood drawing (n=366), except age and SBP. Those who refused blood drawing were significantly younger (20.33 years) and had higher SBP levels (116.36 mmHg) compared with those who provided blood samples (21.44 years and 114.25 mmHg). Thus, nonparticipation bias may have occurred in this study. Second, we used the BMI standard commonly applied to adults.[26–27] For students younger than 19 years, it may be more appropriate to define overweight and obesity using the CDC criteria for children and adolescents (i.e., overweight as $\geq 85^{th}$ BMI percentile and obesity as $\geq 95^{th}$ BMI percentile for age and sex).[30] To be consistent, we have used only one method of definition applied to adults for all participants. Third, other factors that may influence CVD risk, such as stress and alcohol consumption, were not addressed in this study. Fourth, the findings should be interpreted with caution, as the participants were recruited using a

convenience sampling method. Hence, the results may not be generalizable to all college students. Despite the limitation of localized data, our report would be of value as overweight, obesity, and cardiovascular diseases are national problems and have global public health implications.

CONCLUSION

The present study supports the findings of previous studies that overweight and obese individuals have higher cardiovascular risks compared with those who are underweight or normal weight. The findings hold true in young college students of diverse racial/ethnic backgrounds. University health professionals should consider weight control as a high priority topic to prevent CVD and its consequences later in life. College wellness classes may be a mechanism to educate students about the cardiovascular risk indices.

TRANSLATION TO HEALTH EDUCATION PRACTICE

This report has significant insights for health educators and other professionals committed to improving the health of college students. First, the need exists to decrease smoking and increase physical activity among college students on the study campus. Second, while these factors are modifiable personal risks, other contributing factors should be further explored. For example, health educators may collaborate with other researchers to assess whether environmental modification of the campus could likely influence smoking and physical activity levels. Such modifications need not be costly and may include such efforts as making stairways and gyms more attractive, walking and biking paths more accessible, and fewer designated smoking areas on campus. Third, more studies are needed to determine if culturally appropriate health education messages are warranted on ethnically diverse college campuses such as the study campus.

Overweight and other cardiovascular risk problems are not unique to college students who attend the study campus. In fact, most modifiable CVD risks are prevalent across college campuses in the U.S. Overweight/obesity is a global problem. Health educators should learn as much as possible about this critical public health problem. This report is an endeavor to make information available for future intervention studies.

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