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Research Article

Prevalence of Obesity and Chronic Disease Risks among Ethnic Groups of College Students in Southeast Texas

Chen JJ[1]*, Pegram LI[2], Adcock KR[1] and Johnson MR[1]

[1]Department of Family and Consumer Sciences, Lamar University, USA

[2]Independent nutrition consultant, USA

***Corresponding author:** Chen JJ, Department of Family and Consumer Sciences, P.O. Box 10035, Lamar University, Beaumont, TX 77710, USA

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Abstract

Obesity at a young age poses a greater risk of developing chronic diseases such as heart disease, hypertension, type-II diabetes, and certain types of cancers, yet many young adults at risk for these diseases are unaware of their body weights, family histories, and health risks. The present study used anthropometrics and behavioral risk factors to assess the prevalence of obesity and chronic disease risks among ethnic groups of college students in Southeast Texas. The participants completed a self-reported health and dietary behavior survey containing 29 questions followed by the measurements of anthropometrics, blood pressure, and blood glucose. Chronic disease risk factors were summed and scored from 0-8. The mean age of the 96 participants was 22±5.3 years; 52% were overweight or obese (BMI ≥ 25 kg/m2). The black participants showed a trend of higher average body weight, BMI, waist circumference, and hip circumference than other ethnic groups; specifically, 39% of the black participants had abdominal obesity. Over one third of the participants (37%) had four to seven chronic disease risk factors which included family history of diabetes or heart disease. Those who reported eating vegetables or fruits two or more times daily totaled only 39% and 37%, respectively. In summary, overweight or obesity was prevalent on the Southeast Texas college campus, especially among black participants. About two third of the participants had multiple chronic disease risk factors. Activities to raise awareness of risk factors for chronic diseases and actions to promote a healthy lifestyle are needed on the college campus.

Keywords: Chronic disease; Risk factors; Ethnic groups; Anthropometry; Obesity

Introduction

According to a report from the Centers for Disease Control and Prevention (CDC) in October 2013, the prevalence of obesity among adults in the U.S. remains very high (34.9%) and has remained statistically unchanged between 2009–2010 and 2011–2012 [1]. Although obesity remains most prevalent among the middle aged, the rate of obesity among U.S. adolescents aged 12-19 more than quadrupled from 1980 to 2012, from 5% to nearly 21% [2]. Similarly, the greatest magnitude of increase in obesity between the years 1991 to 2001 was among 18-29 year olds, rising from 7.1% to 14%, based upon results of the Behavioral Risk Factor Surveillance System (BRFSS), a cross-sectional telephone survey of women and men, ages 18 and older, living within the U.S. [3,4]. This age group represents the majority of U.S. college students. Researchers have also discovered that becoming overweight or obese during adolescence and early adulthood increases one's likelihood of remaining overweight or becoming obese throughout adulthood [5].

Obesity at a young age poses a greater risk of developing chronic diseases such as heart disease, high blood pressure, type-2 diabetes (DM), and certain types of cancers in young adults [6]. Poor diet, inactivity, and family history are major risk factors for these diseases, which are also commonly linked to obesity. Research suggests that younger generations may have shorter life expectancies than their parents if the obesity epidemic is not controlled [7,8]. The development of the chronic diseases could largely be reduced or even prevented if actions promoting increased awareness, early intervention, and lifestyle changes are implemented early. Yet many young adults at risk for these diseases are unaware of their body weights and health risks due to a lack of medical care and misinformation. Routine recommendations for young adults are blood pressure and weight checks about every 2 years after their initial checkups and a cholesterol check every 5 years after age 35. Women who are sexually active should receive a well-woman check-up every year. Many college students do not receive annual checkups and fail to request testing for blood glucose, blood pressure or cholesterol [9].

Besides obesity, family histories of diabetes and heart disease were the most prevalent risk factors for chronic diseases. Family history of heart attack has been shown to nearly double the risk of heart attack in men and increase the risk to nearly 70% in women [10,11]. In Texas the African American population had the highest age-adjusted mortality rate for cardiovascular disease (CVD) than other racial/ethnic populations [12]. The Vital Signs publication from CDC has also shown that African Americans are nearly twice as likely as whites to die early from preventable heart disease and stroke [13].

The purpose of this study was to assess the prevalence of obesity and risk factors for chronic diseases among racial/ethnic groups of college students in Southeast Texas. Early detection of risk factors in target groups along with lifestyle changes, such as increased physical

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activities and improved quality of diet, may effectively lower the risks of the chronic diseases and even prevent or delay their occurrences in the future. Few studies of this nature have been conducted in this region.

Materials and Methods

Study population and recruitment

College students from a midsize four year public university located in Southeast Texas of the United States (student enrollment, approximately 14,000 as of spring 2014) were recruited for a free health assessment. An advertisement was sent in an email to each student through the University email system. Flyers were also strategically placed on bulletin boards throughout the campus. On the day of the health fair students who passed by the event booths were solicited for a free health assessment.

The study was approved by the University's Institutional Review Board (IRB). We certify that all processes and procedures regarding the ethical use of human subjects in this study were in accordance with all applicable regulations. A signed written informed consent was obtained from each participant prior to taking the survey or initiation of any measurements.

Instrumentation

The Behavioral Risk Factor Surveillance System (BRFSS) survey [14], which was created by the CDC to screen for health related behavioral risks such as smoking, alcohol use, diet practices, physical activity, and family medical history, was adapted to fit the needs of this study. Additional questions to obtain demographic information were added to form the 29 questions used in the health assessment survey. Participants' ethnicity and racial background were self-reported using the following categories: White, Black or African American, Hispanic or Latino, American Indian or Alaska Native, Asian, Hawaiian or Pacific Islander, and Multiracial. Examples of other questions included family history of diabetes, heart disease, and hypertension.

Participants' height and weight were measured with a calibrated medical scale with a height rod in inches and centimeters (Detecto, Cardinal Scale Manufacturing Co, Webb City, MO 64870). Body mass index (BMI) was calculated according to CDC and NIH published guidelines and categorized as underweight (BMI < 18.49 kg/m^2), normal (BMI =18.5 to 24.9 kg/m^2), overweight (BMI= 25 to 29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2) [15,16].

Waist and hip circumferences were measured to the nearest 0.1 cm with a non-extensible tape. For waist circumference the tape was placed at the uppermost lateral border of the hip crest (ilium) [17]. A waist circumference that was greater than 88 cm (35 inches) for women or greater than 102 cm (40 inches) for men substantially increased the risks for heart disease and type 2 diabetes and was classified as abdominal obesity [18]. Hip circumference was measured at the largest circumference of the buttocks. Waist-to-hip ratio (WHR) was defined as the waist circumference divided by the hip circumference. Participants who are WHR were above 0.90 in men and above 0.85 in women were classified as high risk for chronic diseases [18].

Percentage of body fat was determined through the use of a bioelectrical impedance analysis (BIA) instrument (Model Quantum IV, RJL systems, Clinton Township, Michigan 48035, USA). The electrodes were placed on the right hand and right foot of the participant according to the manufacturer's instructions. The resistance and reactance were recorded and entered into the system program to obtain percentage of body fat.

A blood pressure sphygmomanometer (Model BP710, Omron Healthcare, Inc., Bannockburn, IL 60015) was used to screen participants for hypertension. According to the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) guidelines systolic blood pressure > 130 mm Hg or diastolic blood pressure > 85 mm Hg is considered one of the risk factors for metabolic syndrome [19]. Casual blood glucose was measured with a blood glucose meter (Accu-Chek Aviva, Roche Diagnostics, Indianapolis, Indiana 46250), and a level exceeding 200 mg/dl was considered elevated [20].

Protocol

On the day of the health fair, students who passed by the event location were solicited to participate in the study. Students were informed about the study's protocol, the confidentiality of the data collected, and their right to withdraw or refuse to answer any questions, or to be measured at any time during the study. A signed informed consent was obtained from each student who agreed to participate. Pregnant or lactating women and students who wore a pace maker were identified before signing the consent form and were excluded from the study. Anthropometric measurements began after the participants completed the health survey.

Trained research staff screened the participants, administered the survey, followed the protocol, and conducted anthropometric measurements. Participants were instructed to remove shoes, heavy clothing, and objects from the pockets for height and weight measurements. Waist and hip circumferences were measured with a medical measuring tape. Subjects then reclined in a slanted chair with both feet up and socks removed for bioelectrical impedance analysis. Blood sugar and blood pressure were measured last after the participant had been sitting calmly for at least five minutes.

Eight risk factors were selected on the basis of previously identified factors in the literature and comprised of both measurement-derived items and self-reported items. Three measurement-derived items included BMI ≥ 25 kg/m^2, high risk waist circumference (> 102 cm for men or > 88 cm for women) [18], and high risk blood pressure (BP) that included systolic BP (SBP) > 130 mm Hg or diastolic BP (DBP) > 85 mm Hg (NCEP-ATP III) [19]. Five self-reported items obtained from the survey included being a current smoker, over-drinking (alcohol), physical inactivity, family history of diabetes (FHxDM), and family history of CVD (FHxCVD). A current smoker was defined as consistently smoking a tobacco product within the past year. Over-drinking was defined following Dietary Guidelines for Americans as consuming more than the recommended two drinks for men or one drink for women in one day [21]. Physical inactivity was defined as physical activity performed less than 3 times a week.

Statistical analysis

Continuous variables are presented as means and standard deviations (SDs), and categorical data are summarized as frequency and percentages. Differences between races/ethnicities on continuous

Table 1: Anthropometric characteristics of the participants based on race/ethnicity.

Characteristics	Total		White (n=46)		Black (n=36)		Hispanic (n=6)		Asian (n=8)		
	Mean ±	SD	Mean ±	SD	Mean ±	SD	Mean ±	SD	Mean ±	SD	*p*
Age, year	22.3 ±	5.3	23.4 ±	6.7	20.8 ±	3.3	20.2 ±	1.9	24.4 ±	3.0	0.066
Height, cm	168.8 ±	8.7	170.5 ±	9.0	167.5 ±	8.5	165.6 ±	7.1	167.1 ±	7.8	0.306
Weight, kg	76.6 ±	19.7	74.6 ±	16.8	81.5 ±	22.8	74.5 ±	24.0	67.4 ±	13.3	0.210
BMI, kg/m^2	26.8 ±	6.4	25.6 ±	5.4	28.9 ±	7.5	26.8 ±	6.5	23.9 ±	3.5	0.067
Body Fat, %	25.6 ±	10.6	24.4 ±	9.6	26.8 ±	12.1	31.3 ±	12.2	22.0 ±	5.5	0.299
Waist Circumference, cm	85.4 ±	16.8	82.2 ±	13.7	90.9 ±	20.1	83.0 ±	15.0	80.2 ±	12.6	0.096
Hip Circumference, cm	103.6 ±	12.6	101.8 ±	10.2	107.4 ±	14.9	100.4 ±	15.7	98.6 ±	7.9	0.114
Waist-Hip Ratio	0.82 ±	0.09	0.81 ±	0.08	0.84 ±	0.09	0.83 ±	0.07	0.81 ±	0.08	0.354
Systolic BP, mm Hg	122.6 ±	13.5	124.0 ±	15.0	123.7 ±	10.9	117.2 ±	16.9	114.3 ±	11.7	0.198
Diastolic BP, mm Hg	74.8 ±	10.6	73.0 ±	10.7	78.1 ±	9.8	71.2 ±	11.9	72.3 ±	11.1	0.124
Glucose, Casual, mg/dl	99.1 ±	17.6	100.6 ±	21.0	96.9 ±	14.0	90.7 ±	12.5	107.3 ±	12.4	0.268

variables were analyzed using analysis of variance (ANOVA). Categorical data and demographic variables were analyzed using cross-tabulations and were compared using Pearson's chi-square tests. Chronic disease risk factors were dichotomized into presence or absence of risk. A multiple risk factor score ranging from 0 to 8 (0 = no risk factor, 8 = all 8 risk factors) was obtained by summing individual risk factors. A p value < 0.05 was considered statistically significant for all analyses. All data analyses were performed with Statistical Package for the Social Sciences (SPSS) software, version 19.0 (Chicago, IL, USA).

Results

Anthropometric characteristics of the participants

A total of 96 students participated in the study. Table 1 shows the characteristics of the participants and anthropometric results based on race/ethnicity. The average age was 22.3 years old (±5.3 years). Asian and White students were three to four years older than Black and Hispanic students in average age. Average height, weight, BMI and the remaining anthropometric measurements showed no significant differences among participants of different races/ethnicities. The overall mean weight was 76.6 kg and ranged from 67.4 kg in Asians to 81.5 kg in Black or African Americans. Similar trends appeared in BMI which spanned from 23.9 in Asian to 28.9 in Black or African American students with an overall average of 26.8 ± 6.4. Although the average of body fat percentages was the highest in Hispanic students, due to a low number of participants, the differences were not statistically significant. For waist and hip circumferences, Black or African American students showed the highest circumferences compared to other ethnic groups. No participant's casual blood glucose level was over 200 mg/dl.

Table 2 shows that 47% of the participants were males and 53% were females. Among the participants, 48% were White, 38% were Black or African Americans, only 6% were Hispanic or Latino, and 8% were Asian. No other races/ethnicities were reported. The distribution of BMI showed that only 3% were underweight (all were white females) and the majority of students (45%) were in the normal weight category. However, participants in the 'Overweight' or 'Obese' categories together totaled 52%.In the obese category, 15% were Black and 9% were White. It showed that among the obese participants 56% (14 out of 25) were Black. When examining the distribution within race, obesity occurred more prevalently among the Black; 14 out of 36 (39%) Black or African American participants were obese. A similar trend was observed in abdominal obesity, which indicated that at least one out of three Black or African Americans in our study were obese or had abdominal obesity.

Distribution of chronic disease risk factors

A summary of the percentage of participants with cumulative risk factors and the contribution from each factor is presented in Table 3. The most prevalent risk factor among our participants was a family history of diabetes, totaling 63%, followed by overweight or obesity (BMI > 25 kg/m^2), 52%. A family history of heart disease, totaling 48%, ranked the third most prevalent risk factor. Having two to four chronic disease risk factors appeared to be the most common among the participants, each ranging from 20-25%. Only 4% of the participants had no risk factor at all, and no one had all eight risk factors. Overall 17% of the participants had five or more risk factors.

Table 2: Participants' characteristics and weight categories based on race/ethnicity[a].

Characteristics	Total (n)	White (n)	Black (n)	Hispanic (n)	Asian (n)
Gender					
Male	47% (45)	25% (24)	13% (12)	2% (2)	7% (7)
Female	53% (51)	23% (22)	25% (24)	4% (4)	1% (1)
Total	100% (96)	48% (46)	38% (36)	6% (6)	8% (8)
BMI category					
Underweight	3% (3)	3% (3)	0% (0)	0% (0)	0% (0)
Normal	45% (43)	22% (21)	16% (15)	3% (3)	4% (4)
Overweight	26% (25)	14% (13)	7% (7)	1%(1)	4% (4)
Obese	26% (25)	9% (9)	15% (14)	2% (2)	0% (0)
Abdominal Obesity[b]					
Yes	24% (23)	7% (7)	15% (14)	2% (2)	0% (0)
No	76% (73)	40% (39)	23% (22)	4% (4)	8% (8)

[a]Percentage distribution was based on the total percentage within each characteristic (e.g., gender, BMI, abdominal obesity)rather than the total percentage within the race/ethnicity.

[b]Abdominal obesity was defined as waist circumference greater than 88 cm (35 inches) for women or greater than 102 cm (40 inches) for men [18].

Table 3: Summary of risk factor distribution among participants and ethnic groups.

No. of Total Risk Factors	n (%)	FHxDM[a]	BMI ≥ 25	FHxCVD[a]	Over Drinking	High Risk BP	Current Smoker	Physical Inactivity	High Risk WC[a]
0	4 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
1	13 (14%)	4 (7%)	0 (0%)	3 (7%)	3 (9%)	1 (3%)	2 (7%)	0 (0%)	0 (0%)
2	19 (20%)	11 (19%)	8 (16%)	4 (9%)	4 (12%)	3 (9%)	3 (11%)	4 (17%)	1 (4%)
3	24 (25%)	12 (21%)	17 (34%)	9 (21%)	6 (18%)	10 (29%)	6 (22%)	5 (21%)	7 (30%)
4	19 (20%)	15 (26%)	10 (20%)	13 (30%)	10 (30%)	8 (24%)	7 (26%)	8 (33%)	5 (22%)
5	10 (10%)	10 (17%)	8 (16%)	9 (21%)	5 (15%)	6 (18%)	3 (11%)	5 (21%)	4 (17%)
6	6 (6%)	5 (9%)	6 (12%)	4 (9%)	4 (12%)	5 (15%)	5 (19%)	2 (8%)	5 (22%)
7	1 (1%)	1 (2%)	1 (2%)	1 (2%)	1 (3%)	1 (3%)	1 (4%)	0 (0%)	1 (4%)
% of Total	100%	63%	52%	48%	39%	37%	28%	28%	25%
White	-	21 (23%)	22 (23%)	24 (27%)	19 (23%)	16 (17%)	20 (21%)	13 (15%)	7 (7%)
Black	-	28 (30%)	21 (22%)	13 (15%)	10 (12%)	14 (15%)	4 (4%)	9 (10%)	14 (15%)
Hispanic	-	4 (4%)	3 (3%)	3 (3%)	1 (1%)	3 (3%)	1 (1%)	1 (1%)	2 (2%)
Asian	-	5 (5%)	4 (4%)	3 (3%)	3 (4%)	1 (1%)	2 (2%)	1 (1%)	0 (0%)

[a]FHxDM: Family history of diabetes, FHxCVD: Family history of cardiovascular disease. High risk waist circumference (WC) was defined as waist circumference greater than 88 cm (35 inches) for women or greater than 102 cm (40 inches) for men [18].

The results from the health survey also reflected this trend: When asked about their health condition in general, 83% (n = 80) of the students responded "Excellent/very good/good" and 15% (n = 14) responded only "Fair/poor."

When examining the risk factors within each racial/ethnic group, it appeared that more Black or African American students had a family history of diabetes than White students, and more White students had a family history of heart disease. Also, more White students showed overdrinking and current smoking behaviors than Black or African American students. More Black students had abdominal obesity (or high risk waist circumference) than other ethnic groups.

Fruit/vegetable/bean/fruit juice consumption

The results of participants' self-reported fruit, vegetable, bean and 100% fruit juice consumption are shown in Table 4. Only 37% of participants consumed fruits two or more times a day (meeting recommendation) and the pattern had no significant difference between ethnic groups. Similar pattern appeared in vegetable (non-potato products) consumption frequency where only 39% of participants consumed vegetables two or more times a day. For bean consumption, 75% of participants consumed beans at least once per week and 16% claimed not consuming beans at all. Regarding fruit juice consumption, 66% of participants drank at least once per week, nearly 27% claimed drinking it more than once per day, and 24% did not drink juice at all.

Discussion

The study was intended to determine if obesity was prevalent in college students in Southeast Texas and if any racial/ethnic groups were more at risk of chronic diseases since Beaumont-Port Arthur area was named the fifth most obese metropolitan area in the nation according to a Gallup-Health ways poll revealed in 2012 [22]. Based on the data from Census 2010, the population in the Beaumont-Port Arthur area in Southeast Texas consisted of 45% White, 34% Black or African American, 17% Hispanic or Latino and 3.9% other populations according to the Texas State Data Center [23]. While the percentage of Hispanic and Asian populations in the study may vary slightly from the state data, the overall distribution trend was similar to the reported state data. However, due to a very small sample size of participants from Hispanic and Asian populations, many of the study results were unable to show statistical significance.

Overweight or obesity is prevalent in an estimated 30-35% of US college students [24,25]. Our reported overweight or obesity rate was about 52%, which was significantly higher than the average reported in other studies, and over 20% of our participants were obese with a high risk waist circumference. The overall data from anthropometric results showed that Black or African American students had a higher

Table 4: Participants' fruit, vegetable, bean, and fruit juice consumption by race/ethnicity[a].

Characteristics	Total	White	Black	Hispanic	Asian	pValue[b]
Fruit consumption frequency:						
≥ 2 times/day	36.8%	41.9%	29.0%	66.7%	14.3%	0.164
< 2 times/day	63.2%	58.1%	71.0%	33.3%	85.7%	
Vegetable consumption frequency:						
≥ 2 times/day	39.1%	45.5%	33.3%	50.0%	14.3%	0.351
< 2 times/day	60.9%	54.5%	66.7%	50.0%	85.7%	
Bean consumption frequency:						
≥ 1 time/day	14.3%	16.7%	13.0%	16.7%	0.0%	0.771
1 - 6 times/week	61.0%	64.3%	52.2%	50.0%	83.3%	
< 4 times/month	9.1%	4.8%	17.4%	16.7%	0.0%	
Not at all	15.6%	14.3%	17.4%	16.7%	16.7%	
Fruit juice consumption frequency:						
≥ 1 time/day	26.6%	19.0%	34.6%	50.0%	20.0%	0.032*
1 - 6 times/week	39.2%	50.0%	11.5%	50.0%	80.0%	
< 4 times/month	10.1%	9.5%	15.4%	0.0%	0.0%	
Not at all	24.1%	21.4%	38.5%	0.0%	0.0%	

[a]Racial differences determined by Pearson's chi-square tests. Data considered statistically significant (*) at p< 0.05.

average on body weight, BMI, waist and hip circumferences than other ethnic groups. According to the National Heart Lung and Blood Institute, increased waist circumference combined with overweight or obesity further amplifies a person's associated disease risk for type 2 diabetes, hypertension, and CVD [26]. The Vital Signs publication from CDC [13] has also shown that blacks or African Americans are nearly twice as likely as whites to die early from preventable heart disease and stroke. Learning from the results, more research may be needed to further explore the causes of increased risk in this ethnic group, so that more effective health promotion activities and disease prevention strategies targeting this group can be developed.

Although there is debate in the scientific community regarding a BMI cut-off point for determining overweight and obesity in Asian populations, there is not enough data to suggest a clear cut-off point for all Asians for overweight or obesity [27]. The WHO expert consultation did suggest the public health action points at BMI of 23.0, 27.5, 32.5, and 37.5 kg/m^2, and proposed methods by which countries could establish their own definition of increased risk for their own population. Since the Asian participants in the current study had BMIs in the range of 18.8 – 27.4 kg/m^2 and some may come from different countries or may be born in the US, therefore we retained the WHO international classification of BMI for the Asian participants in the study.

Besides obesity, family histories of diabetes and heart disease were the most dominant risk factors among the eight chronic disease risk factors we summarized in our study. The relative risks of developing type 2 diabetes for an individual with a moderate to high familial history, and without other risk factors, could range from 2.3 to 5.5 times more than a person without a family history of diabetes [28]. Family history of heart attack has been shown to nearly double the risk of heart attack in men, and increases the risk to nearly 70% in women [10,11]. The surveillance report on Cardiovascular Disease in Texas 2012 indicated that the African American population had a higher age-adjusted mortality rate for CVD than other racial/ethnic populations in Texas [12]. Since increased awareness, early intervention, and lifestyle changes are proven strategies to lower the risks of these chronic diseases, a self-administered web-based tool called "My Family Health Portrait" developed by the CDC [29] that enables persons to collect family health history, may benefit certain subgroups of the population to become more aware of their family health histories.

Other behavioral risk factors that are major determinants of adult chronic disease morbidity and mortality include: drinking alcohol, smoking tobacco, physical inactivity, and poor diet [30,31]. The percentage of over drinking and smoking occurred higher in White students than in Black or African American students in our sample. Smoking is a well-established risk factor for a number of diseases, and this cause of disease is largely preventable. Education to advocate smoking cessation and moderate consumption of alcohol on campus may benefit all students. Physical inactivity has been implicated in numerous studies as a modifiable risk factor. An active lifestyle may bring about positive effects to correct the overweight or obesity problem, and at the same time, lower waist circumference and blood pressure.

The percentages of participants meeting fruit or vegetable consumption recommendations (both measured at two or more times per day) were very low (fruit, 36.8%; vegetables, 39.1%). The results showed a similar trend to the reported national data collected in 2009 (fruit, two or more times per day, 32.5%; vegetables, however, were measured at three or more times per day, 26.3%) [32]. Many studies have found that fruit and vegetable consumption was linked to lower risks of chronic diseases such as heart disease [33], cancer, or stroke [34]. Starting in 2005, a national initiative called the "Five A Day" program advocates the consumption of 5-9 servings of fruit and vegetables a day for better health, yet recent results from the CDC showed that no state met *Healthy People 2010* targets related to fruit (consuming two or more times per day) or vegetable (consuming three or more times per day) consumption among adults [32]. Clearly, there are gaps between recommended and actual fruit and vegetable consumption across all demographic and socioeconomic strata, and among individuals with various lifestyle risk factors. However, action must be initiated. The college setting offers a great educational opportunity to set out health promotion campaigns that may contain multiple behavioral pathways such as being physically active or following a healthy diet. Research has shown that using general nutrition courses to implement nutrition intervention for promoting fruit and vegetable consumption is a successful and effective venue [35]. Other venues for such targeted education activities may include freshmen orientation sessions, dining facilities for point-of-sale education, student clubs/associations, and residence halls. Other small actions on campus may include health promotion signage (e.g., benefits of fruit and vegetable consumption, stair climbing) posted across campus to increase awareness, and offering exercise classes in an open space to increase visibility and to attract participation. For school policy makers or health professionals, creating a health program that allows students to accurately track their risk of developing chronic disease (e.g., CDC's "My Family Health Portrait" [29]) and at the same time offers incentives to incorporate a healthy lifestyle or behaviors would be an area of challenge, but will certainly offer great rewards in promoting a healthier campus in the future.

Strengths of the current study included use of the survey adopted from BRFSS and accompanied by the measurements of anthropometrics. The BRFSS survey had no direct measurements of anthropometrics, body fat percentage, blood pressure, and blood glucose. The other strength was the inclusion of eight risk factors that included family history of diabetes and heart disease. There were also limitations in the current study. First, the study involved only a small sample size of 96 participants recruited from a convenience sample of a mid-sized college campus, which limits the generalizability of the study findings. Furthermore, having an insignificant number of Hispanic and Asian participants lowered the statistical power of the study. Second, the survey was based upon self-reporting and thus subject to recall and social desirability biases, especially on survey questions regarding smoking, alcohol use, physical activity, and consumption of fruits, vegetables, beans, and juice. Third, high risk participants (e.g., obesity, high risk waist circumference, and high blood pressure) were contacted later for further testing of fasting blood glucose and lipid profiles to assess their metabolic syndrome risk; however, most of them were lost for follow-up. Availability of the measures of these parameters would have strengthened our findings.

Conclusion

The study was attempted to examine the prevalence of obesity and chronic disease risks among racial/ethnic groups in college students in Southeast Texas. The results showed the prevalence of overweight and obesity on the college campus. Black or African American students in the study showed a trend of having higher average weights, BMIs, waist and hip circumferences than other ethnic groups. Also they had the highest percentage of obesity with high risk waist circumferences, which placed them in very high or extremely high risk for type II diabetes, hypertension, and/or heart disease. More than one third of the participants had four to seven risk factors, including the two most common non-modifiable ones, i.e. family history of diabetes and heart disease. Healthful behaviors formed during this period of time may have long-lasting health effects. Promotion of healthy behaviors such as regular physical activity, nutrition education, and routine health checkups, along with keeping track of family health history in order to continue monitoring the disease risks, would be desirable for current college students to lower the risks of common chronic diseases in the future.

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