Obesity-related Behaviors of Students at Historically Black Colleges and Universities and Students at non-Historically Black Colleges and Universities

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Objective: We investigated racial differences in overweight and obesity among 4 subgroups: (1) Whites at historically black colleges and universities (HBCUs); (2) Whites at non-HBCUs; (3) Blacks at HBCUs; and (4) Blacks at non-HBCUs. **Methods:** We conducted multivariable logistic regression using cross-sectional data to examine correlates of overweight or obesity by race and school type among white and black students (N = 260,719) who completed the American College Health Association-National College Health Assessment IIb from fall 2011 to spring 2015. **Results:** Among men, more Whites at HBCUs than Whites at non-HBCUs (22.22% vs 9.67%; $p < .001$) and more Blacks at HBCUs than Blacks at non-HBCUs (27.84% vs 16.64%; $p < .001$) had obesity. Among women, more Whites at HBCUs than Whites at non-HBCUs (25.82% vs 8.80%; $p < .001$) and more Blacks at HBCUs than Blacks at non-HBCUs (27.62% vs 20.58%; $p < .001$) had obesity. Overall, highest adjusted odds ratios for overweight and obesity were observed for Blacks at HBCUs ($p < .001$). **Conclusions:** Findings suggest the need for implementation of aggressive overweight and obesity prevention strategies for students at HBCUs. Additional research is needed to understand determinants of overweight and obesity among students at HBCUs.

Key words: obesity; college students; historically black colleges and universities (HBCUs); racial differences
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Overweight and obesity among college students are a global health problem, affecting individuals in developed and developing countries alike.[1] In the United States (US) approximately 20% of college students are overweight and 10% have obesity.[2] Individuals with overweight and obesity are susceptible to multiple comorbidities, such as cardiovascular disease, type 2 diabetes, and cancer.[3,4] Whereas weight management ideally occurs at all stages of life to prevent obesity-related comorbidities,[3,4] studies suggest that weight-related interventions are particularly important for college

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students.[5-7] Many college students experience rapid weight gain during their first year in college,[8] and without proper intervention, the weight students gain in college and behaviors that lead to the weight gain continue until later in life.[6, 9]

Many factors predict an individual's likelihood of developing overweight or obesity. Cigarette use,[10] alcohol use,[11] lower consumption of fruits and vegetables,[12] physical inactivity,[13] depression,[14] sleep problems,[15] and poor body weight perception[16] are commonly associated with overweight and obesity in the adult population. In addition to these individual factors, given the social-ecological model[17] in which human behavior is explained in terms of the complex interplay among policies, environmental factors, and institutional, interpersonal, and intrapersonal factors where the behavior is performed, one might assume that behaviors of college students may be influenced by their college environment. For example, the type of college students' residence predicts obesity and health behaviors.[18] Specifically, students who live off-campus are more likely to have overweight or obesity, smoke, and consume alcohol, and less likely to consume fruits and vegetables than those who live on-campus.[18] These findings, however, may not equally apply to all college students due to racial/ethnic disparities in college overweight and obesity.[2]

Past studies have reported that non-Hispanic Blacks (Blacks) are more likely to be overweight or obese than non-Hispanic Whites (Whites).[2, 19] Prior research also reported that black college students are more likely to underestimate their body weight[20] and to be satisfied with their body size[21, 22] than their white counterparts,[2, 19] which may result in higher overweight and obesity rates in the black college population.[23, 24] College type has emerged as a factor that may be related to racial/ethnic differences in overweight and obesity among college students, though the number of relevant research has been limited, with mixed results. On one hand, there are studies suggesting that historically black colleges and universities (HBCUs) are significantly different from non-HBCUs in predicting students' body weight.[2,25] Although the studies have not examined the underlying causes rigorously, such differences may be attributed to HBCUs having unique structural features like black culture.[26-29] On the other hand, there is a study suggesting that HBCUs are not significantly different from non-HBCUs in predicting students' body weight when comparing members of the same race/ethnicity.[30] The study compares body mass index (BMI) between black women at one HBCU and black women at one predominately white university in Florida, but found no significant differences.[30] Thus, it may be that students at HBCUs show higher rates of overweight or obesity,[25] only because the majority of students attending HBCUs are Blacks and predisposed toward overweight and obesity.[25,30]

To the best of our knowledge, no studies have made rigorous examination of racial differences in overweight and obesity by college type. It is unclear which US college students and at which college type are at greater risk for overweight and obesity. Thus, the purpose of this study was to examine racial differences in overweight and obesity among 4 subgroups: (1) Whites at HBCUs; (2) Whites at non-HBCUs; (3) Blacks at HBCUs; and (4) Blacks at non-HBCUs. Based on previous studies,[2,25-30] we hypothesized that Whites at HBCUs would be more likely to be overweight or obese than their white counterparts at non-HBCUs, and likewise Blacks at HBCUs would be more likely to be overweight or obese than their black counterparts at non-HBCUs. This study also provides much needed research on correlates of college overweight and obesity by race and college type, allowing for identification of college students who are particularly vulnerable to overweight and obesity.

METHODS

Data and Participants

Multi-year data for the current cross-sectional study were drawn from the National College Health Assessment study organized by the American College Health Association (ACHA-NCHA). The ACHA-NCHA is an annual national survey to measure health-related behaviors and outcomes among students in public and private colleges and universities in the US that has been conducted since 2000. The validity and reliability of the ACHA-NCHA were established by the ACHA.[31] In the current study, we analyzed ACHA-NCHA IIb data collected from 201 self-selected postsecondary institutions. Participating institutions used random sampling to survey a nationally representative sample of US college students. The response rates ranged from 15% to 21%

for Web-based surveys and 71% to 100% for paper-based surveys. Participating institutions varied by school size (ranging from < 2500 to > 20,000) and HBCU status. In total, 500,860 undergraduate and graduate students participated in ACHA-NCHA IIb only one time from fall 2011 to spring 2015. Informed consent was acquired from participants who completed the ACHA-NCHA IIb. Based on prior research,[32,33] exclusion criteria included: (1) being transgender; (2) being biracial or multiracial; (3) having race/ethnicity not identified; (4) being > 25 years of age at time of survey; and (5) being an international student. Considering the study purpose, Hispanics, non-Hispanic Asians, American Indians, Alaskan Natives, and Native Hawaiians were not included in this investigation. Participants with missing data (N = 49,853) about demographics (eg, sex and age) and BMI also were excluded from the sample. A total of 260,719 students comprised the final analytic sample.

Measures

Dependent variable. BMI was calculated as self-reported weight (kilograms) divided by self-reported height (meters squared). BMI was classified into 4 categories: underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 25.0), overweight (25.0 ≤ BMI < 30.0), and obesity (BMI ≥ 30.0). We dichotomized these categories to capture overweight or obesity status (no vs overweight or obese).

Independent variables. Participants answered questions about demographic characteristics (eg, age, sex, and race/ethnicity), and ACHA-NCHA provided information about school size (< 2500, 2500-4999, 5000-9999, 10,000-19,999, and ≥ 20,000) and whether institutions have an HBCU designation.

Perceived overall health was measured by asking participants: "*How would you describe your general health?*" with 6 response options (1 = excellent, 2 = very good, 3 = good, 4 = fair, 5 = poor, 6 = don't know).[34] The response options were combined into 3 categories (excellent/very good; good; and fair/poor) due to small cell sizes. Self-perception of weight was assessed by comparing students' actual BMI categories and self-perceived weight status.[35] Self-perceived weight was measured by the question: "*How do you describe your weight?*" with 5 response options (1 = very underweight, 2 = slightly underweight, 3 = about the right weight, 4 = slightly overweight, and 5 = very overweight). When students' self-perceived weight accurately represented their actual BMI categories (eg, students having BMI between 18.5 and 24.9 reported that they are about the right weight), they were categorized as 'accurate estimation'. Students were categorized as 'underestimation' when their perceived weight was lighter than their BMI (eg, students perceive their weight is about the right weight when their actual BMI signals overweight). Likewise, 'overestimation' was defined as heavier perceived weight compared to actual BMI. Weight management goal was assessed by the question: "*Are you trying to do any of the following about your weight?*" with 4 response options (1 = I am not trying to do anything about my weight, 2 = stay the same weight, 3 = lose weight, and 4 = gain weight).

Sleep quality was measured by the question: "*On how many of the past 7 days did you get enough sleep so that you felt rested when you woke up in the morning?*" with 8 response options ranging from 0 days to 7 days.[36] Due to small cell sizes, answer options were combined into 3 categories (0 days, 1-2 days, and ≥ 3 days). Sleep difficulties were assessed using a dichotomous (yes/no) measure: "*Within the last 12 months, have sleep difficulties been traumatic or very difficult for you to handle?"*

Because living environment can affect students' eating behaviors,[37] it was assessed by asking: "*Where do you currently live?*" with 6 response options (1 = campus residence hall, 2 = fraternity or sorority house, 3 = other college/university housing, 4 = parent/guardian's home, 5 = other off-campus housing, and 6 = other). These options were dichotomized (on-campus vs off-campus). As work hours have been associated with eating behaviors,[38] work hours were measured by the question: "*How many hours a week do you work for pay?*" with 7 response options ranging from 0 hours to ≥ 40 hours. We combined the options to make 4 categories (0 hours, 1-19 hours, 20-39 hours, and ≥ 40 hours) due to small cell sizes.

Controlled variables. In measuring overall stress level, participants were asked: "*Within the last 12 months, how would you rate the overall level of stress you have experienced?*" with 5 response options (1 = no stress, 2 = less than average stress, 3 = average stress, 4 = more than average stress, and 5 =

tremendous stress). Participants were asked about their anxiety by the question: "*Within the last 12 months, have you been diagnosed or treated by a professional for any of the following*?*"* with 6 response options (1 = no; 2 = yes, diagnosed but not treated; 3 = yes, treated with medication; 4 = yes, treated with psychotherapy; 5 = yes, treated with medication and psychotherapy; and 6 = yes, other treatment). Due to small cell sizes, the response options were dichotomized (no vs other responses).

For cigarette smoking, participants were asked to indicate their frequency of smoking to the question: "*Within the last 30 days, on how many days did you use cigarettes?*" using 8 response options (1 = never used; 2 = have used, but not in last 30 days; 3 = 1-2 days; 4 = 3-5 days; 5 = 6-9 days; 6 = 10-19 days; 7 = 20-29 days; and 8 = used daily). Frequency of alcohol consumption in the past 30 days was measured using the same question and answer options. For both cigarette and alcohol use, the answer options were re-categorized into 4 groups (never used, have used but not in the last 30 days, 1-9 days, and ≥ 10 days) due to small cell sizes. Daily fruit and vegetable consumption was measured by the question: "*How many servings of fruits and vegetables do you usually have per day?*" with 4 answer options (1 = 0 servings/day, 2 = 1-2 servings/day, 3 = 3-4 servings/day, and 4 = 5 or more servings/day). The response options were combined to make 3 categories (0 serving/day, 1-2 servings/day, ≥ 3 servings/day). Depression status was measured by the question: "*Have you ever been diagnosed with depression?*" with a dichotomous answer option (yes/no).

Also, we assessed whether students met the physical activity guidelines by asking on how many days in the past 7 days did they: "*do moderate-intensity cardio or aerobic exercise (caused a noticeable increase in heart rate, such as a brisk walk) for at least 30 minutes?*" and "*do vigorous-intensity cardio or aerobic exercise (caused large increases in breathing or heart rate, such as jogging) for at least 20 minutes?*" with 8 response options ranging from 0 days to 7 days. To meet the physical activity guidelines, students had to engage in moderate-intensity cardio or aerobic exercise for at least 30 minutes on 5 or more days per week, or vigorous-intensity cardio or aerobic exercise for at least 20 minutes on 3 or more days per week. Based on these criteria, the responses were dichotomized (met the guidelines vs no).

Data Analysis

Based on race and the types of colleges/universities participants were attending, participants were divided into 4 subgroups: Blacks at HBCUs, Blacks at non-HBCUs, Whites at HBCUs, and Whites at non-HBCU. To compare sample characteristics across the 4 groups, Pearson's chi-square tests were conducted for male and female students, respectively. Additionally, we constructed 5 separate multivariable logistic regression models to assess correlates of overweight or obesity status in different samples. For the first model, we included all participants from the 4 subgroups. To find the association between the race/college settings and overweight or obesity status, we controlled for the effects of other confounding factors (stress status, anxiety status, cigarette use in the last 30 days, alcohol use in the last 30 days, daily fruit and vegetable consumption, depression status, and meeting physical activity guidelines) based on prior research.[2,39,40] The remaining 4 models represented each one of the 4 subgroups (ie, Blacks at HBCUs, Blacks at non-HBCUs, Whites at HBCUs, and Whites at non-HBCU) with the same confounding variables controlled for as mentioned above. We used Stata version 14 (Stata Press, College Station, TX) for data analysis with statistical significance set at .05.

RESULTS

Of the entire sample (N = 260,719), 176,877 (67.84%) were female students with ages ranging from 18 to 25 (M = 20.36 years; SD = 1.79). The majority (99.48%) attended non-HBCUs. The 4 subgroups of our sample (Blacks at HBCUs; Blacks at non-HBCUs; Whites at HBCUs; Whites at non-HBCUs) showed statistically significant differences in age, self-perceived overall health, past 30-day use of cigarettes and alcohol, fruit/vegetable intake, BMI, body weight perception, weight management goal, physical activities, and sleep patterns (Tables 1 and 2).

Among men, Whites at HBCUs were significantly more likely to be obese compared to Whites at non-HBCUs (22.22% vs 9.67%; $p < .001$) (Table 1). Similarly, Blacks at HBCUs were more likely to be obese than Blacks at non-HBCUs (27.84% vs 16.64%; $p < .001$). Interestingly, 42.27% of Blacks at HBCUs underestimated their body weight, com-

Table 1
Characteristics of College Men by Race and HBCU Status (N = 83,842)

	White at HBCU (N = 270) N (%)	White at non-HBCU (N = 79,082) N (%)	Black at HBCU (N = 194) N (%)	Black at non-HBCU (N = 4296) N (%)	Effect size[a] (DF)	p-value
Age					.02 (1)	< .001
18 – 20 years old	158 (58.52)	43,044 (54.43)	117 (60.31)	2,535 (59.01)		
21 – 25 years old	112 (41.48)	36,038 (45.57)	77 (39.69)	1,761 (40.99)		
Perceived overall health					.01 (2)	.001
Excellent/very good	145 (57.31)	52,175 (67.31)	118 (65.19)	2,698 (65.20)		
Good	91 (35.97)	20,605 (26.58)	44 (24.31)	1,164 (28.13)		
Fair/poor	17 (6.72)	4,739 (6.11)	19 (10.50)	276 (6.67)		
Cigarette use in last 30 days					.05 (3)	< .001
Never used	177 (65.56)	52,328 (66.47)	156 (82.11)	3,553 (83.33)		
Used, but not in last 30 days	41 (15.19)	13,159 (16.72)	16 (8.42)	387 (9.08)		
Used 1-9 days	18 (6.67)	8,048 (10.22)	7 (3.68)	216 (5.07)		
Used ≥ 10 days	34 (12.59)	5,185 (6.59)	11 (5.79)	108 (2.53)		
Alcohol use in last 30 days					.06 (3)	< .001
Never used	99 (36.94)	15,066 (19.19)	84 (44.68)	1,408 (33.31)		
Used, but not in last 30 days	54 (20.15)	8,325 (10.60)	26 (13.83)	621 (14.69)		
Used 1-9 days	86 (32.09)	38,727 (49.32)	52 (27.66)	1,725 (40.81)		
Used ≥ 10 days	29 (10.82)	16,399 (20.89)	26 (13.83)	473 (11.19)		
Fruit/vegetable intake					.05 (2)	< .001
0 serving/day	30 (11.19)	5,721 (7.25)	22 (11.46)	561 (13.10)		
1-2 servings/day	172 (64.18)	47,839 (60.61)	130 (67.71)	2,777 (64.84)		
≥ 3 servings/day	66 (24.63)	25,374 (32.15)	40 (20.83)	945 (22.06)		
BMI categories					.04 (3)	< .001
Underweight	10 (3.70)	2,500 (3.16)	0 (0.00)	67 (1.56)		
Normal weight	123 (45.56)	48,116 (60.84)	75 (38.66)	2,210 (51.44)		
Overweight	77 (28.52)	20,816 (26.32)	65 (33.51)	1,304 (30.35)		
Obesity	60 (22.22)	7,650 (9.67)	54 (27.84)	715 (16.64)		
Self-perception of weight					.03 (2)	< .001
Underestimation	73 (27.04)	20,471 (25.91)	82 (42.27)	1,456 (33.92)		
Accurate estimation	187 (69.26)	54,914 (69.50)	109 (56.19)	2,705 (63.02)		
Overestimation	10 (3.70)	3,631 (4.60)	3 (1.55)	131 (3.05)		

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Table 1 *(cont)*
Characteristics of College Men by Race and HBCU Status (N = 83,842)

	White at HBCU (N = 270) N (%)	White at non-HBCU (N = 79,082) N (%)	Black at HBCU (N = 194) N (%)	Black at non-HBCU (N = 4296) N (%)	Effect size[a] (DF)	p-value
Weight management goal					.03 (3)	< .001
Do nothing	55 (20.45)	16,749 (21.21)	17 (8.81)	688 (16.07)		
Stay the same weight	53 (19.70)	20,926 (26.50)	46 (23.83)	926 (21.64)		
Lose weight	108 (40.15)	24,770 (31.38)	67 (34.72)	1,397 (32.64)		
Gain weight	53 (19.70)	16,509 (20.91)	63 (32.64)	1,269 (29.65)		
Meeting physical activity guidelines[b]					.04 (1)	< .001
Meeting	133 (49.81)	51,515 (65.56)	120 (63.83)	3,148 (74.11)		
Not meeting	134 (50.19)	27,067 (34.44)	68 (36.17)	1,100 (25.89)		
Getting enough sleep to feel rested in the morning in past 7 days					.03 (2)	< .001
0 days	38 (14.07)	5,578 (7.08)	25 (13.09)	501 (11.74)		
1-2 days	72 (26.67)	20,601 (26.14)	62 (32.46)	1,264 (29.61)		
≥ 3 days	160 (59.26)	52,623 (66.78)	104 (54.45)	2,504 (58.66)		

Note.
The percentages may not add up to 100% because of no responses or rounding errors.
Abbreviations: BMI = body mass index; HBCU = historically Black colleges and universities; DF = degrees of freedom
[a] Cramer's V effect sizes were considered small = 0.10, medium = 0.30, and large = .50 with DF = 1; small = .07, medium = .21, and large = .35 with DF = 2; small = .06, medium = .17, and large = .29 with DF = 3
[b] Moderate-intensity cardio or aerobic exercise for at least 30 minutes on 5 or more days per week, or vigorous-intensity cardio or aerobic exercise for at least 20 minutes on 3 or more days per week.

pared to only 33.92% of Blacks at non-HBCUs (p < .001). About twice as many Whites at HBCUs than Whites at non-HBCUs (14.07% vs 7.08%; p < .001) reported 0 days of getting enough sleep to feel rested in the morning in the past 7 days.

Female students exhibited similar patterns with Whites at HBCUs showing a higher rate of obesity than Whites at non-HBCUs (25.82% vs 8.80%; p < .001) (Table 2). Likewise, more Blacks at HBCUs than Blacks at non-HBCUs had obesity (27.62% vs 20.58%; p < .001). Whereas 16.62% of Blacks at HBCUs underestimated their body weight, only 12.08% of Blacks at non-HBCUs did. More Whites at HBCUs than Whites at non-HBCUs (14.75% vs 9.18%; p < .001) reported 0 days of getting enough sleep to feel rested in the morning in the past 7 days.

Table 3 shows that in comparison with Whites at non-HBCUs, Whites at HBCUs (adjusted odds ratio [AOR]: 1.60, 95% confidence interval [CI]: 1.34-1.90), Blacks at HBCUs (AOR: 2.41, 95% CI: 1.98-2.94), and Blacks at non-HBCUs (AOR: 1.87, 95% CI: 1.80-1.94) were at greater risk for overweight or obesity after controlling for covariates. Men were more likely to have overweight or obesity than women (AOR: 1.19, 95% CI: 1.17-1.22).

Among all participants, those living off-campus showed higher likelihood of being overweight or obese than those living on-campus (AOR: 1.06, 95% CI: 1.04-1.08). Compared with participants who did not work, participants with more work hours were more likely to be overweight or obese (p < .001). In contrast to those getting enough sleep for more than 3 days in the past 7 days, participants who had no days (AOR: 1.23, 95% CI: 1.19-1.27) and 1-2 days of getting enough sleep (AOR: 1.11, 95% CI: 1.09-1.14) showed higher odds of

Table 2
Characteristics of College Women by Race and HBCU Status (N = 83,842)

	White at HBCU (N = 270) N (%)	White at non-HBCU (N = 79,082) N (%)	Black at HBCU (N = 194) N (%)	Black at non-HBCU (N = 4296) N (%)	Effect size[a] (DF)	P-value
Age					.01 (1)	< .001
18 – 20 years old	236 (48.36)	96,054 (58.43)	239 (61.13)	6,902 (59.46)		
21 – 25 years old	252 (51.64)	68,337 (41.57)	152 (38.87)	4,705 (40.54)		
Perceived overall health					.05 (2)	< .001
Excellent/very good	216 (47.89)	95,751 (59.15)	161 (43.75)	5,197 (46.11)		
Good	180 (39.91)	53,045 (32.77)	148 (40.22)	4,483 (39.77)		
Fair/poor	55 (12.20)	13,092 (8.09)	59 (16.03)	1,592 (14.12)		
Cigarette use in last 30 days					.05 (3)	< .001
Never used	304 (62.42)	121,050 (73.91)	356 (91.52)	10,073 (87.33)		
Used, but not in last 30 days	70 (14.37)	24,830 (15.16)	16 (4.11)	928 (8.05)		
Used 1-9 days	27 (5.54)	10,941 (6.68)	6 (1.54)	346 (3.00)		
Used ≥ 10 days	86 (17.66)	6,959 (4.25)	11 (2.83)	188 (1.63)		
Alcohol use in last 30 days					.06 (3)	< .001
Never used	160 (32.99)	28,253 (17.32)	132 (34.02)	3,490 (30.36)		
Used, but not in last 30 days	117 (24.12)	19,989 (12.25)	79 (20.36)	2,036 (17.71)		
Used 1-9 days	176 (36.29)	90,920 (55.74)	148 (38.14)	4,967 (43.21)		
Used ≥ 10 days	32 (6.60)	23,962 (14.69)	29 (7.47)	1,002 (8.72)		
Fruit/vegetable intake					.09 (2)	< .001
0 serving/day	35 (7.19)	7,410 (4.51)	58 (14.87)	1,391 (12.02)		
1-2 servings/day	321 (65.91)	93,804 (57.13)	255 (65.38)	7,963 (68.78)		
≥ 3 servings/day	131 (26.90)	62,983 (38.36)	77 (19.74)	2,223 (19.20)		
BMI categories					.07 (3)	< .001
Underweight	31 (6.35)	8,527 (5.19)	11 (2.81)	445 (3.83)		
Normal weight	235 (48.16)	111,463 (67.80)	173 (44.25)	5,859 (50.48)		
Overweight	96 (19.67)	29,937 (18.21)	99 (25.32)	2,914 (25.11)		
Obesity	126 (25.82)	14,464 (8.80)	108 (27.62)	2,389 (20.58)		
Self-perception of weight					.04 (2)	< .001
Underestimation	41 (8.42)	11,772 (7.17)	65 (16.62)	1,400 (12.08)		
Accurate estimation	415 (85.22)	133,469 (81.24)	309 (79.03)	9,423 (81.30)		
Overestimation	31 (6.37)	19,053 (11.60)	17 (4.35)	767 (6.62)		

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Table 2 *(cont)*
Characteristics of College Women by Race and HBCU Status (N = 83,842)

	White at HBCU (N = 270) N (%)	White at non-HBCU (N = 79,082) N (%)	Black at HBCU (N = 194) N (%)	Black at non-HBCU (N = 4296) N (%)	Effect size[a] (DF)	P-value
Weight management goal					.06 (3)	< .001
Do nothing	68 (13.99)	22,936 (13.97)	49 (12.56)	1,611 (13.91)		
Stay the same weight	96 (19.75)	42,509 (25.88)	86 (22.05)	2,346 (20.26)		
Lose weight	304 (62.55)	95,510 (58.16)	215 (55.13)	6,718 (58.01)		
Gain weight	18 (3.70)	3,273 (1.99)	40 (10.26)	905 (7.82)		
Meeting physical activity guidelines[b]					.03 (1)	< .001
Met	212 (44.07)	102,066 (62.49)	243 (62.79)	7,819 (67.95)		
Not met	269 (55.93)	61,276 (37.51)	144 (37.21)	3,688 (32.05)		
Getting enough sleep to feel rested in the morning in past 7 days					.04 (2)	< .001
0 days	72 (14.75)	15,050 (9.18)	69 (17.78)	1,619 (14.05)		
1-2 days	184 (37.70)	50,066 (30.54)	139 (35.82)	4,201 (36.45)		
≥ 3 days	232 (47.54)	98,813 (60.28)	180 (46.39)	5,704 (49.50)		

Note.
The percentages may not add up to 100% because of no responses or rounding errors.
Abbreviations: BMI = body mass index; HBCU = historically Black colleges and universities; DF = degrees of freedom
[a] Cramer's V effect sizes were considered small = 0.10, medium = 0.30, and large = .50 with DF = 1; small = .07, medium = .21, and large = .35 with DF = 2; small = .06, medium = .17, and large = .29 with DF = 3
[b] Moderate-intensity cardio or aerobic exercise for at least 30 minutes on 5 or more days per week, or vigorous-intensity cardio or aerobic exercise for at least 20 minutes on 3 or more days per week.

overweight or obesity. Participants with sleep difficulties were more likely to be overweight or obese than those without them (AOR: 1.16, 95% CI: 1.14-1.19). Participants who underestimated their body weight were at greater risk for overweight or obesity (AOR: 2.54, 95% CI: 2.48-2.60) than those who accurately estimated their body weight. Participants in schools with less than 2500 students showed higher odds of overweight or obesity (AOR: 1.14, 95% CI: 1.11-1.18) compared to schools with more than 5000 students.

We found no correlates among Whites at HBCUs to be significantly associated with overweight or obesity. Among Whites at non-HBCUs, men showed higher odds of overweight or obesity than women (AOR: 1.22, 95% CI: 1.20-1.25). Participants living off-campus were more likely to be overweight or obese in comparison to those living on-campus (AOR: 1.06, 95% CI: 1.03-1.08). Compared with participants who did not work, those with more work hours had higher odds of overweight or obesity ($p < .001$). The likelihood of overweight or obesity was higher among participants who had no days (AOR: 1.24, 95% CI: 1.19-1.29) and 1-2 days of getting enough sleep (AOR: 1.12, 95% CI: 1.10-1.15) relative to those getting enough sleep for ≥ 3 days in the past 7 days. Participants with sleep difficulties showed higher odds of overweight or obesity in comparison with those without them (AOR: 1.16, 95% CI: 1.13-1.19). Participants who underestimated their body weight were more likely to have overweight or obesity (AOR: 2.49, 95% CI: 1.46-4.26), compared with participants who accurately estimated their body weight. We found higher odds for overweight or obesity for participants in small-sized schools com-

Table 3
Multiple Logistic Regression of Overweight or Obesity by Race (N = 260,719)

	All (N = 260,719)	White at HBCU (N = 758)	White at non-HBCU (N = 243,473)	Black at HBCU (N = 585)	Black at non-HBCU (N = 15,903)
	AOR (95% CI)[a]				
Sex					
Men	1.19 (1.17, 1.22) ***	1.16 (0.78, 1.74)	1.22 (1.20, 1.25) ***	1.11 (0.65, 1.91)	0.83 (0.75, 0.90)
Women	Reference	Reference	Reference	Reference	Reference
Race					
White at HBCU	1.60 (1.34, 1.90) ***	---	---	---	---
White at non-HBCU	Reference	---	---	---	---
Black at HBCU	2.41 (1.98, 2.94) ***	---	---	---	---
Black at non-HBCU	1.87 (1.80, 1.94) ***	---	---	---	---
Living place					
On-campus	Reference	Reference	Reference	Reference	Reference
Off-campus	1.06 (1.04, 1.08) ***	0.73 (0.35, 1.51)	1.06 (1.03, 1.08) ***	0.78 (0.47, 1.30)	1.08 (1.01, 1.17) *
Weekly paid work hours					
0 h	Reference	Reference	Reference	Reference	Reference
1-19 h	1.02 (1.01, 1.05) *	0.63 (0.40, 1.01)	1.03 (1.01, 1.05) ***	1.05 (0.61, 1.82)	1.00 (0.93, 1.09)
20-39 h	1.25 (1.22, 1.29) ***	0.73 (0.47, 1.14)	1.27 (1.23, 1.31) ***	1.68 (0.95, 2.97)	1.07 (0.96, 1.18)
≥ 40 h	1.40 (1.32, 1.48) ***	1.44 (0.65, 3.20)	1.42 (1.34, 1.50) ***	1.50 (0.53, 4.25)	1.13 (0.91, 1.41)
Getting enough sleep to feel rested in the morning in past 7 days					
0 days	1.23 (1.19, 1.27)***	1.26 (0.69, 2.30)	1.24 (1.19, 1.29)***	0.89 (0.44, 1.78)	1.11 (0.99, 1.25)
1-2 days	1.11 (1.09, 1.14)***	1.04 (0.69, 1.56)	1.12 (1.10, 1.15)***	0.82 (0.49, 1.35)	1.01 (0.93, 1.10)
≥ 3 days	Reference	Reference	Reference	Reference	Reference
Sleep difficulties					
No	Reference	Reference	Reference	Reference	Reference
Yes	1.16 (1.14, 1.19)***	0.71 (0.44, 1.14)	1.16 (1.13, 1.19)***	0.85 (0.50, 1.47)	1.20 (1.10, 1.31)***
Self-perception of weight					
Underestimation	2.54 (2.48, 2.60)***	1.19 (0.72, 1.97)	2.53 (2.47, 2.60)***	2.49 (1.46, 4.26)**	2.64 (2.40, 2.91)***
Accurate estimation	Reference	Reference	Reference	Reference	Reference

Cont. on next page

Table 3 *(cont)*
Multiple Logistic Regression of Overweight or Obesity by Race (N = 260,719)

	All (N = 260,719)	White at HBCU (N = 758)	White at non-HBCU (N = 243,473)	Black at HBCU (N = 585)	Black at non-HBCU (N = 15,903)
	AOR (95% CI)[a]				
School size					
< 2,500	1.14 (1.11, 1.18) ***	0.69 (0.08, 5.89)	1.14 (1.10, 1.18) ***	2.14 (1.01, 4.53) *	0.89 (0.75, 1.07)
2,500-4,999	1.18 (1.14, 1.21) ***	0.84 (0.09, 7.55)	1.19 (1.15, 1.22)	1.38 (0.30, 6.28)	0.89 (0.79, 1.01)
≥ 5,000	Reference	Reference	Reference	Reference	Reference

Note.
***p < .05; **p < .01; ***p < .001**
Overestimation in self-perception of weight was removed from the model due to small cell size.
Abbreviations: HBCU = historically Black colleges and universities; AOR = adjusted odds ratio; CI = confidence interval
[a] Adjusted for stress status, anxiety status, cigarette use in the last 30 days, alcohol use in the last 30 days, daily fruit and vegetable consumption, depression status, and meeting physical activity guidelines.

pared with those in bigger schools (AOR: 2.14, 95% CI: 1.01-4.53).

For black students at HBCUs, underestimating one's weight was predictive of overweight or obesity (AOR: 2.49, 95% CI: 1.46-4.26) in comparison to perceiving one's weight accurately. Also, black students attending schools with less than 2000 students showed higher odds of overweight or obesity than those attending schools with 5000 or more students.

Among Blacks at non-HBCUs, students living off-campus were more likely to be overweight or obese than those living on-campus (AOR: 1.08, 95% CI: 1.01-1.17). Participants with sleep difficulties were at greater risk for overweight or obesity in comparison with those without them (AOR: 1.20, 95% CI: 1.10-1.31). Compared with participants who accurately estimated their body weight, those who underestimated their body weight showed higher odds for overweight or obesity (AOR: 2.64, 95% CI: 2.40-2.91).

DISCUSSION

We aimed to investigate racial differences in overweight and obesity among 4 subgroups of college students by their race (Whites vs Blacks) and college type (HBCUs vs non-HBCUs): (1) Whites at HBCUs; (2) Whites at non-HBCUs; (3) Blacks at HBCUs; and (4) Blacks at non-HBCUs. Previous studies have indicated inconsistent results in the association between HBCUs and overweight and obesity.[25,30] Thus, we examined whether matriculating at HBCUs is associated with overweight and obesity. Furthermore, we conducted multivariable analyses to assess the factors associated with overweight and obesity among college students by different race and college type. To the best of our knowledge, this is the first study to investigate racial differences in overweight and obesity by race and college type, using a population-based sample of US college students.

We found that both white and black male students at HBCUs had a higher proportion of obesity in comparison to their counterparts at non-HBUCs. Similarly, both white and black female students at HBCUs were more likely to be obese than their counterparts at non-HBCUs. Consistent with previous research,[25] these findings support our hypothesis that matriculating at HBCUs could contribute to higher overweight and obesity rates. Especially for Whites, the proportion of students with obesity was more than twice as high at HBCUs than at non-HBCUs for both males (22.22% vs 9.67%; p < .001) and females (25.82% vs 8.80%;

$p < .001$). These findings suggest that intervention efforts should focus on HBCUs to reduce obesity. Obesity is one of the most prominent predictors of cardiovascular disease, type 2 diabetes, and cancer.[3,4] Thus, preventing or reducing overweight and obesity in college students at HBCUs, before the onset of various chronic diseases, is likely to have a lasting effect on improving public health.

College students in this study showed significant racial differences in health behaviors. Overall, in comparison with Whites and Blacks at non-HBCUs, Whites and Blacks at HBCUs were less likely to report getting enough sleep and less likely to meet physical activity guidelines recommended by the American College of Sports Medicine.[41] More women at HBCUs than women at non-HBCUs had no servings of fruits and vegetables per day. Physical activity, sleep, and diet have been known to be critical in determining obesity.[36] The behaviors students establish in the transition from adolescence to adulthood can initiate life-long obesity-related chronic diseases such as cardiovascular disease and type 2 diabetes. Thus, it is important for college health professionals at HBCUs to promote health behaviors for their students. For instance, college health professionals can create an environment that is conducive to a combination of healthy eating and physical activity.

Our findings also suggest that self-perception of weight may be a driver of the higher obesity rates at HBCUs.[42] In our sample, at both HBCUs and non-HBCUs, Blacks who underestimated their weight were more likely to be overweight or obese than Blacks with accurate weight perception. A previous study of a representative sample of college students reported that non-Hispanic Black men and women were more likely to underestimate their weight in comparison to their non-Hispanic White counterparts.[23] Black communities are known to hold more positive views on larger body size in comparison to other racial/ethnic groups.[42] Compared to white women who are overweight, black women tend to report lower body dissatisfaction.[43,44] The variability of the weight perception by culture or race suggests, although speculative, that the higher percentage of obesity at HBCUs might have increased students' tolerance of larger body size. Weight underestimation is associated with one's attitudes about and attempts at weight loss.[45] Thus, we suggest that college health professionals, especially at HBCUs, promote healthy body prototypes and help students accurately perceive their weight status based on health rather than aesthetic standards.

Lastly, we found that students at smaller schools with < 2500 students, compared to those at larger schools with ≥ 5000 students, were more likely to be overweight or obese. One possible reason for the association between school size and overweight or obesity can be the school locations. Most small colleges or universities are located in rural areas where there is limited access to healthy foods or built environment (eg, parks, roads), and rural environment is associated with higher rates of overweight and obesity among children and adults.[46,47] However, the data on the relationship among college students are relatively sparse. Our finding highlights the need for future studies to examine whether colleges or universities located in rural areas have higher prevalence of overweight and obesity and how the school location interacts with race or college type.

The widely cited study conducted by Christakis and Fowler[48] in 2007 regarding the spread of obesity suggests that obesity can spread through social networks. The authors addressed that the spread can be through diverse psychosocial means including the change in acceptability of overweight.[48] Our findings collectively imply that, if overly populated with college students having excess weight, HBCUs could serve as social networks through which underestimation of body weight and obesity can spread. Similarly, HBCUs have potential to serve as a crucial platform on which overweight and obesity related public health resources could be best utilized. Thus, we advise that prevention and intervention efforts for overweight and obesity should take advantage of the HBCUs to maximize the benefits from various public health programs.

Despite the strengths of our study, it has important limitations. First, we used students' self-report for calculation of BMI. Thus, it is possible that our participants had recall bias. Secondly, we had a substantially smaller proportion of students attending HBCUs compared to non-HBCUs. Although the number of HBCU students included in our sample was abundant for statistical analysis, caution is needed when the results are generalized to the population level. In the same vein, one should

note that the multivariable model with all participants show almost identical results with the model for Whites at non-HBCUs, as they represent approximately 94% of the study sample. Lastly, as a cross-sectional study, causal association cannot be determined based on our findings. To overcome these limitations, future studies can benefit from using longitudinal designs with more participants from HBCUs.

IMPLICATIONS FOR HEALTH BEHAVIOR OR POLICY

From a policy perspective, unlike other health policies for risk behaviors (eg, drug and alcohol use) among college students, far less attention has been given to health policies for the prevention of obesity at colleges and universities.[49] Some research[50] demonstrated the lack of availability of healthy foods and unfavorable retail food environments at 10 HBCUs in North Carolina. Based on the social-ecological model[17] that describes an ongoing process in which policies, environmental factors, and institutional, interpersonal, and intrapersonal factors influence each other simultaneously, it is necessary for policymakers (eg, school administrators) at small colleges or universities in rural areas to expand access to healthy foods (eg, fruits and vegetables) and create an environment that encourages and promotes physical activity. Researchers should implement campus-based obesity prevention programs that promote more energy expenditure and less energy intake through improvements in the campus environment (eg, easier access to campus fitness centers and self-serve salad bars in college dining halls). These programs support *Healthy People 2030* goals[51] to eliminate racial/ethnic health disparities in obesity. In addition to the aforementioned policy changes and campus-based obesity prevention programs, it is important for health practitioners at HBCUs to be aware that individuals at HBCUs may be at higher risk for obesity. Efforts to monitor students' health (eg, routine check-ups and health screenings) are strongly encouraged for health practitioners at HBCUs.

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Human Subjects Approval Statement

This study was approved by the Institutional Review Board of the lead author's institution (Approval no. PH-0317, April 27, 2017).

Conflict of Interest Disclosure Statement

The authors declare no conflicts of interest.

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