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The association of nutrition behaviors and physical activity with general and central obesity in Caribbean undergraduate students

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Abstract

Objective—To quantify the prevalence of obesity and obesity-related factors in a cross-sectional, observational study of Caribbean students using the results of three recent surveys of health behavior among undergraduates in Barbados, Grenada, and Jamaica.

Methods—A total of 1 578 Caribbean undergraduate students from Barbados, Grenada and Jamaica (ages 18–30 years) completed questionnaires and had physical measurements recorded. Multivariable logistic regression was used to estimate odds ratios (ORs) for the association of nutrition behaviors with prevalence of obesity (body mass index ≥ 30 kg/m^2); elevated waist-to-height ratio (W/ht) (> 0.5); and high waist circumference (WC) (> 88 cm in females, > 102 cm in males). Models were adjusted for age, year in university, socioeconomic status, and sex.

Results—*There was a higher prevalence of obesity (13% versus 10%), high WC (21% versus 7%), and high W/ht (35% versus 25%) in females relative to males. Compared to females, males had reduced odds of obesity (OR 0.46), high WC (OR 0.22), and high W/ht (OR 0.61) (*P *< 0.05 for all). Both females (46%) and males (24%) reported high levels of physical inactivity. Fruit and vegetable consumption was low (approximately two servings per day). Many students reported avoiding fatty foods (40%); this behavior was associated with high W/ht (OR 1.68), obesity (OR 1.90), and high WC (OR 1.82) (*P *< 0.05 for all). Irregular breakfast consumption, age, and year of*

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study were also positively associated with obesity. Physical activity was not significantly associated with any obesity measure.

Conclusions—There was a low prevalence of healthy behaviors and a high prevalence of obesity in this sample of Caribbean young adults.

Keywords

Obesity; obesity; abdominal; diet; exercise; students; Barbados; Grenada; Jamaica; Caribbean region; West Indies

The nutrition transition and the escalating prevalence of obesity are major public health issues in low- and middle-income countries (1). In these settings, obesity is related to increasing levels of physical inactivity, rapid urbanization, and the Westernization of the diet (2). Obesity-related diseases are among the leading causes of death in the Caribbean region and include heart disease (16%), cancer (15%), cerebrovascular diseases (10%), diabetes (10%), and hypertension (6%) (3). It is important to understand the factors that drive obesity within the Caribbean context to design appropriate health interventions.

The emerging adulthood period (18–25 years) is increasingly recognized as an important period of health behavior formation. This period affords new independence, especially among university students, during which lifestyle patterns may become ingrained (4, 5). Characterizing the prevalence of health behaviors in university students may help to identify useful targets for health promotion. To date, the prevalence of obesity and its related factors have not been well described in Caribbean university students. To help fill this gap, this cross-sectional, observational study quantified the prevalence of obesity and obesity-related factors in Caribbean students, using the results of three recent surveys of health behavior among undergraduates in Barbados, Grenada, and Jamaica. Quantifying the knowledge (risk awareness), attitudes, and behaviors in this population may inform interventions that improve health behaviors and ultimately mitigate chronic disease risk.

MATERIALS AND METHODS

In this study, the authors characterized nutrition and physical activity knowledge, attitudes, and behaviors in Caribbean undergraduates and estimated how health behaviors were associated with prevalence of overweight, general obesity, and central (abdominal) obesity. The authors hypothesized that beneficial health behaviors would be inversely associated with obesity.

Study population

In 2013 and 2014, undergraduate students from universities in Barbados, Grenada, and Jamaica were invited to participate in a cross-sectional, observational prevalence study. In Barbados, a random sample pool of 800 males and 600 females was extracted from the university's register of undergraduates. In Grenada, the entire undergraduate population (n = 823) was invited to participate in the study. The Jamaican survey used a stratified random sample procedure in which the primary sampling unit was each university department. Departments were randomly selected from larger academic faculties, after which courses

within each selected department were randomly selected with probability of selection proportional to the size of each course; a sample pool of 800 undergraduates was selected in this manner. The analytical sample used male and female respondents who were 18 to ≤ 30 years old and of Caribbean origin.

Questionnaires

Respondents completed self-administered questionnaires anonymously and provided data related to multiple dimensions of health knowledge, attitudes, and behaviors. To protect participant anonymity, questionnaires were numbered and students were instructed to submit them in sealed envelopes with no identifying information. These were completed in the classroom. All participants provided signed informed consent forms; the ethical research board from each university approved the study. The Jamaican and Barbadian questionnaires were pilot-tested for cultural appropriateness.

Anthropometry

Trained personnel measured weight, height, and waist circumference (WC) using standard techniques. Measurements were taken after questionnaires had been completed and submitted. The anthropometric measures included 1) underweight (body mass index (BMI) < 18.5 kg/m^2); 2) overweight (BMI ≥ 25 kg/m^2 and < 30 kg/m^2); and 3) obesity (BMI ≥ 30 kg/m^2). These cutoff values are consistent with those recommended for categories of BMI by the World Health Organization (WHO) (6). Central obesity was also quantified by elevated WC (> 88 cm in females, > 102 cm in males); this threshold is associated with "substantially increased" risk according to WHO (6). A second marker of central obesity, elevated waist-to-height ratio (W/ht) (> 0.50), was chosen because a single cutoff value is used for males and females (7).

Explanatory variables

The explanatory variables included the nutrition- and physical activity–related knowledge, attitudes, and behaviors described below.

Nutrition

Respondents were asked to indicate whether they believed heart disease and high blood pressure were influenced by overweight. This nutrition knowledge variable, which was ordinal (scored from 0–2), was taken from the European Health and Behaviour Survey (8) and has been used elsewhere (9). Cronbach's alpha indicated low reliability and consistency for this basic indicator of risk awareness ($\alpha = 0.28$). To capture attitudes related to nutrition, participants were asked to rank the importance of the following nutrition-related health habits on a scale of 1–10: restricting animal fat intake, consuming sufficient fiber, maintaining normal body weight, consuming sufficient fruit, restricting salt intake, consuming breakfast daily, and restricting red meat intake (9). The mean of these reported attitudes served as the nutrition attitude variable, which had strong reliability and consistency based on Cronbach's alpha ($\alpha = 0.82$ in Barbados, 0.87 in Grenada, and 0.84 in Jamaica.)

Obesity-related nutritional factors or behaviors were adopted from the European Health and Behaviour Survey (8, 9). These included 1) frequency of breakfast consumption (an ordinal variable scored as 0 for "almost every day," 1 for "sometimes," and 2 for "rarely or never"); 2) frequency of red meat consumption (an ordinal variable scored as 0 for "never," 1 for "< weekly," 2 for "about every week," 3 for "every 2 or 3 days," and 4 as "daily"); 3) number of meals consumed per day; and 4) number of between-meal snacks consumed per day. Students were asked whether they consciously avoided foods that contained fat or cholesterol ("yes"/"no") or consciously tried to consume more fiber ("yes"/"no") (9). Those who answered "yes" were asked to provide examples of foods typically avoided. Students reported the mean number of servings of vegetables and fruits typically consumed each day (with one serving defined as 80 g) (10). The students were also asked whether they were dieting or trying to lose weight (9).

Physical activity

The physical activity knowledge variable was given an ordinal score (from 0 to 2) based on whether participants accurately reported that exercise could influence heart disease and blood pressure. Attitude toward physical activity was also an ordinal variable, with a possible range of 1–10, based on the perceived importance of exercising regularly (11). Physical activity was classified using the validated (12) International Physical Activity Questionnaire (IPAQ) short form and was based on self-report of the typical number of minutes spent each week 1) walking (assuming 3.3 metabolic equivalents (Mets) per minute); 2) in moderate activity (e.g., carrying light loads or regular bicycling) (4 Mets per minute); and 3) in vigorous activity (e.g., fast bicycling, aerobics, etc.) (8 Mets per minute) (13). The final variable was ordinal and ranged from 1–3 (scored as 1 for "inactive" (< 600 Met minutes per week); 2 for "moderately active" (600 to < 3 000 Met minutes per week); and 3 for "very active" (≥ 3 000 Met minutes per week).

Additional covariates

Confounding in regression analyses was controlled by adjusting for year in university (ordinal); age in years; sex (male = 1, female = 0); and socioeconomic status. Socioeconomic status was an ordinal variable ranging from "quite poor" family background ("within the lowest 25% in your country") to "not very well off" ("within the 25%–50% range for your country"), "quite well off" ("within the 50%–75% range for your country"), or "wealthy" ("within the highest 25% in your country") (9).

Statistical analyses

Descriptive, bivariate comparisons of the three countries were executed using chi-square and one-way ANOVA tests for categorical and continuous variables respectively. Odds ratios (ORs) were estimated using multivariable logistic regression. Knowledge and attitude variables were excluded in order to focus on behavioral correlates of obesity risk because the latter are considered more proximal determinants of health. The first regression analyses were conducted using pooled data from all three countries; these initial analyses included statistical interactions between a dummy (indicator) variable for each country multiplied by each nutrition covariate. A likelihood ratio test was then conducted to see which interactions and covariates significantly contributed to model fit. Variables were retained if 1) the

variable was selected a priori as a potential confounder and 2) the variable (or set of country × behavior interactions) significantly contributed to model fit for at least one obesity outcome, as indicated by a P value < 0.05 for the likelihood ratio test. Where country-specific interactions were retained, estimates presented in the regression table may be interpreted as the ORs associated with that covariate within the context of that country's sample. Jamaica served as the reference country. There was no evidence of multicollinearity (variance inflation factors did not exceed 2.5). All analyses were conducted in Stata 12 (StataCorp LP, College Station, Texas, United States).

RESULTS

Sample characteristics

Response rates to the questionnaires were 42% (582 out of 1 400), 53% (435 out of 823), and 94% (756 out of 800) in Barbados, Grenada, and Jamaica respectively. Of these, a total of 577, 701, and 300 students respectively were of Caribbean origin and 18 to ≤ 30 years old and were thus included in the descriptive analyses. Anthropometric data were only available for 167 respondents from Grenada. Table 1 shows the socio-demographic and other characteristics for the three surveys. The Barbadian sample had relatively fewer non-black students (14%) than Grenada and Jamaica (38% and 40% respectively). There was a higher percentage of males in the Barbadian sample (57%) relative to the other two countries (30% in Grenada and 24% in Jamaica). A large proportion of the students in the Jamaican sample were in their first year of university (74%). Relatively fewer Barbadian students lived on campus (3%) than Grenadian (13%) and Jamaican (26%) students.

The physical activity, nutrition, and anthropometry characteristics are displayed in Table 2. In the full sample, approximately 24% of males and 46% of females reported low levels of physical activity. Overall, 35% of the males and 39% of females reported consuming red meat daily. However, this behavior was most common in Grenadian males (56%) and females (54%). Approximately 40% of students from both sexes reported consciously avoiding fatty foods or cholesterol, but this behavior was least prevalent in the Jamaican undergrads of both sexes (approximately 34%). The specific fatty foods that were avoided included dairy (ice cream, cheese, and butter); deep-fried foods (especially potato fries); refined carbohydrates and pastries; macaroni pie (a Caribbean version of macaroni and cheese); and certain meats, including bacon, burgers, and pork. Fiber-rich foods consciously consumed included whole grain cereals (brown rice, whole wheat flour, fiber bars, and bran foods); legumes; vegetables; certain ground provisions (e.g., yams and other root tubers); and fruits. Mean vegetable and fruit consumption was low overall (less than two servings per day) but these values were lowest in the Jamaican males and females. Students were more aware of the risks of overweight with respect to heart disease and high blood pressure (with mean scores for awareness exceeding 1.3 out of a possible 2) than they were aware of the benefits of exercise in mitigating risk of these diseases (the mean scores did not exceed 0.8 out of a possible 2). Overall, participants reported that nutrition and physical activity were very important to them, assigning them a score of 7 or 8 (out of 10), indicating a positive attitude toward health.

Burden of overweight and obesity by sex and country

Prevalence estimates for three anthropometric markers of excess adiposity are displayed in Table 2. Mean BMI was 24.29 kg/m^2 for males and 23.93 kg/m^2 for females. Overweight prevalence was 24% in males and 18% in females. Obesity prevalence was lower: 10% and 13% in males and females respectively. Barbadian students had the highest mean BMI (25.35 kg/m^2 in females and 24.77 kg/m^2 in males) and the highest prevalence of obesity (18% and 13% in females and males respectively). Of the females, the Jamaican students had the highest prevalence of high WC (23%) and high W/ht (38%). Of the males, the Grenadian students had the highest prevalence of high WC (30%) and high W/ht (26%).

Multivariable logistic regression relating behavior to obesity

Table 3 shows the results of the multivariable logistic regression of four anthropometric markers of excess adiposity onto demographic characteristics and behavior. Age and avoidance of fatty foods were significantly associated with increased odds of overweight. Males also seemed to have higher odds of overweight, but this was not statistically significant. Conscious avoidance of fatty foods; age; and year of study showed positive association with obesity. Males had significantly lower odds of being obese (OR 0.46) and having high WC (OR 0.22). This means that females were nearly twice as likely to be obese and almost five times as likely to have high WC. The Barbadian students were significantly more likely to be obese relative to Jamaican students. Irregular breakfast consumption was also positively associated with obese BMI in Barbados and elevated W/ht and WC in Jamaica.

DISCUSSION

The study analyses revealed a high burden of overweight and obesity among this Caribbean university student population. A recent study of undergraduates from 22 low- and middle-income countries in Africa, Asia, Latin America, and the Caribbean (including data from the studies reported herein) estimated an overall prevalence of obesity as 5.2% in males and 5.8% in females (14). The results reported here reveal a much higher prevalence of obesity in the Caribbean context (10% in males and 13% in females). In a region where the primary causes of death are obesity-related illnesses (3), the high obesity prevalence is worrisome in this relatively young and educated sub-population of Caribbean adults. More investigation is warranted to identify actionable predictors that may help to diminish lifestyle disease risk in the long term.

Lack of regular physical activity is an established risk factor for a range of chronic diseases (15). Despite this, students expressed limited awareness of the links between exercise and heart disease and hypertension risk. A total of 24% of all males and 46% of all females were in the lowest category of physical activity. Although this variable was not significantly associated with any of the three indicators of obesity, as physical activity is an independent risk factor for cardiovascular disease (16), the rates of physical inactivity in this sample—particularly among the women—is cause for concern.

As hypothesized, the results of this study indicated that infrequent breakfast consumption was positively associated with elevated W/ht and elevated WC in Jamaica and BMI ≥ 30 kg/m^2 (obesity) in Barbados. This is concordant with previous studies that reported that skipping breakfast is associated with higher prevalence of overweight (17), metabolic risk (18), and poor health behaviors (19). As only 52% (female students) and 58% (male students) reported consuming breakfast almost every day, there is still room for improvement.

Mean reported fruit and vegetable consumption was two or three servings per day across all three countries in both males and females. This is lower than WHO's recommended five servings (400 g) per day (20). These results are slightly better than those obtained from a global study of fruit and vegetable intake that found that WHO's "America B" subregion, which includes the Caribbean, had the lowest overall mean consumption (approximately two servings) of the nine regions analyzed (21). Using survey data, the authors estimated a mean intake of 148 g (for males) and 167 g (for females) for the 15–29 year age group (21). Although vegetable and fruit consumption patterns were not significantly associated with obesity in the regression analyses, low consumption of these foods has been identified as an important modifiable risk factor for lifestyle diseases (22). Increasing intake fruit and vegetable intake may be an important step in fostering healthy behaviors.

Although snacking was not significantly associated with obesity, when country-stratified analyses were executed, there were indications of negative (Jamaica) and positive (Grenada) associations between number of snacks and obesity. However, these interactions did not meet the a priori criterion for inclusion in the full sample analyses (i.e., the likelihood ratio test *P* value exceeded 0.05). The authors suspect that these findings may be due to the instrument used, as the questionnaire was not optimized to identify the types, quantities, and energy intake of foods consumed. It is unclear whether "snacks" actually served as meal replacements or additional sources of calories in these countries. Obtaining more details regarding the types of snacks consumed would help clarify which kinds of snacks are related to excess adiposity in these student populations (23).

Red meat consumption was not significantly related to overweight/obesity, but the high prevalence of daily red meat consumption in Grenada (> 50% in both males and females) warrants some concern. Red meat consumption has been associated with cardiovascular disease in several studies (24). Despite potential health risks, red meat does provide haem iron, which can reduce iron-deficiency anemia (24). This is a moderate public health issue in the three countries studied; prevalence of anemia among nonpregnant women of reproductive age is 17%, 24%, and 24% in Barbados, Grenada and Jamaica respectively (25). Although the main focus of these analyses was overweight/obesity, more detailed surveys about dietary practices as well as other dimensions of health are needed to inform any dietary interventions in this demographic.

Intriguingly, conscious avoidance of fatty foods was positively related to all four measures of excess adiposity. The 22-country analysis of undergraduate students' health behavior also found a positive association of avoidance of fatty foods/cholesterol with BMI ≥ 30 kg/m^2 (14). This finding may 1) be an artifact of social desirability, with heavier participants

reporting healthy dietary choices to conform to their perceptions of socially appropriate behavior and/or 2) indicate reverse causality (i.e., overweight/obese students are consciously modifying their diets in reaction to their weight). Overall, the students surveyed in the study reported here indicated a positive attitude toward health. Furthermore, between 80% of obese females and 76% of obese males expressed a desire to lose weight, and 55% of obese females and males reported being on a diet (data not shown). However, students may need help turning these attitudes and desires into actions. Altogether, the findings of this study suggest a strong interest in improving weight status.

A striking sex disparity exists in the prevalence of central obesity measured by both elevated W/ht (35% of females and 25% of males) and high WC (21% in females and 7% in males). This sex disparity in weight status has been previously described in all three countries studied (26–30). The prevalence estimates presented here suggest that females were far more inactive than males, and this may be a contributor to their higher obesity rates. Although the regression results showed that males were less likely to have these obesity outcomes, the prevalence of obesity among males was still high. Gender-specific exploration of larger, Caribbean cohorts may reveal more information about the lifestyle behaviors that drive this phenomenon.

Age is a well-established risk factor for weight gain, but it is especially intriguing that the year of study had an independent association with obesity. A review and meta-analysis determined that while weight gain occurs during the first year, most of the weight gained during university occurs in the last three years (31). There may be obesogenic factors in the university environment that promote weight change. One study found that proximity to grocery stores, dining halls, and gyms modified weight gain of students in university dormitories (32). Longitudinal studies are needed to characterize the nature of the university environment in the Caribbean as well as social cues that may promote weight gain during these years.

Limitations

The study had several limitations. First, the cross-sectional design did not allow for causal inferences. Therefore, the survey did not necessarily capture behaviors that led to obesity but may have captured behaviors inspired by obesity. Second, only the physical activity portion of the questionnaire was validated; the nutrition portion was not validated and participants may have had difficulty estimating fruit and vegetable consumption as they had no examples of what constitutes one 80-g serving. Third, it is not possible to generalize the findings because university students are not representative of their age group (i.e., the association of these behaviors and socio-demographic factors with overweight/obesity may differ from that which exists in their nonuniversity peers in the wider population). The results from Barbados are likely more representative than the estimates for Jamaica and Grenada because of the higher proportion of Barbadian college-aged youth enrolled in university. The most recent UNESCO data show that 61% of Barbadians 16–20 years old are enrolled in tertiary institutions versus 29% of Jamaicans and 53% of Grenadians 17–21 years old (33). Nevertheless, the selectivity of the sample is a major cause of concern, exacerbated by response rates that varied across samples and the fact that a significant proportion of the

Grenada sample did not return to have anthropometry measured. Those who did respond to the three surveys, and contributed anthropometry (particularly in Grenada), are likely to be more motivated and interested in health than their university peers. Other factors that may further reduce generalizability of the study findings include 1) those responding to the Barbadian survey were more likely to be male (57%) than the university population of that country (34%, according to internal correspondence), and 2) first-year students were over-represented in the Jamaican sample (74%). More detailed study of the dietary and lifestyle practices in this demographic may help explain the large burden of overweight and obesity found in this study by isolating sex-specific risk factors, determining the frequency and type of snacking in university students, and further clarifying the obesogenic characteristics of the university environment.

Conclusions

The use of data from three island nations in the region makes this the only large-scale study of university undergraduates in the Caribbean. The results reveal 1) a high prevalence of overweight BMI, high waist circumference, high W/ht, and obese BMI and 2) a low prevalence of healthy physical and dietary behaviors in a sub-population whose educational profile is expected to facilitate a more favorable distribution of health knowledge and behaviors that could help mitigate disease risk.

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TABLE 1.

Frequency distribution of socio-demographic and other characteristics in Caribbean undergraduate students 18–30 years old participating in study of the association of nutrition behaviors and physical activity with general and central obesity, Barbados, Grenada, and Jamaica, 2013–2014[a]

Characteristic	Barbados (No. = 577)	Jamaica (No. = 701)	Grenada (No. = 300)	Full sample (*n* = 1 578)	*P*[b]
Socioeconomic status (%)					< 0.01
“Quite poor”	9.50	7.96	5.86	7.51	
“Not very well off”	41.53	46.16	42.41	45.12	
“Quite well off”	44.63	44.72	48.62	44.23	
“Wealthy”	4.34	1.16	3.10	3.14	
Non-black race (%)	14.49	40.29	37.92	30.37	< 0.01
Mean age in years (standard deviation)	21.55 (2.70)	20.20 (2.02)	22.84 (3.46)	21.20	< 0.01
Male sex (%)	57.19	23.82	29.67	37.14	< 0.01
Year in university (%)					< 0.01
1	35.20	74.24	22.87	50.32	
2	30.30	17.55	20.14	22.72	
3	25.22	6.91	29.69	17.91	
4	9.28	1.29	27.30	9.05	
Married (%)	1.43	1.30	6.67	2.39	< 0.01
Residence (%)					< 0.01
On-campus	2.69	25.97	13.42	15.21	
Off-campus, no guardians	19.03	17.79	33.56	21.26	
Off-campus, with guardians	78.28	56.24	53.02	63.53	

[a]This table was prepared by authors for this study and has not been presented elsewhere in this format.

[b]*P* = values for chi-square and one-way ANOVA statistical tests that compared data from each country; full sample estimates are also provided.

TABLE 2.

Distribution of physical activity, nutrition, and anthropometric variables[a] in Caribbean undergraduate students 18–30 years old participating in study of the association of nutrition behaviors and physical activity with general and central obesity (n = 1 578), by sex and country, Barbados, Grenada,[b] and Jamaica, 2013–2104

Variable	Female undergraduates					Male undergraduates				
	Barbados (No. = 247)	Grenada (No. = 211)	Jamaica (No. = 534)	All females (No. = 992)	P^c	Barbados (No. = 330)	Grenada (No. = 89)	Jamaica (No. = 167)	All males (No. = 586)	P
Behavior										
Physical activity level (%)					0.41					0.45
“Inactive”	41.98	42.44	48.49	45.60		23.20	21.84	25.31	23.59	
“Moderately active”	31.28	30.73	28.11	29.45		31.03	34.48	37.65	33.45	
“Very active”	26.75	26.83	23.40	24.95		45.77	43.68	37.04	42.96	
Breakfast consumption (%)					0.07					< 0.01
“Almost every day”	51.01	60.29	48.88	51.82		64.83	55.68	47.31	58.42	
“Sometimes”	29.55	25.84	32.96	30.61		19.27	28.41	38.92	26.29	
“Rarely or never”	19.43	13.88	18.16	17.58		15.90	15.91	13.77	15.29	
Red meat consumption (%)					< 0.01					< 0.01
“Never”	6.75	7.69	2.27	4.52		5.70	4.71	3.59	4.93	
“Less than once per week”	16.88	11.54	10.61	12.33		12.66	7.06	8.98	10.74	
“About once per week”	24.05	10.58	16.67	17.16		21.84	8.24	14.97	17.78	
“Every two or three days”	23.63	15.87	32.58	26.82		35.13	23.53	29.94	31.87	
“At least once per day”	28.69	54.33	37.88	39.16		24.68	56.47	42.51	34.68	
“Tries to eat fiber” (%)	50.73	53.73	33.33	41.68	< 0.01	38.77	36.90	25.61	34.35	0.02
“Avoids fatty foods/cholesterol” (%)	45.87	46.23	34.24	39.51	< 0.01	40.89	50.06	33.73	40.22	0.03
No. of snacks per day	2.19 (1.31)	2.07 (1.32)	1.82 (1.25)	1.96 (1.29)	< 0.01	2.01 (1.30)	2.11 (1.25)	1.80 (1.24)	1.96 (1.28)	0.13
No. of meals per day	2.80 (0.87)	2.71 (0.78)	2.58 (0.85)	2.66 (0.85)	< 0.01	2.99 (0.87)	2.95 (1.06)	2.69 (0.91)	2.90 (0.92)	< 0.01
Fruit servings per day	1.09 (0.93)	1.19 (0.95)	0.98 (1.04)	1.05 (1.00)	0.03	1.23 (1.59)	1.28 (1.06)	0.93 (0.84)	1.14 (1.30)	0.05
Vegetable servings per day	1.21 (0.86)	1.36 (1.02)	1.13 (1.14)	1.20 (1.07)	0.03	1.55 (1.75)	1.71 (1.27)	1.08 (1.18)	1.42 (1.51)	< 0.01
Fruits + vegetables per day	2.09 (1.49)	2.54 (1.71)	2.04 (1.87)	2.16 (1.77)	< 0.01	2.54 (3.04)	2.94 (2.09)	2.00 (1.81)	2.44 (2.57)	0.01
Smoker (%)	3.55	_[d]	2.81	3.02	–	8.10	–	8.07	8.09	–

Variable	Female undergraduates					Male undergraduates				
	Barbados (No. = 247)	Grenada (No. = 211)	Jamaica (No. = 534)	All females (No. = 992)	*P*[c]	Barbados (No. = 330)	Grenada (No. = 89)	Jamaica (No. = 167)	All males (No. = 586)	*P*
Knowledge (range 0–2)										
Risks of overweight	1.44 (0.64)	1.40 (0.69)	1.38 (0.65)	1.40 (0.66)	0.50	1.45 (0.67)	1.33 (0.72)	1.41 (0.68)	1.42 (0.68)	0.33
Benefits of physical activity	0.70 (0.79)	0.81 (0.83)	0.60 (0.73)	0.67 (0.77)	< 0.01	0.52 (0.74)	0.53 (0.71)	0.58 (0.71)	0.54 (0.73)	0.68
Attitude (range 1–10)										
Importance of nutrition to participant	7.61 (1.83)	7.94 (1.88)	7.37 (2.04)	7.55 (1.97)	< 0.01	7.07 (1.78)	7.05 (2.06)	6.50 (2.06)	6.90 (1.93)	0.01
Importance of physical activity to participant	7.86 (2.51)	8.25 (2.37)	7.40 (2.70)	7.69 (2.61)	< 0.01	8.12 (2.05)	8.15 (2.39)	7.69 (2.30)	8.00 (2.18)	0.10
Anthropometry										
BMI (kg/m^2)	25.35 (7.62)	23.62 (5.64)	23.27 (5.75)	23.93 (6.40)	< 0.01	24.77 (5.38)	23.50 (3.90)	23.48 (4.18)	24.29 (4.99)	0.02
Height (cm)	163.84 (7.61)	165.23 (6.58)	164.66 (6.94)	164.50 (7.10)	0.16	176.56 (7.30)	177.40 (6.53)	176.17 (8.94)	176.52 (7.73)	0.64
High waist circumference[e] (%)	19.11	20.54	22.80	21.41	0.50	7.01	10.00	4.70	6.58	0.42
High waist/height ratio[f] (%)	30.48	31.25	38.36	35.09	0.07	23.47	30.00	26.17	24.76	0.59
Normal weight[g] (%)	47.56	55.37	61.84	56.75	< 0.01	55.49	65.91	68.92	60.19	0.02
Obese[h] (%)	18.29	13.22	9.85	12.80	0.06	12.50	9.09	5.41	10.19	0.06
Overweight[i] (%)	21.95	17.36	16.35	18.13	0.18	26.21	15.91	21.62	24.04	0.23
Underweight[j] (%)	12.20	14.05	11.94	12.32	0.82	5.79	9.09	4.05	5.58	0.43
Waist (cm)	77.84 (13.37)	78.83 (13.04)	81.52 (10.91)	80.08 (12.08)	< 0.01	82.01 (12.54)	83.35 (9.41)	83.09 (8.90)	82.43 (11.38)	0.55
Weight (kg)	68.10 (21.20)	64.34 (16.00)	62.99 (15.31)	64.67 (17.45)	< 0.01	77.20 (17.57)	74.23 (13.00)	73.18 (15.85)	75.81 (16.83)	0.04

[a] Values are means (standard deviations) except where percentage (%) is indicated.

[b] Anthropometric data were only available for a subset of the Grenadian sample: data for weight, height, body mass index (BMI), and waist circumference were available for 123, 122, 121, and 112 females and 44, 45, 44, and 40 males respectively.

[c] *P* = values for chi-square and one-way ANOVA statistical tests that compared data from each country within male and female strata; sex-specific sample estimates are also provided for all females and males in the full sample.

[d] Not applicable.

[e] > 88 cm in females, > 102 cm in males.

[f] > 0.50.

[g] BMI ≥ 18.50 kg/m^2 and < 25 kg/m^2.

[h] BMI ≥ 30 kg/m^2.

[i] BMI ≥ 25 kg/m^2 and < 30 kg/m^2.

[j] BMI < 18.50 kg/m^2.

TABLE 3.

Multivariable logistic regression of overweight and obesity on behavioral and socio-demographic characteristics in Caribbean undergraduate students 18–30 years old participating in study of the association of nutrition behaviors and physical activity with general and central obesity, Barbados, Grenada,[a] and Jamaica, 2013–2014[b]

Variable	Overweight[c] OR[d]	95% CI[e]	Obese[f] OR	95% CI	High W/ht[g] OR	95% CI	High WC[h] OR	95% CI
Behavior								
Irregular breakfast consumption								
Grenada	0.88	(0.42, 1.86)	1.07	(0.43, 2.64)	0.61	(0.32, 1.15)	0.74	(0.34, 1.63)
Barbados	1.16	(0.67, 2.00)	2.65[i]	(1.32, 5.30)	0.71	(0.44, 1.16)	1.16	(0.62, 2.16)
Jamaica	1.19	(0.86, 1.64)	1.31	(0.86, 1.98)	1.40[i]	(1.08, 1.83)	1.40[i]	(1.02, 1.93)
Avoidance of fatty foods	1.45[i]	(1.00, 2.05)	1.90[i]	(1.24, 2.92)	1.68[i]	(1.24, 2.27)	1.82[i]	(1.24, 2.66)
Number of meals per day	0.86	(0.67, 1.10)	0.76	(0.56, 1.03)	0.87	(0.71, 1.06)	0.83	(0.64, 1.08)
Regular red meat consumption	1.02	(0.88, 1.19)	0.99	(0.83, 1.19)	1.01	(0.89, 1.15)	0.93	(0.80, 1.09)
Vegetable (servings)	1.00	(0.85, 1.17)	1.13	(0.95, 1.34)	1.14	(0.99, 1.31)	1.07	(0.90, 1.27)
Fruit (servings)	0.98	(0.82, 1.18)	0.97	(0.79, 1.18)	0.95	(0.82, 1.10)	0.98	(0.81, 1.18)
No. of snacks per day	0.91	(0.78, 1.05)	0.94	(0.79, 1.11)	0.93	(0.83, 1.05)	0.92	(0.79, 1.07)
Physical activity level	1.07	(0.86, 1.33)	1.16	(0.89, 1.51)	1.14	(0.95, 1.37)	1.03	(0.82, 1.29)
Origin of sample[j]								
Barbados	1.26	(0.51, 3.11)	3.87[i]	(1.23, 12.11)	1.06	(0.47, 2.40)	2.44	(0.85, 7.05)
Grenada	1.32	(0.37, 4.74)	1.58	(0.35, 7.21)	1.16	(0.38, 3.49)	1.30	(0.35, 4.85)
Jamaica[k]	1.00	_[l]	1.00	–	1.00	–	1.00	–
Socio-demographic covariates								
Age (years)	1.09[i]	(1.02, 1.17)	1.03	(0.95, 1.12)	1.11[i]	(1.04, 1.18)	1.13[i]	(1.05, 1.22)
Year in university	1.08	(0.88, 1.31)	1.45[i]	(1.15, 1.84)	1.22[i]	(1.02, 1.46)	1.20	(0.97, 1.50)
Socioeconomic status	1.10	(0.86, 1.41)	1.15	(0.85, 1.56)	1.12	(0.90, 1.39)	1.34[i]	(1.01, 1.76)
Male sex	1.43	(0.99, 2.07)	0.46[i]	(0.27, 0.75)	0.61[i]	(0.44, 0.85)	0.22[i]	(0.13, 0.37)

[a]Anthropometric data were only available for a subset of the Grenadian sample: data for BMI and waist circumference were available for 165 and 152 individuals respectively.

[b] This table was prepared by the authors for this study and has not been presented elsewhere in this format.

[c] Body mass index (BMI) ≥ 25 kg/m^2 and < 30 kg/m^2.

[d] OR: odds ratio.

[e] CI: confidence interval.

[f] BMI ≥ 30 kg/m^2.

[g] Waist-to-height ratio > 0.50.

[h] Waist circumference > 88 cm in women or > 102 cm in men.

[i] Statistical significance ($P < 0.05$) in the results of the multivariable logistic regression analyses.

[j] Odds ratio indicates risk associated with being a participant from indicated country.

[k] Reference variable.

[l] Not applicable.