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Psychosocial stress is associated with obesity and diet quality in Hispanic/Latino adults

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Abstract

Purpose—To examine the association of psychosocial stress with obesity, adiposity, and dietary intake in a diverse sample of Hispanic/Latino adults.

Methods—Participants were 5077 men and women, 18–74 years old, from diverse Hispanic/Latino ethnic backgrounds. Linear regression models were used to assess the association of ongoing chronic stressors and recent perceived stress with measures of adiposity (waist circumference and percentage body fat) and dietary intake (total energy, saturated fat, alternative healthy eating index [AHEI-2010]). Multinomial logistic models were used to describe the odds of obesity or overweight relative to normal weight.

Results—Greater number of chronic stressors and greater perceived stress were associated with higher total energy intake. Greater recent perceived stress was associated with lower diet quality

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as indicated by AHEI-2010 scores. Compared to no stressors, reporting ≥ 3 chronic stressors was associated with higher odds of being obese (OR = 1.5, 95%CI 1.01–2.1), greater waist circumference (β = 3.3, 95%CI 1.0–5.5) and percentage body fat (β = 1.5, 95%CI 0.4, 2.6).

Conclusions—The study found an association between stress and obesity and adiposity measures, suggesting that stress management techniques may be useful in obesity prevention and treatment programs that target Hispanic/Latino populations.

INTRODUCTION

Obesity is currently a public health problem in the US and disproportionately affects minority and low-income populations. Among Hispanic/Latino adults, 40% of men and 44% of women are obese.[1] Psychosocial stress is emerging as a potential risk factor for excess weight and it may contribute to the race/ethnic disparities observed in prior research. Cross-sectional and prospective studies indicate that individuals with higher stress levels are more likely to be obese and experience greater weight gain over time.[2–6] Psychosocial stress may be related to the development of obesity through biological and behavioral pathways. Biological responses to stress include the activation of neuroendocrine and inflammatory pathways that directly increase fat accumulation, promoting visceral adiposity; [7,8] and the release of appetite hormones that increase food consumption, leading to a positive energy balance.[7] Furthermore, when under stress, as the brain reward system becomes activated,[9] individuals may show a preference for more palatable foods that are richer in sugars and fats, contributing to excess calories.[2,10–13] Other behavioral changes have also been proposed as possible explanations for the stress-obesity relationship, such as engaging in less physical activity [14] and consuming fast foods more frequently.[15]

Few studies distinguish between chronic ongoing stress and recent exposure to stress, which may have different associations with obesity. Prolonged exposure to stress may be needed to activate and maintain the biological and behavioral pathways that lead to increased weight, while the effects of recent exposure may be observed in terms of changes in lifestyle behaviors that, if occurring for a limited amount of time, may not lead to excess weight. In this study, we examined ongoing chronic stress in important life domains and perceived stress during the past 30 days in relation to obesity and dietary intake in Hispanic/Latino adults who are participants in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL), a large multicenter cohort. This study includes a subset of HCHS/SOL participants who completed a separate assessment of socio-cultural factors, including stress measures. We hypothesized that participants reporting more chronic stressors would be more likely to be obese and have higher adiposity (assessed by waist circumference and percentage body fat) than participants with lower stress levels. In addition, we hypothesized that participants reporting higher recent perceived stress (past 30 days) would have a higher intake of total calories and saturated fat. However, we would not expect that those participants with higher recent perceived stress would be more likely to be obese than participants experiencing lower recent stress because a longer period would be needed for the excess calories to manifest as obesity. Furthermore, because prior research has shown evidence for differences in the stress/obesity association by sex,[5,6,8] we also examined whether the relationship between stress and obesity was modified by sex.

METHODS

HCHS/SOL is a population-based cohort study of 16,415 Hispanic/Latino adults (ages 18–74 years) who were selected using two-stage probability sampling design from four US communities (Chicago, IL; Miami, FL; Bronx, NY; San Diego, CA). The HCHS/SOL Socio-Cultural Ancillary Study (SCAS) enrolled 5,313 participants from the HCHS/SOL between February 2010 and June 2011. Participants were asked to return to the HCHS/SOL clinic within 9 months of their baseline exam to complete a comprehensive set of psychosocial measures that included self-reported stress. However, the majority of participants (72%) completed the psychosocial assessment within 3 months. Details about the aims and methodology of HCHS/SOL and HCHS/SOL SCAS are published elsewhere.[16–18] Of the 5,313 participants, 236 were excluded because they were missing body mass index (BMI) or stress measures, leaving a final analytic sample of N= 5,077.

Measures

Overweight and Obesity—Height and weight were obtained at each field center as part of the HCHS/SOL baseline examination. Height (cm) was measured with a wall stadiometer (SECA 222, Germany) and weight (Kg) was obtained with a digital scale (Tanita Body Composition Analyzer, TBF 300, Japan). BMI was calculated as weight in kilograms divided by height in meters squared. BMI values were used to define weight categories according to National Heart Lung and Blood Institute (NHLBI) guidelines: underweight (<18.5 kg/m^2)/normal weight (BMI 18.5 – 24.9 kg/m^2), overweight (BMI 25.0 to 29.9 kg/m^2), and obese (BMI ≥ 30.0 kg/m^2). Because the number of underweight participants was very small (n=41) we grouped underweight individuals with those of normal weight into a single category. Obesity was further classified into categories of severity: Class I (BMI 30 – 34.9 kg/m^2), class II (BMI 35 – 39.9 kg/m^2) and class III (BMI ≥40 kg/m^2).[19]

Adiposity—Waist circumference was obtained using the lateral border of the ilium as the anatomical reference, according to a standardized protocol. Percentage body fat was obtained by bioelectrical impedance analysis using the Tanita Body Composition Analyzer (TBF 300, Japan).

Stress Measures—Two measures of psychosocial stress were examined. ***Chronic stress burden*** (8 items)[20,21] asked participants about ongoing stressors in important life domains (health, work, relationships) that have lasted for at least 6 months. A score was created by summing the number of ongoing stressors reported (range 0–8), which was later categorized into number of reported stressors (0, 1, 2, ≥3). ***Perceived stress scale***[22] queried participants' perceptions of feeling stressed during the last month (10 items). Responses were on a 5-point scale from "never" to "very often." Scores were summed to indicate current stress levels, with higher scores suggesting greater perceived stress (Cronbach's α for participants answering questionnaire in English= .86; Cronbach's α = .84 in Spanish). Prior to analysis, the sum score (range 0–40) was divided into quartiles (Q1: 0–9; Q2: 10–14; Q3: 15–18; Q4: ≥19), with the top quartile indicating the highest perceived stress.

Dietary Intake—Dietary intake was obtained with two interviewer -administered 24-hr recalls using the Nutrition Data System for Research (NDSR) software developed by the University of Minnesota. The first recall was conducted in person during the HCHS/SOL examination and the second recall was conducted by phone within one month of the initial assessment. Using the National Cancer Institute (NCI) approach[23] we predicted usual energy intake and percent calories from saturated fat, adjusting for age, gender, Hispanic/Latino background, field center, weekend (including Friday), recall sequence, and self-report intake amount. In addition, to assess overall dietary quality we used the alternative healthy eating index (AHEI-2010), which is based on 11 components (vegetable and fruit intake, whole grains, sugar-sweetened beverages and fruit juices, nuts and legumes, red/processed meat, trans fat, long-chain fats, polyunsaturated fats, sodium, and alcohol intake) that are known to be predictive of chronic disease.[24,25] AHEI-2010 scores were calculated based on NCI predicted usual nutrient intake and gender-specific serving sizes for component items from 24-hour dietary recalls. AHEI-2010 scores range from 0 to 110 and higher scores indicate better diet quality. **Eating meals prepared outside the home** was assessed with a 10-item scale that asked participants to indicate how often they ate their meals outside the home at establishments such as fast food restaurants, or brought home ready-to-eat foods from grocery stores, on-street vendors or similar venues.[26]

Physical activity—Self-reported physical activity was obtained using a modified version of the World Health Organization (WHO) Global Physical Activity Questionnaire (GPAQ), which obtains information about participants' habitual activities in three domains: work, transportation, and leisure.[27]

Depressive symptoms were assessed with the 10-item form of Center for Epidemiological Studies Depression Scale, CES-D10[28]. This scale includes a subset of items from the original 20-item CES-D measure, asking how often the respondent has experienced a symptom in the past week. Response categories range from "none of the time" to "most of the time."[28,29]

Chronic conditions—Presence of chronic conditions was ascertained at the baseline examination and defined as self-reported history of asthma, COPD, MI, angina, stroke, mini-stroke, TIA, or balloon angioplasty or surgery in the arteries in the neck, or presence of diabetes [American Diabetes Association definition].[30]

Socio-demographic variables—Participants also reported their Hispanic/Latino background (Central American, Cuban, Dominican, Mexican, Puerto Rican, South American, and other/mixed), date of birth, sex, nativity, years living in the continental US, household income and educational attainment.

Statistical analysis

Differences in chronic and perceived stress by socio-demographic (e.g. sex, age, income) characteristics were evaluated using the Rao-Scott chi-square test. To assess the association between stress and BMI categories, multinomial logistic regression models were used with normal weight as the reference category and with each stress scale modeled separately.

These logistic models were adjusted for age, gender, educational achievement, income, Hispanic/Latino background, field center, and a 3-level nativity variable (US born, foreign born and living in the US for less than 10 years, and foreign born and living in the US for 10 or more years). Given the HCHS/SOL sampling design,[17] specific Hispanic/Latino backgrounds tended to concentrate in specific geographic areas, which meant that not all backgrounds were present in each field center. For example, Cubans were predominantly enrolled in Miami, Dominicans were predominantly enrolled in the Bronx, and participants from San Diego were predominantly Mexican. We therefore accounted for possible field center effects within Hispanic background by adjusting for a 17-level background-by-center interaction variable in place of the background variable, with levels corresponding to the 13 combinations of center and background that had 100 or more participants in the analysis sample, and one combined level per center for the mixed/other background category plus all other cells with count < 100. Models were further adjusted for physical activity, eating meals outside the home, depressive symptoms and chronic diseases. Linear regression models were used to assess the association between stress categories and continuous dependent variables (adiposity and dietary variables) adjusted for the aforementioned variables. Models examining the association of stress with diet were further adjusted for BMI category and energy intake. Interaction effects with sex were examined. All analyses accounted for the complex sampling design of HCHS/SOL using SAS-callable SUDAAN version 11.0 (SAS Institute, Cary, NC).

RESULTS

In this sample, 3,141 (61.9%) were women and 3,106 (61.2%) were ≥45 years old. Participants were predominantly born outside of the 50 US states (82.5%) and were of low socio-economic status: 36.1% did not graduate from high school; 34.1% had annual household income ≤ $20,000. Thirty five percent of women were overweight and 44% were obese, while 39% of men were overweight and 38% were obese. Women had a significantly higher percent body fat than men (38.5% SE=0.27 vs. 27.6% SE=0.28, $P < 0.0001$). Men had larger waist circumferences than women (99.0 cm SE=0.43 vs. 97.1 cm SE=0.60, $p = 0.0064$). There was a moderate correlation between chronic and perceived stress ($r = 0.38$). No significant difference in chronic stress was reported between women and men (Table 1). However, women were more likely than men to report being in the highest quartile of perceived stress (Table 1). Older participants (≥45 years) reported higher chronic stressors, but younger participants reported higher perceived stress (Table 1). Chronic and perceived stress varied by income level, with lower stress levels at higher levels of income. However, only perceived stress varied by educational attainment, with participants with college education reporting less perceived stress. Participants of Puerto Rican background reported higher chronic and perceived stress compared to other groups (Table 1).

The relationship of stress with usual dietary intake

Reporting more chronic stressors and higher perceived stress was associated with higher caloric intake (Table 2). Compared to the lowest quartile of perceived stress, moderate levels of perceived stress (quartile 3) had higher intake of saturated fat. Furthermore, there was an inverse association of perceived stress with AHEI-2010 scores, suggesting a less healthy eating pattern among those reporting higher perceived stress during the past month. However, chronic stress was not significantly associated with AHEI-2010 scores. Adjusting for eating meals prepared away from home reduced the effects estimates for the association of both stress measures and total energy intake, suggesting that eating more meals prepared outside home partially explained these associations (Table 2). The inverse association of perceived stress with AHEI-2010 scores was also attenuated after further adjustment for eating meals prepared outside home (Table 2). Additional adjustment for the time between dietary intake and perceived stress assessments did not change the estimates for the association of perceived stress with total energy intake, saturated fat, and AHEI-2010 (data not shown).

The relationship of stress with obesity and adiposity

The number of chronic stressors was positively associated with BMI categories, with a higher proportion of individuals with severe obesity reporting ≥ 3 chronic stressors (Figure 1). Adjusting for the potential confounders listed in table 3, individuals experiencing ≥ 3 chronic stressors were more likely to be obese than those without stressors (OR = 1.5, 95% Confidence Interval 1.01, 2.1) (Table 3). However, chronic stress was not associated with overweight. Waist circumference and percentage body fat increased with the number of chronic stressors reported (Table 3). Perceived stress during the past month was not associated with overweight or obesity. No stress by sex interaction effects were observed in relation to obesity or adiposity measures. The effects of chronic stress with obesity and adiposity were independent of energy intake, self-reported physical activity levels, depressive symptoms, and presence of chronic conditions.

DISCUSSION

As we hypothesized, the current study identified positive associations of chronic stress with obesity and other measures of adiposity that were independent of physical activity, energy intake, depressive symptoms or presence of chronic conditions. In contrast, perceived stress was not associated with overweight or obesity. Our findings are consistent with other studies showing an association of chronic psychological stress with obesity.[3–6,14,15,31] Baseline data from the Jackson Heart Study, a cohort of African-American adults, showed an association of greater number of negative life events with higher odds of obesity.[32] Furthermore, a prospective study of Australian adults showed that individuals experiencing 3 or more stressful life events during the past year had a higher weight gain when compared to individuals with no stressors,[3] an association that was also independent of lifestyle behaviors. The lack of association of perceived stress during the past month with obesity is also consistent with the literature. Barrington et al.[14], in a sample of predominantly non-Hispanic white adults, showed no association of perceived stress with body mass index, but significant correlation with lifestyle behaviors, which supports our hypotheses that prolonged exposure to stressors may be necessary for the effects of stress to manifest as obesity. In our study, women reported more chronic stressors and greater perceived stress than men, but we did not observe an interaction with sex in relation to adiposity as other studies have reported.[5,6]

Our results showed that both measures of psychosocial stress were associated with higher energy intake. Consistent with our hypotheses, recent perceived stress (past 30 months) was associated with lower diet quality. Our data also suggest that higher frequency of eating meals prepared outside home may contribute to the association of higher energy intake with stress measures. The relationship of stress with dietary intake is inconsistent in the literature, which may be explained in part by the challenges in measuring dietary intake and habitual diet. Groez et al.[33] showed that greater perceived stress is associated with intake of energy dense foods in women. In the Boston Puerto Rican Health Study greater perceived stress was also related to an unhealthy dietary pattern, characterized by higher intake of salty snacks and lower intake of protein, fruit and vegetables.[13] Other studies have found an association of perceived stress with higher saturated fat intake,[34] lower consumption of fruit and vegetables,[35] and higher intake of energy dense foods.[12] However, there are other studies that did not find an association between perceived stress and diet.[15,36] In the current study we used two 24-hr recalls to estimate usual dietary intake. This approach is considered the gold standard for dietary assessments in epidemiological studies but measurement error due to underreporting is an important limitation that may affect the magnitude of the estimated associations. Moreover, dietary recalls may not be an optimal method for examining immediate responses to recent stressors; other methods such as ecological momentary assessment may be better suited to capturing exposure to stress and concomitant behavioral responses as they occur in real time.

The results of this study have to be interpreted with caution, as the study reports on cross-sectional associations, and temporality cannot be directly addressed. In addition, the current study did not obtain biological markers of stress, thus, we could not assess the biological mechanisms that relate psychosocial stress with obesity. However, the strong association of chronic stress with waist circumference (a measure of abdominal adiposity) may indicate neuroendocrine pathways. Furthermore, research including assessments of hormones that regulate appetite may be useful to better understand the relationships of stress and dietary intake. Future studies are needed to help gain a better understanding of the factors that explain the relationship between stress and excess weight. For example, differences in eating styles and coping styles may moderate these associations.[11,37,38] More research is also needed to identify groups that may be more vulnerable to obesity and changing eating patterns when under stress. In addition, ecological momentary assessment or other approaches that simultaneously obtain reports of recent exposure to stress and ways of coping as they occur in every day life are needed to understand if exposure to stressors lead to behavioral changes over time.

Despite the limitations noted, the study findings suggest that stress reduction strategies may be useful in programs designed to prevent or treat obesity in Hispanics/Latinos. Obesity is an important public health problem in this population and the need for effective preventative and treatment programs remains for this group. Furthermore, psychosocial stress appears to be increasing among Hispanic/Latino groups compared to other ethnic/racial groups.[39] Prior research supports the notion of specifically targeting stress in weight reduction programs. Psychosocial stress is an important factor influencing the success of weight loss interventions [40] and weight loss interventions that are based on stress management show promise in improving weight among obese individuals.[41–43]

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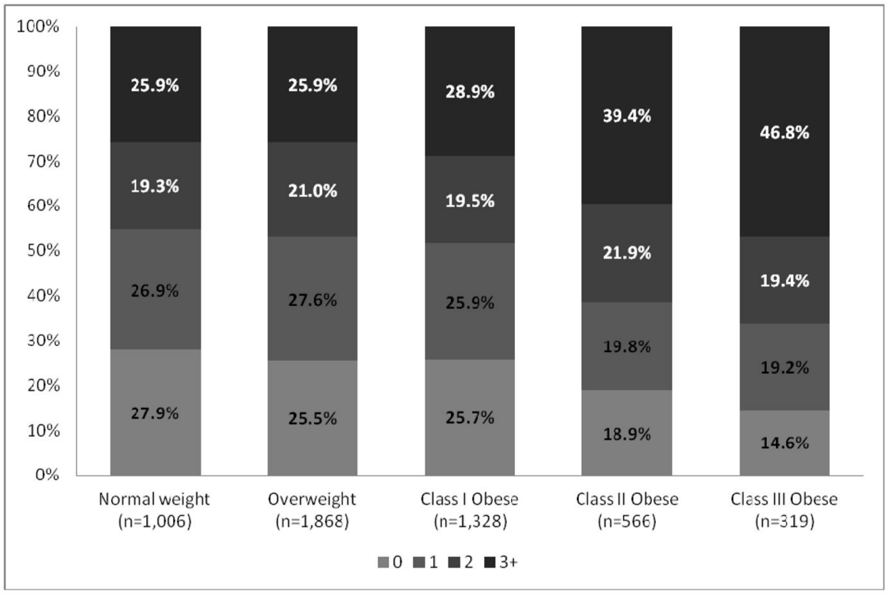

Figure 1.

Age-sex adjusted distribution of number of chronic stressors by weight category

Definitions: Normal weight is defined a BMI < 25; overweight is defined as BMI ≥ 25 and BMI <30; obese class I is defined a BMI ≥30 and BMI <35; obese class II is defined as BMI ≥35 and BMI <40; obese class III is defined as BMI ≥40.

Table 1

Age-sex adjusted distribution of stress measures by socio-demographic characteristics. The HCHS/SOL Socio-Cultural Ancillary Study.

		Chronic Stress				Perceived Stress†			
		0	1	2	3+	Q1	Q2	Q3	Q4
	N	%	%	%	%	%	%	%	%
Sex[a]									
Women	3141	23.6	25.1	20.3	31.0	18.5	26.9	22.1	32.6**
Men	1936	26.1	26.5	20.1	27.3	25.8	29.1	19.8	25.3
Age group[b]									
18–44 years	1971	28.9	27.5	18.4	25.2**	19.4	28.5	22.9	29.3*
≥ 45 years	3106	18.9	23.3	22.7	35.1	25.2	27.2	18.4	29.2
Household Income									
< $10,000	840	23.0	26.3	20.7	30.0*	20.1	26.4	21.8	31.7**
$10,001 – $20,000	1587	26.8	24.7	18.6	30.0	21.9	30.6	22.2	25.2
$20,001 – $40,000	1522	17.3	26.7	21.1	34.9	17.4	21.8	20.9	39.9
>$40,000	709	30.4	25.1	20.7	23.9	30.6	31.4	16.7	21.3
Educational Attainment									
Less than high school	1795	25.6	26.9	18.7	28.8	18.2	23.1	23.0	34.7**
High school	1312	25.5	24.4	19.9	30.1	19.5	27.7	20.7	32.1
Some college or more	1868	23.3	25.7	21.8	29.3	25.6	31.3	20.0	23.2
Nativity**									
Continental US Born	890	19.5	19.9	22.5	38.1**	15.8	24.3	21.7	38.2**
Foreign-born, ≥10 years in US	2974	25.7	26.0	19.1	29.3	22.7	27.4	20.5	29.5
Foreign-born, <10 years in US	1210	27.4	30.0	20.5	22.2	25.2	31.8	21.6	21.5
Hispanic/Latino background									
Central American	533	25.8	32.5	19.2	22.6*	18.9	28.5	22.5	30.1*
Cuban	729	22.6	29.5	23.0	24.9	26.4	28.1	18.1	27.4

		Chronic Stress				Perceived Stress[†]			
		0	1	2	3+	Q1	Q2	Q3	Q4
	N	%	%	%	%	%	%	%	%
Dominican	522	25.8	23.5	21.5	29.1	25.1	25.0	20.3	29.7
Mexican	1990	29.1	25.4	18.5	26.9	23.1	29.0	20.8	27.2
Puerto Rican	831	17.7	19.2	20.4	42.7	14.1	28.0	21.7	36.2
South American	334	25.3	31.8	20.1	22.9	20.7	30.6	26.1	22.5
Mixed/Other	134	14.8	20.8	20.5	43.9	13.3	18.9	29.5	38.4
Eating meals prepared outside the home									
Yes	3338	23.8	24.9	20.4	31.0[‡]	20.9	25.8	21.7	31.6[*]
No	1838	26.7	27.5	19.9	25.9	23.6	32.2	19.7	24.5
Elevated depressive symptoms									
Yes (CESD-10≥10)	1463	14.4	18.8	20.1	46.8[**]	3.4	13.7	19.5	63.5[**]
No (CESD-10<10)	3467	29.6	29.1	20.2	21.1	30.5	34.7	21.7	13.1

[a] Not sex adjusted;

[b] not age adjusted

[†] Perceived stress quartile range is as follows: Q1: 0–9; Q2: 10–14; Q3: 15–18; Q4: ≥19

p-value obtained from chi-square tests;

[‡] <0.05,

[*] p <0.01,

[**] p <0.0001

Table 2

Beta regression coefficients from multiple linear regression models for the association of stress with dietary intake.

	Total Energy (kCal)		**Saturated fat (% from calories)**		**AHEI-2010**	
	Model 1[a] β (95% CI)	**Model 2[b] β (95% CI)**	**Model 1[a] β (95% CI)**	**Model 2[b] β (95% CI)**	**Model 1[a,c] β (95% CI)**	**Model 2[b,c] β (95% CI)**
Chronic Stress (# of events)						
1 vs. 0	−24.7 (−73.8, 24.5)	−26.8 (−75.8, 22.1)	−0.04 (−0.15, 0.07)	−0.04 (−0.15, 0.07)	−0.47 (−1.03, 0.09)	−0.43 (−.99, 0.12)
2 vs. 0	17.0 (−28.6, 62.7)	13.3 (−32.0, 58.6)	−0.03 (−0.15, 0.09)	−0.03 (−0.15, 0.09)	−0.17 (−0.78, 0.43)	−0.11 (−0.71, 0.49)
3+ vs. 0	88.2 (33.7, 142.7)	83.5 (28.9, 138.2)	−0.04 (−0.15, 0.08)	−0.04 (−0.16, 0.07)	−0.26 (−0.86, 0.35)	−0.19 (−0.80, 0.41)
Perceived stress [d]						
Q2 vs. Q1	29.9 (−15.2, 75.0)	31.9 (−12.7, 76.4)	−0.02 (−0.14, 0.09)	−0.02 (−0.13, 0.09)	−0.19 (−0.75, 0.36)	−0.23 (−0.78, 0.32)
Q3 vs. Q1	97.0 (48.4, 145.7)	93.5 (45.6, 141.4)	0.12 (0.00, 0.24)	0.12 (0.00, 0.23)	−0.68 (−1.32, −0.05)	−0.63 (−1.25, −0.01)
Q4 vs. Q1	109.2 (59.0, 159.4)	103.2 (52.7, 153.7)	0.08 (−0.04, 0.20)	0.07 (−0.05, 0.19)	−0.70 (−1.27, −0.12)	−0.61 (−1.18, −0.03)

[a]Model 1: Adjusted for age, sex, weight category, education, household income, Hispanic/Latino background, field center, and nativity.

[b]Model 2: Adjusted for variables in model 1, plus further adjustment for eating meals prepared outside home

[c]Further adjusted for predicted total energy intake

[d]Perceived stress quartile range is as follows: Q1: 0–9; Q2: 10–14; Q3: 15–18; Q4: ≥19.

Table 3

Association of stress measures with obesity and adiposity*

	Overweight (BMI 25–30 kg/m^2)	Obesity (BMI ≥30 kg/m^2)	Waist Circumference (cm)	Percentage Body Fat
	OR (95% CI) §	OR (95% CI) §	β (95% CI)	β (95% CI)
Chronic stress (# of events)				
1 vs. 0	1.2 (0.9, 1.5)	1.1 (0.8, 1.5)	0.3 (−1.3, 1.9)	0.4 (−0.5, 1.4)
2 vs. 0	1.3 (0.9, 1.8)	1.3 (0.9, 1.7)	1.0 (−0.5, 2.5)	0.8 (−0.2, 1.7)
3+ vs. 0	1.1 (0.7, 1.6)	1.5 (1.01, 2.1)	3.3 (1.0, 5.5)	1.5 (0.4, 2.6)
Perceived stress†				
Q2 vs. Q1	0.8 (0.6, 1.2)	1.0 (0.7, 1.4)	1.0 (−0.3, 2.3)	0.5 (−0.3, 1.4)
Q3 vs. Q1	0.7 (0.5, 1.1)	0.8 (0.6, 1.2)	0.3 (−1.3, 1.9)	0.3 (−0.7, 1.3)
Q4 vs. Q1	0.7 (0.5, 1.1)	0.7 (0.5, 1.1)	0.7 (−1.1, 2.5)	0.4 (−1.4, 0.7)

*Adjusted for age, sex, education, household income, and Hispanic/Latino background, field center, nativity, energy intake, and self-reported physical activity, depressive symptoms, and chronic diseases (asthma, COPD, diabetes [ADA defined], MI, angina, stroke, mini-stroke, TIA, or balloon angioplasty or surgery in the arteries in the neck).

§Normal weight is the reference category

†Perceived stress quartile range is as follows: Q1: 0–9; Q2: 10–14; Q3: 15–18; Q4: ≥19.