

Perceived Stress and Eating Behaviors by Sex, Obesity Status, and Stress Vulnerability: Findings from the Vitamins and Lifestyle (VITAL) Study

Wendy E. Barrington, PhD; Shirley A. A. Beresford, PhD; Bonnie A. McGregor, PhD; Emily White, PhD

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ABSTRACT

Stress has been associated with eating patterns in human studies with differences due to the type and duration of stressor, type of food, and individual susceptibility factors. Laboratory and smaller epidemiological studies have reported stress-associated preferences for foods high in sugar and fat; associations have been found more consistently among women and people who are obese. Larger studies are needed to sufficiently test these relationships. The aim of this study was to evaluate associations between self-reported amount of stress and dietary nutrient intakes (percentage energy from fat, carbohydrates, added sugar) and dietary behaviors (number of eating occasions and servings of fruits and vegetables, high-fat snacks, fast-food items, and sweetened drinks) by sex, obesity status, and stress vulnerability. Linear regression was used to estimate associations of perceived stress with eating patterns among 65,235 older adults while adjusting for demographic factors, body mass index, physical activity, alcohol intake, number of comorbidities, and other relevant covariates. Higher perceived stress was associated with greater intake of energy from fat, high-fat snacks, and fast-food items as well as lower intake of energy from carbohydrates (all P for trend ≤ 0.002). Among those with high perceived stress vulnerability, perceived stress was associated with fewer eating occasions (P for interaction < 0.0001). Although associations were small, significant relationships were found for perceived stress arising from everyday experiences among an older, mostly white population. These findings have public health implications and suggest that stress may be important to consider in programs promoting healthy eating.

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OBESITY CONTINUES TO BE A MAJOR PUBLIC health problem that may be attributable, in part, to modern lifestyles characterized by sedentary behaviors and the overconsumption of high-fat and high-sugar foods.^{1,2} Understanding what drives these obesogenic behaviors is essential to prevention efforts. Stress may be a bio-behavioral mechanism through which modern lifestyles promote obesogenic eating behaviors and, ultimately, obesity risk. In a US representative sample, multiple dimensions of stress were associated with 10-year weight gain among men and women, especially among those who were already overweight or obese.³

Yet, explaining how stress relates to eating is complex; most people eat more in response to stress, whereas some eat less.^{4,5} Stress can be conceptualized as comprising multiple bio-behavioral cascades. Stress “begins” when environmental demands overwhelm the resources of an individual and perceptions of stress arise, which may result in physiological, cognitive, and behavioral processes designed to maintain allostasis in the short-term.⁶ Stress as a construct has been measured, therefore, as counts of potential sources of stress (ie, environmental demands), perceived stress, or behavioral

or physiologic responses to stress. Chronic activation of the stress response can lead to dysregulation that has been associated with increased appetite,^{7,8} preference for foods high in sugar and fat,⁴ visceral fat accumulation and deposition,^{4,8,9} and obesity.^{6,8} The type and severity of stressor may be important to associations with eating.⁸ Also, repeated exposure to stressors that threaten one’s social self (eg, stressors associated with social position) are thought to especially contribute to this dysregulation.⁴

Greeno and Wing suggest that individual differences in learning history, attitudes, and biology are integral to stress-eating models because such differences may impact the susceptibility of an individual to stress-related eating.¹⁰ Many laboratory studies have evaluated the relationship of stress and eating with respect to sex, obesity-status, and disinhibited eating (eg, eating in response to external cues or emotional states).⁴ Obese individuals may be more susceptible to hunger, but the prevalence of disinhibited eating is higher both among women and those who are obese.^{4,11} Overall, laboratory studies suggest that women, the obese, and those who display disinhibited eating are more likely to engage in stress-related eating.⁴ It is conceivable that

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disinhibited eating may occur among those who are more vulnerable to stress as a means of coping and allostasis.^{4,12} There is some evidence that preference of foods high in fat and sugar may influence opioid releases in the brain as a coping “reward” after a stressful situation, which produces behavioral reinforcement.^{4,13}

Ultimately, curbing the obesity epidemic depends on successful intervention strategies aimed at long-term maintenance after weight loss.¹⁴ Further understanding of how stress relates to eating in everyday life could inform broad-level obesity-prevention strategies. Although smaller observational studies suggest relationships between stress and obesogenic eating behaviors,^{15–17} additional evaluation in large population subgroups is needed. To address this gap, associations between perceived stress and dietary factors associated with high energy intake were evaluated in a large, well-characterized epidemiologic cohort. We hypothesized that greater perceived stress would be related to obesogenic eating behaviors and that these relationships would vary by sex, obesity status, and perceived vulnerability to stress.

MATERIALS AND METHODS

Participants

The Vitamins and Lifestyle (VITAL) Study is a prospective study that was established to investigate the association of vitamin and mineral supplement use and other lifestyle factors with cancer risk. Men and women were eligible to join if they were between the ages of 50 and 76 years and lived within western Washington state. Names of eligible individuals were acquired through purchased mailing lists, and baseline questionnaires querying supplement use, health history, cancer risk factors, and diet were mailed to 364,418 individuals. Of those, 77,718 men and women passed questionnaire quality-control checks and were enrolled into the study between 2000 and 2002. Further details of study design are reported elsewhere.¹⁸ Individuals were excluded from the present analyses if they reported intestinal malabsorption disorders ($n=45$), which may have a substantial effect on eating patterns (eg, gastric bypass surgery). Individuals were also excluded if they had missing data on self-reported stress ($n=1,620$), stress vulnerability ($n=303$), body mass index (BMI) ($n=3,569$), covariates (listed in a later section) ($n=1,401$), or if they failed quality-control checks on the food frequency questionnaire (FFQ) (described in later section) ($n=5,545$), resulting in a sample of 65,235. Mean perceived stress was similar between those dropped (3.39) and retained (3.44). This project was reviewed and approved by the Fred Hutchinson Cancer Research Center Institutional Review Board.

Perceived Stress (Independent Variable)

The amount of perceived stress was measured by a single item: “In the past year, how would you rate the amount of stress in your life (at home and at work)?” with possible responses ranging from 1 (“no stress”) to 6 (“extreme stress”). To capture more chronic stress as well as correspond to the time period over which dietary data were collected, we asked the question in reference to the past year.¹⁹ This item was validated within a subsample of the cohort using validated instruments¹⁹: (a) a modified 53-item questionnaire based on the Hassles and Uplifts Scale²⁰ ($r=0.50$); (b) the 4-item

Perceived Stress Scale (PSS-4)²¹ ($r=0.36$); and (c) a 10-item questionnaire on major life events based on the Women’s Health Initiative Life Events questionnaire²² ($r=0.38$). The 3-month test–retest reliability for this perceived stress item was moderate (weighted kappa=0.66).¹⁹

Nutrient Intake and Dietary Behaviors (Outcomes)

Nutrient intake and dietary behaviors were assessed via a semi-quantitative FFQ, based on the FFQ developed for the Women’s Health Initiative and other studies,²³ which asks about the frequency of consumption and portion sizes of 120 foods or food groups over the last year. The FFQ analytic program is based on nutrient values from the Minnesota Nutrition Data System for Research.²⁴ Participants were excluded from dietary calculations if they did not complete at least five items per page of the FFQ or if their energy intake was less than 800 kcal/day or more than 5,000 kcal/day for men or less than 600 kcal/day or more than 4,000 kcal/day for women. Nutrient outcomes included percent energy from fat, from carbohydrates, and from added sugar. Added sugars included dietary fructose, galactose, glucose, lactose, maltose, and sucrose not from whole foods.

Dietary behaviors that were outcomes in this study included the frequency of: (a) eating occasions, (b) servings of fruits and vegetables (F/V), (c) servings of high-fat snacks, (d) servings of fast-food items, and (e) servings of sweetened drinks. Total eating occasions was assessed via a single item: “On average, how many times a day did you eat (meals and snacks)?” Participants were instructed to not count drinking beverages alone as snacks except beverages with milk. Total F/V intake was calculated by summing all servings except fruit juice and potatoes, with adjustment for serving sizes and self-reported total F/V consumption. High-fat snack items included servings of: chips, muffins, croissants, scones, biscuits, and chocolate, candy bars, and other candy. Consumption of fast-food items was defined as the number of servings per week of foods typically served in fast-food restaurants and included servings of: regular-fat hamburger, regular-fat hot dogs, fried chicken, fried fish, pizza, and french fries.²⁵ Sweetened drink servings included both regular and diet varieties of soda as well as fruit-flavored drinks (not juice).²⁶

Potential Effect Modifiers

Sex, BMI, and perceived vulnerability to stress were evaluated as potential effect modifiers of associations between perceived stress and dietary outcomes. BMI was based on self-report and calculated as current weight at baseline in kilograms divided by maximum height in meters squared. Obese individuals were defined as having a BMI ≥ 30.0 , which translated to being at or above the top 25th percentile for this variable distribution. The ability to handle stress, referred to as “perceived vulnerability to stress” in this paper, was assessed via a single item: “On a scale of 1 to 6, how would you rate your ability to handle stress?” (from 1=“I can shake off stress” to 6=“Stress eats away at me”). This item has demonstrated good reliability within a subsample of this cohort (weighted kappa=0.71).¹⁹ High perceived vulnerability to stress was defined as being at or above the top 25th percentile for this variable distribution (score: 5–6).

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