Stress and Weight Management — Learn About the Body’s Physiological Responses to Stress and Effect Stress Has on Weight Management
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It’s no secret that we live in a fast-paced world. As a result of work responsibilities, demands of home life, and other everyday challenges, many people feel overwhelmed and pulled in different directions. It’s not surprising, therefore, that a 2007 poll by the American Psychological Association found that one-third of people in the United States report experiencing extreme levels of stress. At the same time, the obesity epidemic continues to spread. From 2011 to 2012, 69% of adults aged 20 or older were overweight or obese. According to the Centers for Disease Control and Prevention (CDC), the rates of overweight and obesity in adults more than doubled between 1976 and 1980 and between 2009 and 2010. In addition, it’s well known that many individuals reach for comfort foods to relieve stress. Given the prevalence of stress and the rise in obesity, it’s imperative to look at the relationship between these two conditions.

Nutrition professionals are trained to understand the multifactorial aspects of obesity. While their focus on helping clients improve eating behaviors and increase physical activity is vital for bettering overweight and obesity outcomes, research suggests that RDs’ efforts to understand the effects of stress on weight management may be equally important.

This continuing education course explores the physiological responses to stress and the effect of stress on weight management.

Stress in the United States
Stress has been defined as “the generalized, nonspecific response of the body to any factor that overwhets, or threatens to overwhelm, the body’s compensatory abilities to maintain homeostasis.” The American Psychological Association (APA) prepares an annual report called “Stress in America,” the most recent of which, released in February 2015, indicates an improvement in stress between 2007 and 2014. In 2007, participants on average rated their stress as 6.2 on a scale from one to 10, with one being little stress and 10 being high stress. In 2014, participants averaged a 4.9 rating.

Seventy-five percent of Americans reported experiencing at least one symptom of stress, such as depression/sadness, anxiety, fatigue, and irritability, within the month before the APA’s survey. The causes of stress may pertain to money, work, the economy, family responsibilities, and personal health concerns. Studies suggest that 40% of individuals view their jobs as being very or extremely stressful. A report by the CDC indicates that individuals attribute more health complaints to work stress than to family problems or even financial
burdens. Nearly three-fourths of adults, however, report feeling stressed about money at least some of the time, and nearly one-fourth say they experience extreme stress about money.\(^5\)

According to the CDC, many studies have identified common health complaints associated with stress, including cardiovascular disease, musculoskeletal disorders, psychological disorders, and workplace injury.\(^6\) In addition, research is under way to examine the relationship between chronic stress and weight management. More studies are needed in these areas. Given the outcomes already indicating the relationship between stress and disease states, and the emerging data suggesting a link with overweight and obesity, it’s vital that RDs educate clients on stress control to help improve their quality of life and at the same time prevent or manage overweight and obesity.

**Acute vs Chronic Stress**

Acute and chronic stress can produce different physiological reactions, yet both can result in an increase in hunger. During acute bouts of stress, the sympathetic adrenal medullary system mounts a response to the stressful stimuli, releasing adrenaline, a catecholamine.\(^7\) This is commonly called the fight-or-flight response. The adrenaline produces physiological effects, including elevated blood pressure, increased heart rate, and shunting of blood from nonessential organs including the kidneys, skin, and digestive system to the muscles and brain to make them better able to fight or flee.\(^8\) This form of stress response occurs most often in reaction to dangerous events such as running for one’s life or fleeing from an intense situation.

Once the acute stressful event has subsided, the hypothalamic-pituitary adrenal (HPA) axis is activated. The HPA axis is responsible for the body’s response to chronic or prolonged stress. The HPA axis comprises the paraventricular nucleus of the hypothalamus, the anterior lobe of the pituitary gland, and the adrenal gland. In response to stressful stimuli, the hypothalamus produces corticotropin-releasing factor (also known as corticotropin-releasing hormone [CRH]), the primary regulator of the HPA axis. This stimulates the anterior lobe of the pituitary gland to secrete adrenocorticotropic hormone, which in turn stimulates cortisol secretion by the adrenal glands. Cortisol increases appetite, which is beneficial because nutrients are expended during the physical response to the stressful event (ie, calories burned during a fleeing situation). If activation of this acute stress response system becomes chronic, such as in prolonged psychological stress, secretion of cortisol also occurs. Since an actual fight-or-flight response doesn’t occur in chronic stress, there’s no resulting nutrient depletion and therefore no need for replenishment. Nevertheless, the secretion of cortisol increases hunger, leading individuals to consume more food, creating the potential for weight gain.

**Stress Hormones and Appetite Regulation**

Adrenaline, also called epinephrine, is produced in the adrenal medulla, the inner region of the adrenal glands. Adrenaline is responsible for glycogen breakdown in the liver and fat breakdown in adipose tissue to make fuel available to the heart and skeletal muscle in times of need.\(^10\) Initially, the release of adrenaline, which predominately occurs during acute bouts of stress, decreases appetite.\(^6\) This happens due to the shunting of blood from the digestive system to areas with more immediate need.
When adrenaline production decreases after the acute stressful event, cortisol production increases. Cortisol, produced in the adrenal cortex, is known to stimulate appetite and is thought to be especially important after fight-or-flight situations to replenish calories expended during the event.

Cortisol is involved in the metabolism of carbohydrates, protein, and fats. It’s the body’s main glucocorticoid, the principal hormone involved in stress regulation. It’s considered the primary culprit in stress-induced weight gain as it is responsible for increased hunger after stress, whether acute or chronic. The possibility that cortisol levels are related to obesity and metabolic disease was first recognized during clinical assessments of patients with Cushing's syndrome, a condition in which an individual has high levels of cortisol. Upper body obesity was observed in patients who had chronically elevated cortisol levels.

Cortisol secretion and the HPA axis appear to be directly correlated. It’s thought that a chronic activation of the HPA axis, possibly due to a secretion of CRH, results in chronic secretion of cortisol, which increases appetite and the potential for weight gain.

CRH is secreted by the paraventricular nucleus of the hypothalamus in response to stress. It initially decreases appetite; however, this isn’t a long-term effect as cortisol is released shortly after the stress-inducing event, resulting in a subsequent increase in appetite. George and colleagues assessed the effect of an injection of CRH on food intake in a double-blind, placebo-controlled study involving 14 healthy, nonobese individuals. Eight participants were given the placebo, a saline injection, while six were injected with CRH. Subjects were then presented with snack baskets containing high-fat sweet snacks, high-fat salty snacks, low-fat sweet snacks, and low-fat salty snacks. Analysis of particular snack consumption wasn’t assessed; the goal was to assess the total consumption after the injection and placebo. Subjects that had been injected with CRH had markedly elevated cortisol levels compared with those who received the placebo. Those injected with CRH also ate more compared with those in the placebo group. Peak cortisol levels were directly related to both caloric intake and food consumption.

This study suggests that elevated cortisol levels as a result of CRH injections lead to increased total food consumption and overall total caloric intake. The study findings highlight the potential role elevated CRH and cortisol may play in contributing to an increase in obesity. Although its sample size was small, this study adds to research findings indicating a link between CRH, the HPA axis stress response system, and eating behaviors.

The hormones ghrelin and leptin, which play a significant role in appetite regulation, aren’t considered stress-response hormones, but they do warrant attention. Ghrelin, a hormone produced mainly in the stomach, is involved in the stimulation of hunger. It generally increases before meals and decreases after meals. Leptin, which is secreted from adipose cells, decreases appetite and increases energy stores. Ghrelin and leptin are antagonists in appetite regulation; ghrelin increases appetite and leptin decreases it. Although the mechanism isn’t well understood, leptin is thought to have an effect on increasing CRH.
Rouach and colleagues designed a study to assess whether ghrelin is associated with an increase in food intake in individuals under stress. Twenty-four subjects—16 women and eight men—were divided into three groups: an obese group, a normal-weight group, and an obese group with a history of binge eating disorder. The study aimed to be consistent with the ratio of men to women within each group. All three groups were tasked with the same stressor activity—a speech for a job interview, recorded to increase the pressure and add to the psychological stress. Subjects were then asked to complete a questionnaire about their urge to eat before and after the stressful event. Ghrelin blood samples were obtained before and immediately after the stressful event, as well as 20, 40, and 60 minutes afterward. All groups reported more subjective perceived stress after the stress test. There was an increase in blood pressure in all subjects, but heart rate remained stable and even decreased toward the end of the stressor. Most subjects denied an urge to eat before and after the stressful event but those who did have an urge to eat tended to be in the obese with binge eating disorder group. Cortisol levels were tested and found to be elevated in 13 of the 24 individuals who were classified as “cortisol responders.” Ghrelin levels increased in cortisol responders but not in the cortisol nonresponders.

The study is the first to indicate that psychological stress increases ghrelin levels, but Rouach and colleagues indicate that more research is needed to assess the correlation between ghrelin and cortisol. This study suggests that the increased association between such hormones might increase appetite, and, thus, intake, resulting in potential weight gain in stressful situations.

Stress and Comfort Eating
In addition to the physiological response to stress, it’s equally important to consider how individuals cope with stress. Thirty-three percent of Americans report eating too much and/or eating unhealthful foods as a result of high stress. Although findings have been mixed, some studies suggest that stress may lead to an increased intake of comfort food, which generally may be classified as high in fat and calories yet low in nutrient density.

Some human studies have shown positive correlations between stress response and an increased consumption of high-calorie, high-fat foods. A 2003 study by Ng and Jeffery explored the associations between stress and diet, and physical activity and smoking. The study relied on data from a research trial on smoking cessation in workplaces involving 6,620 women and 5,490 men in 26 worksites in Minnesota. Each participant was asked to complete a survey related to stress, fat consumption, physical activity, smoking, and alcohol use. Results suggest that individuals who had a higher rate of perceived stress had a higher fat intake and generally performed less physical activity. In this study, there was no significant difference in outcomes between men and women.

In another study, 68 men and women were recruited from the University of London to take part in a study of perceived hunger associated with a stressful stimulus. The participants in the intervention group were led to believe they would be participating in a speech presentation. The control group, for the same duration, was given a nonstressful task of listening to emotionally neutral text. The researchers’ goal was to assess how the level of stress would affect food intake. Study participants were all generally healthy, nonobese individuals, equally
and randomly divided into the control and intervention groups. Participants were asked to avoid food for four hours before the study to elicit hunger. Before being offered food, each group was provided with pictures of the foods to be consumed to assess appetite ratings on the different varieties of foods. Each group was then allowed to eat freely for 15 minutes from a buffet lunch. The foods pictured and available at the buffet lunch included bland high-fat and low-fat foods, sweet, and salty foods. Results indicated that there was no significant difference between the intervention and control groups in amount of total food consumed. The participants rated the photos to indicate which they most desired, revealing that high-fat sweet foods were the most liked and salty low-fat foods were the least liked. Self-reported stressed emotional eaters were noted to consume more sweet high-fat foods and a more calorie-dense meal compared with the unstressed and nonemotional eaters.20 This suggests that although there was little difference in the overall amount of intake, emotional eaters gravitated toward high-fat and high-sweet snack foods.

Another study by Wardle and colleagues assessed the relationship between high- and low-workload stress periods and food intake, while also assessing whether the participants' tendency to restrict eating behaviors affected food intake during periods of stress.21 Participants were recruited from a large department store in London. A total of 90 individuals took part in the study; 71 participants completed all four assessments.

The first assessment consisted of a standardized questionnaire to evaluate restrained eating as well as a 24-hour food recall; the other three assessments evaluated a 24-hour recall, each participant’s weight, and ratings of subjective stress and emotional well-being. Assessments were completed at varying times of the year. The 24-hour recall was completed with the assistance of a dietitian. The dietary data indicated a modest increase in energy, fat, and sugar intake in periods of high-workload stress compared with low-workload stress. In addition, results indicated that restrained eaters (who were mostly women) not only ate more overall but also ate more sweet and high-fat foods in the high-workload stress session. The results of this study found that individuals tend to choose large food quantities, specifically sweet and fatty foods, when under high amounts of perceived stress.21

While studies of humans yield variable results with respect to stress and food intake, animal studies consistently show increased food intake in response to stressful stimuli.22,23 Several animal studies have assessed appetite stimulation from perceived acute and chronic stress. Studies indicate that severe stressors decrease appetite and food intake while mild stressors are dependent on the type of food provided. For example, researchers found that if mildly stressed rats were presented with a highly palatable food (in this case sweetened milk) and their regular rat chow, they were more likely to consume the highly palatable food than they were to consume their regular rat chow.14,15 This suggests that animals in chronic stressful situations might experience increased appetite for sweetened or higher fat foods.

These studies lend credence to the suggestion that individuals who eat under stress may have a desire for higher calorie, higher fat foods. There’s limited long-term research to assess the relationship between weight gain and dietary habits related to stress response, but the findings of existing studies suggest that these individuals would be at a higher risk of weight gain given the caloric density of their overall dietary intake. In addition, those who choose high-calorie,
high-fat snack foods in addition to their regular meals may experience weight gain given the excess calories.

**Stress and Gender Differences**

Although most of the previously mentioned studies related to stress eating indicate no significant difference when accounting for gender, some studies have shown there’s a difference in weight gain related to stress between men and women. According to the APA, women generally report a higher level of stress than men: 5.2 vs 4.5 on a 10-point scale in 2014 vs 6.3 vs 6 in 2007, respectively. In addition, women who say their stress is high, particularly when involving money, are more likely to report they engage in sedentary or unhealthful behaviors to manage their stress. Some of these reported activities include watching television/movies for more than two hours per day, surfing the Internet, napping/sleeping, eating, drinking alcohol, or smoking.

Vicennati and colleagues performed a retrospective study to assess how a stressful event influenced weight gain among three groups of women. The study looked at women who rapidly gained weight after a stressful event, women who developed obesity unrelated to a stressful event, and a control group of healthy-weight women. The study measured their anthropometric, metabolic, and hormonal status, including insulin, 24-hour urinary free cortisol, and sex hormones. Three groups were observed: 14 women in the stress-related obesity group, 21 women in the nonstress-related obesity group, and 21 healthy-weight women in the control group. All women were premenopausal and of similar age.

The study revealed no significant difference in anthropometrics, the age at which weight gain began, or body weight before weight gain among the stress-related and the nonstress-related groups. Weight gain results indicated that the women in the stressful event group gained weight faster and at a higher rate than did the nonstress-related group. Women in the stress group also had higher levels of 24-hour urinary free cortisol, which resulted in a significant correlation between the urinary free cortisol and the time and amount of weight gain. The 24-hour urinary free cortisol excretion rate is used as a measure of HPA axis activity. Therefore, given the elevated 24-hour urinary free cortisol, this study further emphasizes that the prolonged stress-related hyperactivity of the HPA axis can affect weight gain and thus result in obesity. These results may indicate that the HPA axis is affected by sex hormones, but more studies also are needed in this area.

In another study, Barry and Petry set out to assess the relationship among BMI, gender, and stressful life events using the National Epidemiological Survey on Alcohol and Related conditions, a survey taken by the National Institute on Alcohol Abuse and Alcoholism to assess data related to alcohol and a range of comorbid disorders. The survey’s target population included noninstitutionalized US civilians aged 18 or older from all 50 states and the District of Columbia. Data were collected between 2001 and 2002 to assess the prevalence of alcohol use and associated physical and emotional disturbances.

Stressful life events were divided into the following four categories: health, job, social, and legal. A total of 43,093 individuals responded to the survey with a resultant 41,217 respondents after exclusions. Individuals who were pregnant or didn’t provide their height and
weight, making it impossible to calculate their BMI, were excluded from the study. Of the 41,217 participants included in the study, 23,058 were women and 18,159 were men. The researchers found an association between an increased number of stressful life events and an increase in BMI in both men and women. Women who were moderately overweight were more likely than normal-weight women to experience several stressors; among men, increased stressors were noted only in the obese and extremely obese BMI categories. This study supports the idea that women with more stressful life events are more likely to be overweight or obese compared with their normal-weight peers. In addition, the study supports the idea that women may be more susceptible to overweight and obesity compared with men.

These studies suggest that physiological and emotional stress factors may contribute to obesity among both men and women. Further research in this area may provide insight into strategies to combat obesity, focused on methods for coping with stress and limiting emotional stress eating.

**Putting It Into Practice**
To help their clients, dietitians must be aware of all factors that affect weight management, including stress. RDs should focus primarily on recommending a healthful, balanced diet, rich in nutrient-dense, plant-based foods and naturally occurring antioxidants, and encouraging exercise as the main focus of weight management. However, it's important for nutrition professionals to assess stress when completing a nutrition assessment and evaluate how it may affect an individual's dietary habits. It may be prudent to discuss with clients the importance of stress management in attaining their weight management goals.

During the nutrition assessment, if comfort eating to relieve stress is an identified issue, methods to combat emotional eating should be discussed within the RD's scope of practice. Such methods could include encouraging mindful eating, attempting calming activities appropriate to the specific individual, encouraging nonfood activities as distractors from stress, as well as ensuring adequate sleep.

According to the APA report “Stress in America,” activities that individuals report using to manage stress include listening to music, exercising or walking, watching television, reading, and spending time with friends and family. RDs not only can be instrumental in helping clients find alternate nonfood activities to manage stress, but also can continue to encourage such activities during follow-up appointments.

Furthermore, RDs should maintain a multidisciplinary network so they can refer clients to other health care professionals who specialize in stress management and can help them meet their long-term weight-management goals.

**Complex Factors**
The physiological and psychological aspects of stress on weight gain are complex and multifactorial. Recent research has provided insight into how stress affects weight management, but more research is needed to further assess the extent to which high psychological stress levels may influence weight gain and, more important, individuals' long-
term weight management goals. The RD is in a unique position to help clients apply research findings to meet weight management challenges.

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References

2. Obesity and overweight. Centers for Disease Control and Prevention website.  


Quiz

1. Which of the following conditions have been most closely associated with stress?
   A. Renal disease
   B. Cardiovascular disease
   C. Thyroid disease
   D. Cancer

2. Which of the following do most individuals report being one of their biggest stressors?
   A. Health concerns
   B. Friends and family
   C. Job/career
   D. Lack of sleep

3. What system is responsible for the “fight or flight” response?
   A. The hypothalamic-pituitary adrenal (HPA) axis
   B. The sympathetic adrenal medullary system
   C. The endocrine system
   D. The cardiovascular system

4. What system is primarily responsible for the effects that take place in the body during chronic stress?
   A. HPA axis
   B. Sympathetic adrenal medullary system
   C. Endocrine system
   D. Cardiovascular system

5. Which hormone is considered part of the stress response?
   A. Cortisol
   B. Leptin
   C. Norepinephrine
   D. Ghrelin

6. Which hormone is known to increase appetite?
   A. Corticotropin-releasing hormone (CRH)
   B. Adrenaline
   C. Leptin
   D. Ghrelin

7. Which hormone is known as the primary regulator of the HPA axis?
   A. Cortisol
   B. CRH
   C. Leptin
   D. Adrenaline
8. In the Ng and Jeffery study, participants with higher perceived stress did which of the following compared with their nonstressed peers?
A. Consumed more sweet foods
B. Consumed more high-fat foods
C. Consumed fewer high-fat foods
D. Consumed more total calories

9. In the Oliver and colleagues study, which assessed hunger associated with stressful stimuli, participants who classified themselves as emotional eaters preferred which of the following?
A. Salty foods
B. High-fat foods
C. High-fat, sweet snack-type foods
D. Sweet foods

10. What is a potential cause for chronic stress and weight gain?
A. Chronic activation of the HPA axis
B. Low calorie intake
C. Low cortisol levels
D. Low ghrelin levels