

Cortisol Connection: Tips on Managing Stress and Weight

Christine A. Maglione-Garves, Len Kravitz, Ph.D., and Suzanne Schneider, Ph.D.

Introduction

Today there are commercials that tout the effectiveness of supplements like Cortislim™ and Relacore™ that propose to help people lose weight and feel less stressed by inhibiting the effects of cortisol. However, these commercials do not fully inform the general public about:

1. What is stress and its significance to overall physiological functioning?
2. The actual pathways involved with the stress response and the one responsible for cortisol release.
3. The function and importance of cortisol for bodily function.
4. The potential link between cortisol and obesity.
5. The potential link between stress, cortisol, and appetite.
6. The harmful health effects of stress-induced obesity.

The purpose of this paper is to briefly review, discuss and clarify some misconceptions on these topics and to suggest some practical assessment and stress management ideas for the fitness professional and personal trainer to incorporate with students and clients.

What is stress and its significance to physiological functioning?

Hans Selye, a foremost stress physiologist of the 20th century defined stress as "...the nonspecific response of the body to any demand made upon it (1)." Richard Lazarus, another highly regarded psychologist adds that stress is "...any event in which environmental demands, internal demands, or both tax or exceed the adaptive resources of an individual, social system, or tissue system."

In many different societies, stress is a common term that is often associated with negative situations and settings. Yet, a stress-free life may also be harmful, because an individual will lose his/her ability to react to the different challenges of life. Every person has an optimal positive stress level referred to as eustress, while stress that is harmful is noted to be distress.

What are the stress response pathways?

People can react to a stressor in different ways. For instance, if an individual perceives the stressor as a challenge to his/her control of a situation, norepinephrine, the "fight" hormone is predominantly released. And, if the stress arousal increases and a possible loss of control is felt by the individual, then epinephrine, another "flight/anxiety" hormone is released.

When the stress is prolonged and seen as hopeless, the individual becomes more distressed and feels defeated. This activates the hypothalamus in the brain. What follows is a cascade of hormonal pathways resulting in the final release of cortisol from the adrenal cortex (of the kidney).

The brain has the ability to selectively activate the fight, flight, or defeat responses (3). This usually occurs in day to day living when an individual perceives his/her hassles as a challenge to control or a loss of control. Although the stress pathways work together, they each can uniquely affect the function of bodily processes. For instance, the "fight" or "flight" stress responses cause the heart to beat faster and harder as well as release more free fatty acids (disassembled triglycerides) into the blood. The "defeat" response stress pathway can lead to enhanced lipogenesis (fat creation), visceral obesity (deep abdominal obesity), breakdown of tissues, and suppression of the immune system (1,2).

Where does cortisol come from and what is its purpose in the body?

Cortisol has become a 'prime' hormone of fascination, discussion and confusion within the consumer and fitness industry, due to misleading television commercials and advertisements. It is a steroid (compound based from a steroid nucleus) hormone that is produced in the cortex of the adrenal glands located on top of each kidney. Fasting, food intake, exercising, awakening, and psychosocial stressors cause the body to release cortisol (3,4,6,7). Cortisol is released in a highly irregular manner with peak secretion in the early morning, which then tapers out in the late afternoon and evening. Energy regulation and mobilization are

two critical functions of cortisol (4). Cortisol regulates energy by selecting the right type and amount of substrate (carbohydrate, fat or protein) that is needed by the body to meet the physiological demands that is placed upon it. Cortisol mobilizes energy by tapping into the body's fat stores (in the form of triglycerides) and moving it from one location to another, or delivering it to hungry tissues such as working muscle. Under stressful conditions, cortisol can provide the body with protein for energy production through gluconeogenesis, the process of converting amino acids into useable carbohydrate (glucose) in the liver. Additionally, it can move fat from storage depots and relocate it to fat cell deposits deep in the abdomen (8). Cortisol also aids adipocytes (baby fat cells) to grow up into mature fat cells (9). Finally, cortisol may act as an anti-inflammatory agent, suppressing the immune system during times of physical and psychological stress.

The potential link between cortisol and visceral obesity: What is going on at the tissue level?

Cortisol directly effects fat storage and weight gain in stressed individuals. Tissue cortisol concentrations are controlled by a specific enzyme that converts inactive cortisone to active cortisol (9-11). This particular enzyme is located in adipose (fat) tissues. Studies with human visceral (fat surrounding the stomach and intestines) and subcutaneous fat tissue have demonstrated that the gene for this enzyme is expressed more by obese conditions (11). It has also been demonstrated in research that human visceral fat cells have more of these enzymes compared to subcutaneous fat cells. Thus, higher levels of these enzymes in these deep fat cells surrounding the abdomen may lead to obesity due to greater amounts of cortisol being produced at the tissue level. As well, deep abdominal fat has greater blood flow and four times more cortisol receptors compared to subcutaneous fat (8). This may also increase cortisol's fat accumulating and fat cell size enlarging effect.

What is the potential link between stress, cortisol, and appetite?

Animal and human studies have demonstrated that cortisol injections are associated with increased appetite, cravings for sugar, and weight gain (12). Epel et al. demonstrated that premenopausal women who secreted more cortisol during and after novel laboratory stressors chose to consume more foods high in sugar and fat. It has been thought that cortisol directly influences food consumption by binding to receptors in the brain (specifically, the hypothalamus). This can stimulate an individual to eat food that is high in fat and/or sugar. Cortisol also indirectly influences appetite by regulating other chemicals that are released during stress such as CRH (corticotrophin releasing hormone), leptin, and neuropeptide Y (NPY) (12-13). High levels of NPY and CRH and reduced levels of leptin have been shown to stimulate appetite (13).

What are the harmful health effects associated with stress-induced obesity?

Chronic stress can contribute to several harmful physiological events. When body tissues are exposed to high levels of cortisol for extended periods of time, some cellular and tissue alterations may occur. High levels of cortisol cause fat stores and excess circulating fat to be relocated and deposited deep in the abdomen, which left unchecked can develop into or enhance obesity. In addition, hypertension (high blood pressure), hyperlipidemia (elevated lipids), and hyperglycemia (elevated glucose) have been linked to elevated cortisol levels (10,14). Individuals with a high waist-to-hip ratio (which identifies visceral obesity) are at a greater risk for developing cardiovascular disease, type II diabetes mellitus, and cerebrovascular disease (8).

Are there any practical assessment tips for the fitness professional to utilize?

To help identify clients with a potential risk for the diseases described above (which are associated to stress-induced obesity) and distinguish any patterns of fat distribution, fitness professionals can utilize a waist-to-hip ratio (WHR) measurement or waist circumference measurement. The WHR is the circumference of the waist divided by the circumference of the hips. The waist measurement is at the narrowest part of the torso between the ribs and iliac crest. The hip measurement is around the buttocks at its maximum posterior extension. Norms are available in some fitness texts (16), but in general, health risk is very high for men (30-39 yrs) when WHR is >0.96 and when it is >0.84 for women (30-39 yrs). With waist circumference, the National Cholesterol Education Program recommends using a waist circumference of $>88\text{cm}$ (or >35 inches) for women and >100 (or >39 inches) cm for men, to evaluate obesity as a risk factor to metabolic diseases and coronary heart disease (16).

What are some useful stress management tips for the fitness professional to incorporate with their students and clients?

Fortunately, fitness professionals are already doing many physical activities to help their clients manage stress. Many types of aerobic and anaerobic exercise have been shown to be effective interventions in reducing or managing stress. Some of the popular 'mindful' exercise programs such as yoga and Tai Chi (or Tai Chi Chaun) are also recommended for stress management. Meditation, progressive relaxation, deep breathing, and visualization are methods that can be effective in decreasing stress-induced symptoms. Also, eating right and getting enough rest should be incorporated in a stress management plan for life.

Conclusion

Stress will always be a part of daily living and is necessary for providing challenge to physiological and psychological development. However, too much stress over a period of time combined with poor coping habits may cause physical, chemical, and hormonal imbalances in the body, thus leading to disease and death if left unchecked. The pathways of the stress response are complex and may activate other hormonal pathways, resulting in the release of cortisol. The chronic release of cortisol combined with altered tissue production is linked to the development of abdominal obesity in both men and women. Cortisol is associated to overeating, craving high caloric fatty and sugary foods, and relocating fat from the circulation and storage depots to the deep internal abdominal area. As fitness professionals, we must continually educate the general public of the value of exercise and stress management activities as important strategies for managing stress and lessening the health risks associated with stress-induced obesity.

Bottom line

As fitness professionals, we should familiarize our clients and students with the links between stress and abdominal obesity. Cortisol is a necessary hormone that is responsible for fuel regulation and is released while exercising, eating, awakening, and psychosocial stress. However, if there is too much cortisol in circulation, abdominal obesity can develop. This type of central obesity is linked to developing cardiovascular disease, type II diabetes mellitus, and cerebrovascular disease. An effective and regular exercise and stress management program may be a key to reducing and or preventing stress-induced obesity.

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