

"Stress Hormone": Abnormal Cortisol Levels

Both persons under stress and those suffering from depression may have abnormally elevated cortisol levels.

[Cortisol](#) is produced in and secreted by the [adrenal glands](#) in response to control signals from the [pituitary gland](#) and [hypothalamus](#) of the brain. While cortisol itself has many important functions for the body including regulation of metabolism and blood pressure, its role in the bodily stress response has earned it the nickname of "stress hormone." Cortisol secretion is increased in response to physical and psychological stress of any kind. When the stressful event or situation is over, cortisol levels return to normal.

Interestingly, doctors have shown that in both depressed adults and children, the hypothalamic-pituitary-adrenal axis activity is increased, leading to continually elevated levels of cortisol.

This situation is similar to that seen in persons experiencing chronic stress, who may also have sustained higher-than-normal levels of cortisol.

While prolonged increases in cortisol levels can lead to changes in mood, a causal relationship between elevated cortisol levels and depression has not been firmly established. Clinical depression is a complex condition likely resulting from a combination of inherited, biochemical, and environmental factors. Elevation of cortisol through a prolonged stress response is only one factor that may be related to the mood changes associated with depression.

For more information on cortisol and the stress response, including the effects of elevated cortisol levels on your body and functioning, visit the [Cortisol and Stress Information Hub](#) on this site.

This critical hormone is released in response to stress.

The hormone cortisol, which is released in the body during stressed or agitated states, has gained widespread attention as the so-called "stress hormone." But this hormone is more than a simple marker of stress levels- it is necessary for the functioning of almost every part of the body. Excesses or deficiencies of this crucial hormone are also lead to various physical symptoms and disease states.

Background

Cortisol is a steroid hormone made in the [adrenal glands](#), which are small glands adjacent to the kidneys. Among its important functions in the body include roles in the regulation of blood pressure and cardiovascular function as well as regulation of the body's use of proteins, carbohydrates, and fats.

Cortisol secretion increases in response to any stress in the body, whether physical (such as illness, trauma, surgery, or temperature extremes) or psychological. When cortisol is secreted, it causes a breakdown of muscle protein, leading to release of amino acids (the "building blocks" of protein) into the bloodstream. These amino acids are then used by the liver to synthesize glucose for energy, in a process called gluconeogenesis. This process raises the blood sugar level so the brain will have more glucose for energy. At the same time the other tissues of the body decrease their use of glucose as fuel. Cortisol also leads to the release of so-called fatty acids, an energy source from fat cells, for use by the muscles. Taken together, these energy-directing processes prepare the individual to deal with stressors and ensure that the brain receives adequate energy sources.

The body possesses an elaborate feedback system for controlling cortisol secretion and regulating the amount of cortisol in the bloodstream. The [pituitary gland](#), a small

gland at the base of the brain, makes and secretes a hormone known as adrenocorticotrophin, or ACTH. Secretion of [ACTH](#) signals the adrenal glands to increase cortisol production and secretion. The pituitary, in turn, receives signals from the hypothalamus of the brain in the form of the hormone [CRH](#), or corticotropin-releasing hormone, which signals the pituitary to release ACTH. Almost immediately after a stressful event, the levels of the regulatory hormones ACTH and CRH increase, causing an immediate rise in cortisol levels. When cortisol is present in adequate (or excess) amounts, a negative feedback system operates on the pituitary gland and hypothalamus which alerts these areas to reduce the output of ACTH and CRH, respectively, in order to reduce cortisol secretion when adequate levels are present.

Measurement of Cortisol Levels

The body's level of cortisol in the bloodstream displays what is known as a *diurnal variation* - that is, normal concentrations of cortisol vary throughout a 24-hour period. Cortisol levels in normal individuals are highest in the early morning at around 6-8 am and are lowest around midnight.

Normal levels of cortisol in the bloodstream range from 6-23 mcg/dl (micrograms per deciliter).

In addition to early morning, cortisol levels may be somewhat higher after meals. While the most common test is measurement of the cortisol level in the blood, some doctors measure cortisol through a saliva sample, as salivary cortisol levels have been shown to be an index of blood cortisol levels. Sometimes by-products of cortisol metabolism are also measured, such as 17-hydroxycorticosteroids, which are inactive products of cortisol breakdown in the liver. In some cases measurement of urinary cortisol levels is of value. For this test, urine is collected over a 24-hour period and analyzed.

Normal 24-hour urinary cortisol levels range from 10-100 micrograms/ 24 hours.

Part II: Abnormal Cortisol Levels

Abnormal Cortisol Levels

- Certain drugs can lead to increased cortisol levels. Examples include the diuretic *spironolactone* and *estrogen* hormone therapy. Low cortisol levels can be due to drug therapy with androgens or the anti-seizure medication *phenytoin*. Highly-trained athletes can have higher-than-average cortisol levels, and women in the last trimester of pregnancy also generally have elevated cortisol levels. Recent research has even shown that drinking 2-3 cups of coffee per day can elevate cortisol levels. Likely due to the increased physical and psychological stresses associated with these conditions, persons suffering from depression, anxiety, panic disorder, malnutrition and alcohol abuse also often have elevated cortisol values. Rare tumors of the adrenal glands or pituitary gland can also lead to abnormally high levels of cortisol.

Cushing's Syndrome

Persons exposed to abnormally high levels of cortisol over time develop a syndrome known as *Cushing's Syndrome*.

This condition generally affects adults, and approximately 10-15 per million persons will develop this condition each year. Signs and symptoms of Cushing's Syndrome include elevated blood pressure, development of diabetes, pink-to-purple stretch marks on the abdominal skin, fatigue, depression, moodiness, and accentuated fatty tissue on the face and upper back. Women with Cushing's Syndrome often have irregular menstrual periods and develop new facial hair growth. Men may show a decrease in sex drive. Treatment options are varied and depend on the cause of the excess cortisol.