

PATIENT INFORMATION

# GROWTH HORMONE DEFICIENCY IN ADULTS AND CHILDREN

*YOUR QUESTIONS ANSWERED*



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### What is growth hormone?

Growth hormone (GH) is produced by the pituitary, a small gland located below the brain in the center of the head behind the nose (Figure 1). The pituitary produces a number of hormones in addition to growth hormone. These hormones then circulate in the bloodstream and act on other glands such as the thyroid, adrenal glands, and gonads.

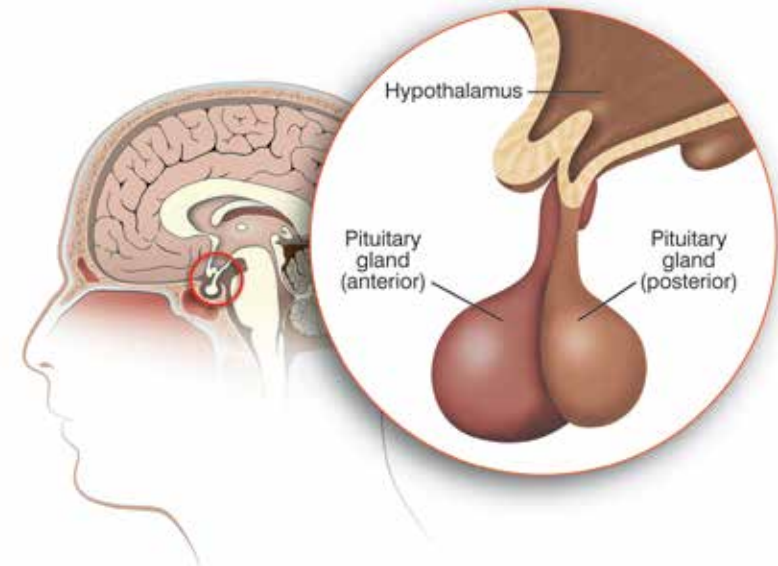


Figure 1. Location of Pituitary Gland and the Hypothalamus

Production of pituitary hormones is largely controlled by hormones produced in the hypothalamus, the gland above the pituitary. GH is produced under the influence of two hormones from the hypothalamus: somatostatin (a GH inhibitor) which decreases GH production, and growth hormone releasing hormone (GHRH) which increases GH production. A third hormone called IGF-1 (insulin-like growth factor 1), produced in the liver under the influence of GH, can also decrease GH production. These three hormones work together to maintain normal levels of GH in the body. Damage to the pituitary or the hypothalamus (by a tumor, surgery or radiation) can result in having too little GH in the body.

*Regulation of GH level is a complicated process controlled by a number of factors. For this reason, it is important to schedule regular checkups with your endocrinologist to ensure your GH level remains within the normal range for your sex and age.*

Growth hormone also circulates in the bloodstream and affects most tissues in the body throughout life. It stimulates linear growth in children and adolescents (height). Growth hormone is also called somatotropin (Greek for “nourishment for the body”), a name that indicates its important role for proper body function. Even after physical growth has stopped, growth hormone continues to have important functions. It maintains muscle and bone mass, decreases fat tissue, and may influence blood lipid levels (cholesterol and triglycerides), in addition to other actions.

### What are the signs and symptoms of growth hormone deficiency?

The consequences of growth hormone deficiency vary depending on the age when it occurs. Babies lacking growth hormone may develop hypoglycemia (low blood sugar). Children and adolescents with growth hormone deficiency grow more slowly than normal and, if left untreated, become unusually short as adults (Figure 2). They also have more body fat, especially around the waistline, and may not achieve normal bone density and strength.



Figure 2. Stunted Growth in Children with Growth Hormone Deficiency

Adults with growth hormone deficiency may complain of fatigue, low exercise ability, lack of initiative and drive, and social isolation. They may also notice fat accumulation around the waistline and loss of muscle bulk. These individuals may also have abnormally low bone mineral (calcium) content, making them more prone to fractures (Figure 3). Other possible consequences of growth hormone deficiency include higher cholesterol levels and insulin resistance; insulin resistance may increase the chance of developing diabetes mellitus (high blood sugar).

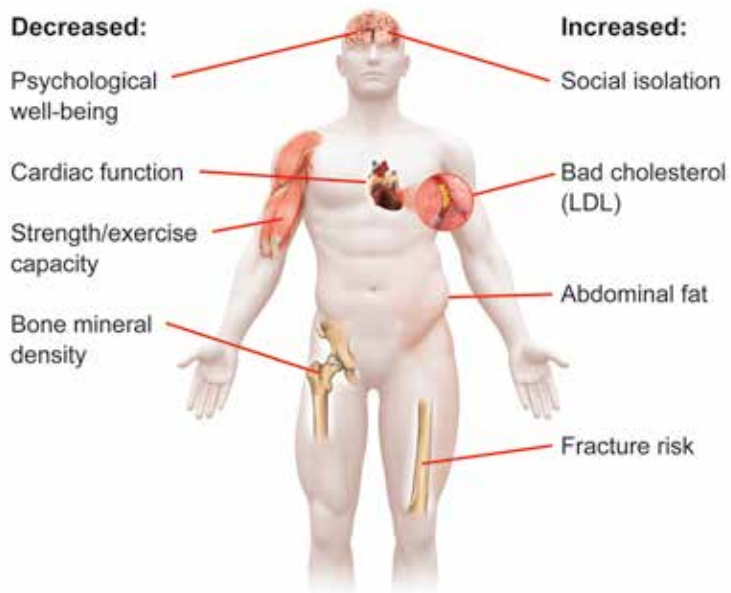


Figure 3. Effects of Growth Hormone Deficiency on the Body

It is common for growth hormone deficiency to occur in association with the loss of other pituitary hormones. These patients may have a variety of symptoms related to decreased pituitary function (such as lack of menstrual periods in women, sexual dysfunction in men, or symptoms caused by low thyroid hormone levels).

### What causes lack of growth hormone (growth hormone deficiency)?

There are many causes of growth hormone deficiency (Table 1). Some people are born with this condition because the pituitary gland failed to develop properly. Other people may have genetic (inherited) problems that prevent growth hormone production or action. In children, growth hormone deficiency is often “idiopathic”, which means that the cause is not known.

In adults (and sometimes in children), growth hormone deficiency can occur as a consequence of another condition that interferes with normal pituitary function, such as a pituitary tumor. Growth hormone deficiency may also occur after pituitary surgery, radiation therapy to the pituitary or brain, head injury, or as a result of inflammation or infection involving the pituitary. Many of these conditions can lead to loss of other pituitary hormones besides growth hormone.

Table 1. Causes of Growth Hormone Deficiency\*

Pituitary adenoma:	<i>Functioning</i> (producing excessive prolactin, growth hormone, cortisol or thyroid hormones) <i>Nonfunctioning</i> (no excessive hormone production)
Other tumors or cysts in or near the pituitary:	Craniopharyngioma Rathke’s cleft cyst Other
Surgery:	Pituitary surgery
Radiation therapy:	Targeting the pituitary Targeting the whole brain
Head injury:	Usually severe head injury
Inflammation or infection:	Hypophysitis Meningitis Tuberculosis Sarcoidosis Langerhans cell histiocytosis
Congenital (occurring at birth):	Failure of the pituitary to develop properly (some of these conditions can be inherited)
Sheehan’s syndrome:	Severe hemorrhage during childbirth
Idiopathic (no known cause):	Common in children

\*In many of these cases, the pituitary may also fail to produce other hormones besides growth hormone.

## How is growth hormone deficiency diagnosed?

Growth hormone deficiency is diagnosed based on the patient's history (particularly the presence of pituitary disease in adults), associated symptoms (as previously described), and the results of blood tests.

## Who should be tested for growth hormone deficiency?

Children and adolescents who are growing too slowly need to be tested for growth hormone deficiency (unless there is another obvious explanation for poor growth). Adults with a history of pituitary disease of any kind who have symptoms that could be related to growth hormone deficiency may also be tested. Growth hormone deficiency is more common in people with deficiency in other pituitary hormones. In fact, when three or more pituitary hormones are deficient, the likelihood of growth hormone deficiency is very high.

Adults with fatigue or obesity, who have no history of pituitary disease, radiation therapy to the head or severe head trauma should not generally be tested for growth hormone deficiency unless there are other indications.

If there is any question about growth hormone deficiency, patients should be seen and evaluated by an endocrinologist.

## What tests are needed?

Testing for growth hormone deficiency may begin by measuring the blood levels of IGF-1, which is controlled by growth hormone. Low IGF-1 can indicate GH deficiency, but many people with GH deficiency have normal or low-normal IGF-1 levels. GH production is also influenced by other factors, such as nutrition, body weight, and some medications.

In most patients, a growth hormone stimulation test is needed. Patients should fast overnight before this test. A nurse will place a small intravenous catheter into the arm for blood samples and will give an injection of a medication that causes the pituitary to release growth hormone. There are several options for such medications, including insulin, glucagon, or arginine. Blood samples are then collected at regular intervals over a period of a few hours to measure growth hormone levels. Growth hormone releasing hormone (GHRH) can be used to test for GH deficiency; however, it is not presently available in the United States.

A growth hormone stimulation test is done under the supervision of a physician in the outpatient setting. The choice of medication used to stimulate growth hormone varies depending on patient's age as well as other factors. For example, the insulin stimulation test should be avoided in people who have heart disease or history of a seizure.

Patients who have growth hormone deficiency should have additional blood tests to measure their other pituitary hormones. Patients with growth hormone deficiency should also have a brain MRI (magnetic resonance imaging) examination to look for a growth or other abnormality in the pituitary gland.

## How is growth hormone deficiency treated?

The condition that caused the growth hormone deficiency should be treated first, before starting growth hormone replacement. The endocrinologist should also check to make sure that there is no reason to avoid growth hormone replacement.

Growth hormone deficiency is treated by replacing the missing growth hormone by means of a daily injection. This is called growth hormone replacement. The medication is usually taken at bedtime using a very small syringe (or special pen device) and needle, delivering the medication right under the skin in the stomach, thighs, or arms. Frequent dose adjustments are often needed early in treatment.

Patients who lack other pituitary hormones also need to take other medications to replace those missing hormones.



## What are the benefits of growth hormone replacement (treatment)?

The goals of GH replacement are to improve patients' quality of life, avoid consequences of growth hormone deficiency, and feel better.

Growth hormone is not needed for survival. However, growth hormone replacement can be quite beneficial in some patients when taken properly. Growth hormone replacement may help improve the growth of children and adolescents, who may gain several inches in height as a result of this treatment. Adults taking growth hormone replacement may notice that their exercise ability and strength improve. They may feel better about themselves and experience an improved quality of life. They may lose weight around their waistline and build more muscle and bone calcium. Cholesterol levels may also improve. However, there is no proof that growth hormone replacement improves longevity (lifespan).

There is also no proof that growth hormone delays aging, and it should not be used for that purpose. Growth hormone is not a weight-loss drug. Growth hormone replacement is not recommended to reverse aging or improve athletic performance, and is illegal in the United States for those indications.

## What are the risks of growth hormone replacement (treatment)?

Most patients tolerate this medication well. However, growth hormone replacement can cause joint or muscle aches, swelling of the hands or feet, tingling in the fingers, or increased blood sugar. These symptoms can often be prevented or controlled by carefully adjusting the medication dose. Other rare side effects may occur.

Growth hormone replacement is not recommended for any patient with evidence of active cancer.

Growth hormone is produced by the placenta during pregnancy. As such, growth hormone replacement may not be necessary during pregnancy. Use of growth hormone during pregnancy and/or lactation has neither been studied in clinical trials nor approved by regulatory agencies for use.



## How is treatment followed?

Patients need to see their endocrinologist regularly to make sure that growth hormone replacement is helping them without causing side effects. Frequent visits are often needed when growth hormone treatment is started to allow for adjustments in the dose to the correct level. Blood tests to measure IGF-1, blood sugar, and other tests are also needed to make sure that the treatment is effective and safe. Children need to have their growth (height and weight) monitored regularly. Ongoing monitoring is necessary because a patient's dose and need for this medication may change over time.

A bone density examination may also be needed to monitor bone calcium content. Patients who have had pituitary tumors should also have regular brain MRI examinations. All patients should also have screening tests that are appropriate for their age and sex (such as Pap smears, mammograms, colonoscopies or prostate examinations).

In some patients, adjustments in the doses of other medications (such as thyroid hormone or hydrocortisone) may be needed after starting growth hormone replacement.

## Is life-long treatment necessary?

Growth hormone deficiency may not always be life-long. In many children or adolescents, growth hormone production may recover as they grow and become adults. Therefore, older adolescents who were treated with growth hormone may need to be retested once they complete their growth to find out if they have ongoing growth hormone deficiency. In contrast, children with growth hormone deficiency caused by tumors in the area of the pituitary do not recover spontaneously. Some adults with growth hormone deficiency may also recover pituitary function and resume producing growth hormone normally. In adults, a trial period of 6 to 9 months is usually needed to determine if this medication can help their symptoms. If not, the medication can be discontinued.

## Summary

Growth hormone deficiency may occur as a result of many different conditions that can affect the pituitary gland. In some cases, the gland may fail to produce other hormones, in addition to growth hormone. Growth hormone deficiency may lead to decreased height in children or adolescents and a variety of symptoms in adults. Growth hormone replacement may help improve height in children and improve body composition, function, and quality of life in adults.

## What do I need to do if I have growth hormone deficiency?

- ***Be involved and proactive:***  
Discuss your concerns with your endocrinologist. If required, you may need to undergo tests necessary to examine your pituitary health and determine the reason (cause) for growth hormone deficiency.
- ***Be attentive and mindful:***  
Pay attention to the effects of the treatment and stay in close touch with your endocrinologist to make sure that the treatment is having its desired effects.
- ***Cooperate:***  
Take your medication as recommended by your endocrinologist and attend regular visits.
- ***Follow up:***  
Have appropriate tests (blood tests, MRIs as needed) as advised by your endocrinologist to make sure that the treatment meets its goals without causing side effects.

For further information

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## Glossary

<b>Endocrinologist:</b>	A physician who specializes in treating hormone problems.
<b>Growth hormone (GH):</b>	A chemical messenger that is produced by the pituitary gland that circulates in the bloodstream and is responsible for growth in children and adolescents. Growth hormone has important effects on body composition and function in individuals of all ages.
<b>Insulin-like growth factor 1 (IGF-1):</b>	A chemical messenger produced under control by growth hormone. The IGF-1 level is indicative of growth hormone action in the body.
<b>Magnetic resonance imaging (MRI):</b>	A scan that can provide an accurate picture of the pituitary gland and can help figure out the reason for pituitary disease. An MRI does not involve the use of radiation.
<b>Pituitary adenoma:</b>	A benign (not cancerous) growth in the pituitary gland that can affect its function. Pituitary adenomas are a common cause for growth hormone deficiency in adults.
<b>Pituitary gland:</b>	A small gland located in the center of the head behind the nose, which is connected to the base of the brain by a thin stalk. The pituitary produces several hormones (chemical messengers) that control many functions in the body.





Educational booklets available from The Pituitary Society:

*Growth Hormone Deficiency in Adults and Children*

*Acromegaly*

*Cushing's Syndrome and Cushing's Disease*

*Hypopituitarism*

*Prolactinomas*

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