

# Thyroid Tests

*National Endocrine and Metabolic Diseases Information Service*



National Institute of  
Diabetes and Digestive  
and Kidney Diseases

## What is the thyroid?

The thyroid is a 2-inch-long, butterfly-shaped gland weighing less than 1 ounce. Located in the front of the neck below the larynx, or voice box, it has two lobes, one on either side of the windpipe.

The thyroid is one of the glands that make up the endocrine system. The glands of the endocrine system produce and store hormones and release them into the bloodstream. The hormones then travel through the body and direct the activity of the body's cells.

## What is the role of thyroid hormones?

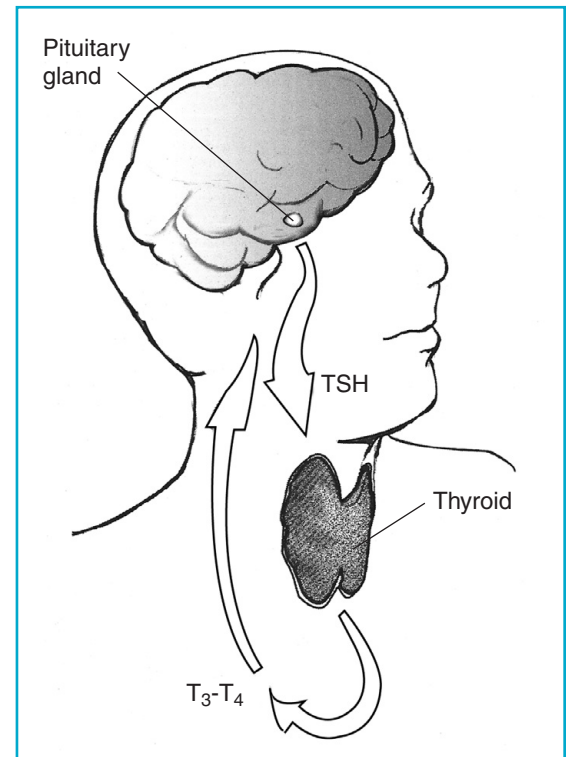
Thyroid hormones regulate metabolism—the way the body uses energy—and affect nearly every organ in the body. Thyroid hormones also affect brain development, breathing, heart and nervous system functions, body temperature, muscle strength, skin dryness, menstrual cycles, weight, and cholesterol levels.

The thyroid makes two thyroid hormones:

- thyroxine ( $T_4$ )
- triiodothyronine ( $T_3$ )

Only a small amount of  $T_3$  in the blood comes from the thyroid. Most  $T_3$  comes from cells all over the body, where it is made from  $T_4$ . Thyroid-stimulating hormone

(TSH), which is made by the pituitary gland in the brain, regulates thyroid hormone production. When thyroid hormone levels in the blood are low, the pituitary releases more TSH. When thyroid hormone levels are high, the pituitary decreases TSH production.



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## Why do health care providers perform thyroid tests?

Health care providers perform thyroid tests to assess how well the thyroid is working. The tests are also used to diagnose and help find the cause of thyroid disorders such as hyperthyroidism and hypothyroidism:

- Hyperthyroidism is a disorder caused by too much thyroid hormone in the bloodstream, which increases the speed of bodily functions and leads to weight loss, sweating, rapid heart rate, and high blood pressure, among other symptoms.
- Hypothyroidism is a disorder that occurs when the thyroid doesn't make enough thyroid hormone for the body's needs. Without enough thyroid hormone, many of the body's functions slow down. People may have symptoms such as fatigue, weight gain, and cold intolerance.

Read more about thyroid disorders in *Hyperthyroidism* and *Hypothyroidism* at [www.endocrine.niddk.nih.gov](http://www.endocrine.niddk.nih.gov).

## What blood tests do health care providers use to check a person's thyroid function?

A health care provider may order several blood tests to check thyroid function, including the following:

- TSH test
- T<sub>4</sub> tests
- T<sub>3</sub> test
- thyroid-stimulating immunoglobulin (TSI) test
- antithyroid antibody test, also called the thyroid peroxidase antibody test (TPOab)

A blood test involves drawing blood at a health care provider's office or a commercial facility and sending the sample to a lab for analysis. Blood tests assess thyroid function by measuring TSH and thyroid hormone levels, and by detecting certain autoantibodies present in autoimmune thyroid disease. Autoantibodies are molecules produced by a person's body that mistakenly attack the body's own tissues.

Many complex factors affect thyroid function and hormone levels. Health care providers take a patient's full medical history into account when interpreting thyroid function tests.

### TSH Test

A health care provider usually performs the TSH blood test first to check how well the thyroid is working. The TSH test measures the amount of TSH a person's pituitary is secreting. The TSH test is the most accurate test for diagnosing both hyperthyroidism and hypothyroidism. Generally, a below-normal level of TSH suggests hyperthyroidism. An abnormally high TSH level suggests hypothyroidism.

The TSH test detects even tiny amounts of TSH in the blood. Normally, the pituitary boosts TSH production when thyroid hormone levels in the blood are low. The thyroid responds by making more hormone. Then, when the body has enough thyroid hormone circulating in the blood, TSH output drops. The cycle repeats continuously to maintain a healthy level of thyroid hormone in the body. In people whose thyroid produces too much thyroid hormone, the pituitary shuts down TSH production, leading to low or even undetectable TSH levels in the blood.

In people whose thyroid is not functioning normally and produces too little thyroid hormone, the thyroid cannot respond normally to TSH by producing thyroid hormone. As a result, the pituitary keeps making TSH, trying to get the thyroid to respond.

If results of the TSH test are abnormal, a person will need one or more additional tests to help find the cause of the problem.

### **T<sub>4</sub> Tests**

The thyroid primarily secretes T<sub>4</sub> and only a small amount of T<sub>3</sub>. T<sub>4</sub> exists in two forms:

- T<sub>4</sub> that is bound to proteins in the blood and is kept in reserve until needed
- a small amount of unbound or “free” T<sub>4</sub> (FT<sub>4</sub>), which is the active form of the hormone and is available to enter body tissues when needed

A high level of total T<sub>4</sub>—bound and FT<sub>4</sub> together—or FT<sub>4</sub> suggests hyperthyroidism, and a low level of total T<sub>4</sub> or FT<sub>4</sub> suggests hypothyroidism.

Both pregnancy and taking oral contraceptives increase levels of binding protein in the blood. In either of these cases, although a woman may have a high total T<sub>4</sub> level, she may not have hyperthyroidism. Severe illness or the use of corticosteroids—a class of medications that treat asthma, arthritis, and skin conditions, among other health problems—can decrease binding protein levels. Therefore, in these cases, the total T<sub>4</sub> level may be low, yet the person does not have hypothyroidism.

### **T<sub>3</sub> Test**

If a health care provider suspects hyperthyroidism in a person who has a normal FT<sub>4</sub> level, a T<sub>3</sub> test can be useful to confirm the condition. In some cases of hyperthyroidism, FT<sub>4</sub> is normal yet free T<sub>3</sub> (FT<sub>3</sub>) is elevated, so measuring both T<sub>4</sub> and T<sub>3</sub> can be useful if a health care provider suspects hyperthyroidism. The T<sub>3</sub> test is not useful in diagnosing hypothyroidism because levels are not reduced until the hypothyroidism is severe.

### **TSI Test**

Thyroid-stimulating immunoglobulin is an autoantibody present in Graves’ disease. TSI mimics TSH by stimulating the thyroid cells, causing the thyroid to secrete extra hormone. The TSI test detects TSI circulating in the blood and is usually measured

- in people with Graves’ disease when the diagnosis is obscure
- during pregnancy
- to find out if a person is in remission, or no longer has hyperthyroidism and its symptoms

### **Antithyroid Antibody Test**

Antithyroid antibodies are markers in the blood that are extremely helpful in diagnosing Hashimoto’s disease. Two principal types of antithyroid antibodies are

- anti-TG antibodies, which attack a protein in the thyroid called thyroglobulin
- anti-thyroperoxidase, or anti-TPO, antibodies, which attack an enzyme in thyroid cells called thyroperoxidase

## What do thyroid test results tell health care providers?

Health care providers look at thyroid test results in people with hyperthyroidism or hypothyroidism to find the underlying cause of their thyroid disorder. The following tables illustrate what test results may show based on the type of thyroid problem.

**Table 1. Typical thyroid function test results: Hyperthyroidism**

Cause	Test			
	TSH	T <sub>3</sub> /T <sub>4</sub>	TSI	Radioactive Iodine Uptake Test
Graves' disease	↓	↑	+	↑
Thyroiditis (with hyperthyroidism)	↓	↑	–	↓
Thyroid nodules (hot, or toxic)	↓	↑	–	↑ or Normal

Key: ↑ = Above Normal    + = Positive  
 ↓ = Below Normal    – = Negative

**Table 2. Typical thyroid function test results: Hypothyroidism**

Cause	Test		
	TSH	T <sub>3</sub> /T <sub>4</sub>	Antithyroid Antibody
Hashimoto's disease (thyroiditis, early stage)	↑	↓ or Normal	+
Hashimoto's disease (thyroiditis, later stage)	↑	↓	+
Pituitary abnormality	↓	↓	–

Key: ↑ = Above Normal    + = Positive  
 ↓ = Below Normal    – = Negative

## What imaging tests do health care providers use to diagnose and find the cause of thyroid disorders?

A health care provider may use one or a combination of imaging tests, such as an ultrasound of the thyroid, a computerized tomography (CT) scan, or nuclear medicine tests, to diagnose and find the cause of thyroid disorders.

- Ultrasound.** Ultrasound uses a device, called a transducer, that bounces safe, painless sound waves off organs to create an image of their structure. A specially trained technician performs the procedure in a health care provider's office, an outpatient center, or a hospital, and a radiologist—a doctor who specializes in medical imaging—interprets the images; a patient does not need anesthesia. The images can show the size and texture of the thyroid, as well as a pattern of typical autoimmune inflammation. The images can also show nodules or growths within the gland that suggest a malignant tumor.
- CT scan.** CT scans use a combination of x rays and computer technology to create images. For a CT scan, a health care provider may give the patient a solution to drink and an injection of a special dye, called contrast medium. CT scans require the patient to lie on a table that slides into a tunnel-shaped device where the x rays are taken. An x-ray technician performs the procedure in an outpatient center or a hospital, and a radiologist interprets the images. The patient does not need anesthesia. CT scans are usually not needed to

diagnose thyroid disease; however, health care providers will use them to view a large goiter. Also, a CT scan will often show a thyroid nodule when a person is having the scan for other health problems.

**Nuclear medicine tests.** Nuclear medicine tests of the thyroid include a thyroid scan and a radioactive iodine uptake test. People often have to follow a low iodine diet prior to having the tests. Read more about a low iodine diet from the American Thyroid Association at [www.thyroid.org/faq-low-iodine-diet](http://www.thyroid.org/faq-low-iodine-diet).

- **Thyroid scan.** A thyroid scan is a type of nuclear medicine imaging. Nuclear medicine uses small amounts of radioactive material to create a picture of an organ and give information about the organ's structure and function. A thyroid scan is used to look at the size, shape, and position of the gland. This test can help find the cause of hyperthyroidism and check for thyroid nodules. The scan also can help a health care provider evaluate thyroid nodules; however, it does not confirm whether the nodules are cancerous or benign.

A specially trained technician performs the procedure in an outpatient center or a hospital, and a radiologist interprets the images; a patient does not need anesthesia. For the scan, radioactive iodine or radioactive technetium is injected into the patient's vein or swallowed in liquid or capsule form. The scan takes place 30 minutes after an injection or 6 to 24 hours after the radioactive substance is swallowed. The patient lies on an exam table for the scan, which takes about 30 minutes.

A device called a gamma camera is suspended over the table or may be located within a large, tunnel-shaped device that resembles a CT scanner. The gamma camera detects the radioactive material and sends images to a computer that show how and where the radioactive substance has been distributed in the thyroid. Nodules that produce too much thyroid hormone—called “hot,” or toxic, nodules—show up clearly because they absorb more radioactive material than normal thyroid tissue. Graves' disease shows up as a spread-out, overall increase in radioactivity rather than an increase in a localized spot.

Even though the amount of radiation used in this test is small, women who are pregnant or breastfeeding should not have this test because of the risks of exposing the fetus or the baby to radiation.

- **Radioactive iodine uptake test.** The radioactive iodine uptake test, also known as a thyroid uptake, is a nuclear medicine test used to evaluate the function of the thyroid and find the cause of a patient's hyperthyroidism. A whole-body thyroid scan is used for people who have had thyroid cancer. The test measures the amount of iodine the thyroid collects from the bloodstream in a given time period. The thyroid uptake is not used to assess hypothyroidism.

A specially trained technician performs the test in an outpatient center or a hospital, and a radiologist interprets the images; a patient does not need anesthesia. For this test, the patient swallows a small amount of radioactive

iodine in liquid or capsule form. After 4 to 6 hours and again at 24 hours, the patient returns to the testing center, where the technician measures the amount of radioactive iodine taken up by the thyroid. The measurement is taken with a small device called a gamma probe, which resembles a microphone. The gamma probe is positioned near the patient's neck over the thyroid. Measurement takes only a few minutes and is painless.

In the diagnosis of hyperthyroidism, a high thyroid uptake reading usually indicates an overactive thyroid that produces too much thyroid hormone, as seen in Graves' disease or a condition called toxic nodular goiter, an enlargement of the thyroid. A low thyroid uptake reading suggests the thyroid is not overactive.

Several thyroid disorders that cause inflammation of the thyroid, or thyroiditis, may cause leakage of thyroid hormone and iodine out of the thyroid into the bloodstream, which can lead to high  $T_4$  levels. When the thyroid is inflamed, it does not take up the radioactive iodine given as part of the thyroid uptake test. For example, hyperthyroidism seen in Graves' disease would be marked by high blood  $T_4$  and a high thyroid uptake reading. In thyroiditis, temporary hyperthyroidism may exist because of the release of  $T_4$  into the blood; however, the thyroid uptake reading is low because of the inflammation. Temporary hyperthyroidism in thyroiditis is often followed by a period of hypothyroidism before the thyroid heals.

Even though the amount of radiation used in this test is small, women who are pregnant or breastfeeding should not have this test because of the risks of exposing the fetus or infant to radiation.

## What tests do health care providers use if a thyroid nodule is found?

If a health care provider feels a nodule in a patient's neck during a physical exam or detects one during imaging tests of the thyroid, a fine needle aspiration biopsy may be done to confirm whether the nodule is cancerous or benign.

A fine needle aspiration biopsy of the thyroid involves taking cells from the thyroid for examination with a microscope. The health care provider with experience in needle aspirations performs the biopsy in his or her office, an outpatient center, or a hospital; he or she may use medication to numb the area. The patient may feel mild discomfort during the test and the biopsy site may be tender for 1 to 2 days.

For this test, the patient lies back with support under the shoulders so the neck can be extended and bent back slightly. The health care provider inserts a small, thin needle attached to a syringe into the thyroid nodule and uses ultrasound to guide its insertion. Samples of the cells in the nodule are drawn through the needle and sent to a lab to be examined by a pathologist—a doctor who specializes in diagnosing diseases. The health care provider may need to take several samples. Once the biopsy is complete, a bandage is placed on the area to lower the chance of bleeding.

## Points to Remember

- The thyroid is one of the glands that make up the endocrine system. Thyroid hormones affect metabolism, brain development, breathing, heart and nervous system functions, body temperature, muscle strength, skin dryness, menstrual cycles, weight, and cholesterol levels.
- The TSH test is the most accurate test for diagnosing both hyperthyroidism and hypothyroidism.
- Health care providers perform thyroid function tests to assess how well the thyroid is working. The tests also are used to diagnose and help find the cause of thyroid disorders.
- Hyperthyroidism is caused by too much thyroid hormone in the bloodstream, which increases the speed of bodily functions and leads to weight loss, sweating, rapid heart rate, and high blood pressure, among other symptoms.
- Hypothyroidism is a disorder that occurs when the thyroid doesn't make enough thyroid hormone for the body's needs. Without enough thyroid hormone, many of the body's functions slow down. People may have symptoms such as fatigue, weight gain, and cold intolerance.
- A health care provider may order several blood tests to check thyroid function.
- A health care provider may use one or a combination of imaging tests, such as an ultrasound of the thyroid, a thyroid scan, or a radioactive iodine uptake test, to diagnose and find the cause of thyroid disorders.

- If a health care provider feels a nodule in a patient's neck during a physical exam or detects one during imaging tests of the thyroid, a fine needle aspiration biopsy may be done to confirm whether the nodule is cancerous or benign.

## Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports research into many kinds of disorders, including thyroid disease. Researchers are investigating the development, signs and symptoms, and genetics of thyroid function disorders to better understand thyroid diseases. Scientists continue to study treatment options for hyperthyroidism, hypothyroidism, and other thyroid diseases.

Clinical trials are research studies involving people. Clinical trials look at safe and effective new ways to prevent, detect, or treat disease. Researchers also use clinical trials to look at other aspects of care, such as improving the quality of life for people with chronic illnesses. To learn more about clinical trials, why they matter, and how to participate, visit the NIH Clinical Research Trials and You website at [www.nih.gov/health/clinicaltrials](http://www.nih.gov/health/clinicaltrials). For information about current studies, visit [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov).

You may also find additional information about this topic by visiting MedlinePlus at [www.medlineplus.gov](http://www.medlineplus.gov).

This publication may contain information about medications and, when taken as prescribed, the conditions they treat. When prepared, this publication included the most current information available. For updates or for questions about any medications, contact the U.S. Food and Drug Administration toll-free at 1-888-INFO-FDA (1-888-463-6332) or visit [www.fda.gov](http://www.fda.gov). Consult your health care provider for more information.

## For More Information

### **American Association of Clinical Endocrinologists**

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### **The Endocrine Society**

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### **Graves' Disease and Thyroid Foundation**

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### **Hormone Health Network**

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## Acknowledgments

Publications produced by the NIDDK are carefully reviewed by both NIDDK scientists and outside experts. This publication was originally reviewed by Lewis Braverman, M.D., Boston Medical Center, and Leonard Wartofsky, M.D., M.A.C.P., Washington Hospital Center.

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The National Endocrine and Metabolic Diseases Information Service is an information dissemination service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health, which is part of the U.S. Department of Health and Human Services.

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National Institute of  
Diabetes and Digestive  
and Kidney Diseases

NIH Publication No. 14-6284  
February 2014