

Pediatric Thyroid Function Tests

WHAT IS THE THYROID GLAND?

The thyroid gland is a butterfly-shaped endocrine gland that is located in the lower front of the neck, just above the collarbone. The thyroid's job is to make thyroid hormones, which are released into the blood and then carried to every tissue in the body. In children, thyroid hormone helps to ensure that growth and development occur normally and that the body's energy, metabolism, heart, muscles, and other organs are working properly.

HOW DOES THE THYROID GLAND FUNCTION?

The major thyroid hormone secreted by the thyroid gland is levothyroxine, (also called T4 because it contains four iodine atoms). The active form of thyroid hormone is tri-iodothyronine (T3) which is converted from T4. This conversion happens outside of the thyroid gland and still occurs normally in people who have thyroid disease or do not have a thyroid gland. It is very important for a healthy body that the amount of thyroid hormone in the bloodstream is just right: not too high and not too low.

The pituitary gland is in the brain and sends a message to the thyroid gland called Thyroid Stimulating Hormone (TSH), which stimulates the thyroid to produce T4. If the level of circulating thyroid hormone drops, the pituitary releases more TSH to push the thyroid gland to make more hormone. If there is too much thyroid hormone in the blood, the pituitary decreases TSH to slow down the thyroid. In this way, the pituitary gland regulates how much thyroid hormone is produced to keep it in a healthy range.

T4 and T3 travel around in the bloodstream attached to carrier (or transport) proteins. Only the T4 and T3 not bound to these proteins is "free" to work. Some patients have unusual levels of carrier proteins (this can run in families). It is not a disease, but the levels of T4 and T3 are abnormal. It is possible to measure the amount of thyroid hormone not

attached to carrier proteins (the free thyroid hormone level). Measuring this free level gives a more accurate assessment of how much thyroid hormone is available in the body.

TESTS

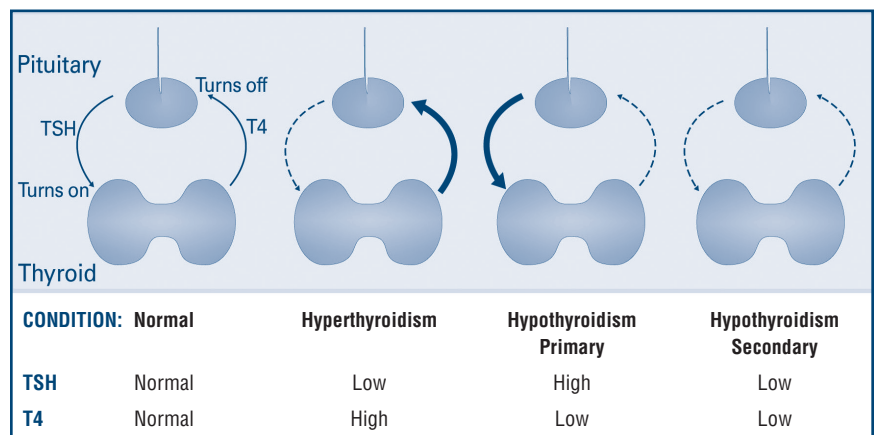
Blood tests to measure TSH, T4, T3 and free T4 are the most commonly used tests to evaluate how well the thyroid gland is working. There are many medications that affect thyroid tests and thyroid hormone levels. Make sure the doctors know all of the medications, vitamins, natural supplements being taken.

TSH TESTS

The best way to initially test how well the thyroid gland is working is to measure the TSH level in a blood sample. In most healthy individuals, a normal TSH level means that the thyroid hormone levels are "just right" and the thyroid gland is healthy. Because TSH is almost always the most accurate test for thyroid function, it is often done first, and other thyroid tests (*see below*) only done if the TSH is abnormal.

T4 TESTS

Tests for T4 measure all of the T4 (bound and free). Free T4 (FT4) measures the amount of thyroid hormone (T4) circulating in the blood and free to enter cells to do its work. Other similar measures exist, such as the free T4 index (FTI).



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MEDICATIONS/SUPPLEMENTS THAT INTERFERE WITH THYROID FUNCTION TESTING

- **Estrogens**, such as in birth control pills, cause high levels of total T4 and T3 by increasing the thyroid binding protein. This typically does not change how thyroid hormone works in the body. In these situations, it is better to ask for TSH with free T4 (rather than the total T4).
- **Biotin**, a commonly taken over-the-counter supplement, can cause several thyroid function tests to look abnormal, when they are in fact normal. Biotin should not be taken for at least 2 days before blood is drawn for thyroid function testing.

HOW TO INTERPRET TSH AND FREE T4 RESULTS:

Combining the TSH test with the FT4 or FTI accurately determines how the thyroid gland is functioning.

A **high TSH** level typically shows that the thyroid is underactive (called *primary* hypothyroidism). If the TSH is high but the FT4 or FTI is normal, the condition is called subclinical hypothyroidism (which means very mild hypothyroidism). A high TSH with a low FT4 or FTI typically indicates more severe, or “overt,” hypothyroidism. A **low TSH** is usually seen when the thyroid gland is releasing too much thyroid hormone (*primary* hyperthyroidism). A low TSH with a normal T4 level is most commonly due to subclinical (very mild) hyperthyroidism. A low TSH with an elevated FT4 or FTI suggests more severe, “overt”, hyperthyroidism.

More rare conditions exist in which the pituitary does not make TSH normally or cannot recognize thyroid hormone in order to release the right amount of TSH. For example, if the pituitary gland is underactive (hypopituitarism), TSH is low or normal and the FT4 or FTI is also low.

T3 TESTS

T3, or free T3, is occasionally useful to diagnose or determine the severity of hyperthyroidism. T3 testing is rarely helpful in the hypothyroid patient, since it is the last test to become abnormal. Patients can be severely hypothyroid, but have a normal T3.

REVERSE T3

Reverse T3 is an inactive form of thyroid hormone. Some reverse T3 is produced normally in the body. In healthy, non-hospitalized people, measurement of reverse T3 does not help determine whether hypothyroidism exists or not and is not clinically useful.

THYROID ANTIBODY TESTS

The immune system of the body normally protects us from foreign invaders such as bacteria and viruses by destroying these invaders with antibodies. In autoimmune thyroid disease, the body’s own immune system attacks the thyroid. Measuring levels of anti-thyroperoxidase or anti-thyroglobulin antibodies may help determine the *cause of thyroid problems*. The presence of these antibodies does not mean there is thyroid disease; many healthy people have these antibodies, but those with antibodies are at a higher risk of developing autoimmune thyroid disease. Detecting antibodies is helpful in determining the cause of thyroid disease but following the levels over time is not helpful and does not alter treatment.

Graves’ disease is an autoimmune disease in which the thyroid is stimulated to *produce excess thyroid hormone*. The presence of antibodies against the TSH receptor (called TRAB or TSI) confirms a diagnosis of Graves’ disease. In Graves’ disease, measuring antibody levels over several months/years may help to assess response to treatment.

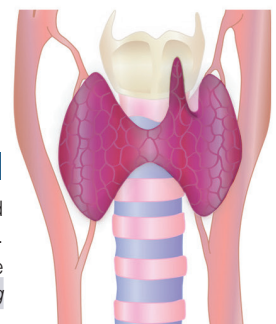
THYROGLOBULIN

Thyroglobulin (Tg) is a protein produced by normal and abnormal thyroid cells. This test is used in patients who have had surgery and radioactive iodine treatment for *papillary or follicular thyroid cancer*.

FURTHER INFORMATION

Further details on this and other thyroid-related topics are available in the patient thyroid information section on the American Thyroid Association® website at www.thyroid.org.

For information on thyroid patient support organizations, please visit the *Patient Support Links* section on the ATA website at www.thyroid.org



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NON-BLOOD TESTS

RADIOACTIVE IODINE UPTAKE AND SCAN

The thyroid gland takes up iodine from the blood to make thyroid hormone. The activity of the thyroid gland (or any thyroid cells) can be measured by swallowing iodine labelled with a very small amount of radioactivity. The radioactivity allows doctors to see where the iodine is absorbed in the body using a special camera which can visualize and measure radiation levels. By measuring the amount of radioactivity that is taken up by the thyroid gland (radioactive iodine uptake, RAIU), doctors can determine problems with the thyroid. For example, a very high RAIU is seen in individuals whose thyroid gland is overactive (*hyperthyroidism*) while a low RAIU is seen in patients whose gland is underactive (hypothyroidism).

THYROID ULTRASOUND

Thyroid ultrasound (US) is the best tool to use when there is concern about a thyroid nodule and to estimate the likelihood of cancer. US uses sound waves to take a picture of the thyroid gland; it is not painful and does not use any *radiation*.



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