

Thyroid testing in primary hypothyroidism

Abstract

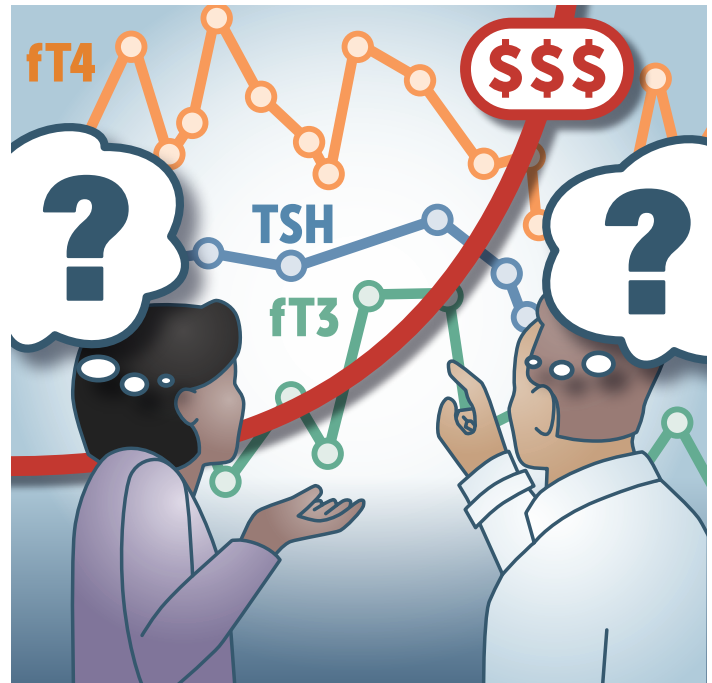
Background:

Thyroid hormones regulate essential metabolic processes and development. The hypothalamic-pituitary-thyroid axis regulates hormone production, with thyroid stimulating hormone (TSH) levels being a key indicator of thyroid function in primary hypothyroidism.

Aims:

This *Therapeutics Letter* emphasizes a TSH-centred approach to the diagnosis and management of primary hypothyroidism (dysfunction at the level of the thyroid gland) in adults. It discourages routine thyroid function screening in asymptomatic individuals due to lack of demonstrated benefit and potential harm from overdiagnosis and overtreatment. It outlines appropriate diagnostic strategies, including when to use TSH, free T4 (thyroxine), and free T3 (triiodothyronine) tests, and outlines indications for antibody testing. Special considerations are provided for subclinical hypothyroidism and hypothyroidism during pregnancy.

Keywords: Diagnostic Tests; Hypothyroidism; Levothyroxine; Mass Screening; Overdiagnosis; Pregnancy Complications; Thyroid Diseases; Thyroid Function Tests.



Recommendations:

- Do not perform routine thyroid function screening in asymptomatic adults.
- Use TSH as the initial test for suspected primary thyroid dysfunction and as the test to monitor levothyroxine monotherapy for primary hypothyroidism.
- Wait six weeks before re-checking TSH after therapy adjustments; once stable, annual testing is sufficient.
- Avoid treating asymptomatic screen-detected subclinical hypothyroidism, except when TSH >10 mU/L in patients under 70 years of age.
- In pregnancy, test TSH only in high-risk women; treat overt hypothyroidism, but avoid routine treatment of subclinical cases.

Thyroid testing in primary hypothyroidism

Vignette: A 40-year-old woman presents to your clinic with symptoms of weight gain, constipation, fatigue, cold intolerance, and brittle nails. Physical exam shows dry skin with excoriations and thin hair. She is concerned about thyroid disease and based on her internet research is requesting you to check her "complete thyroid panel." **What test(s) would you order for her?**

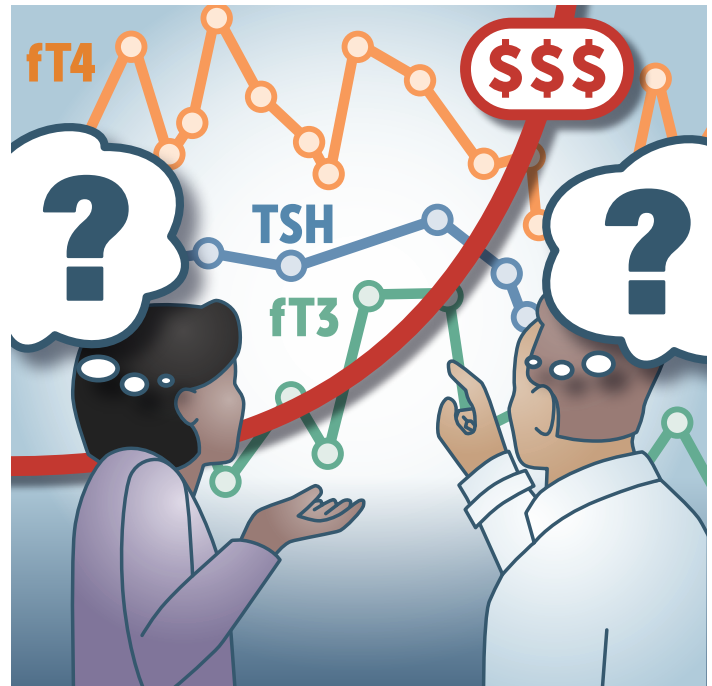
Summary and Conclusions

- Routine screening with thyroid function tests is unnecessary in asymptomatic adult patients.
- If thyroid dysfunction is suspected, clinicians should generally begin diagnostic testing with a thyroid stimulating hormone (TSH) test alone.
- Use TSH alone to monitor therapy for people taking levothyroxine monotherapy for primary hypothyroidism. Once TSH is within the normal range for age, annual re-checks are appropriate in the absence of clinical changes.

Thyroid hormones

Thyroid hormones are necessary for the development of human tissues and metabolic regulation of nearly all cells.¹ Hormone production is regulated by a feedback loop along the hypothalamus-pituitary-thyroid axis. The hypothalamus produces thyrotropin releasing hormone (TRH) which controls production of thyroid stimulating hormone (TSH) by the anterior pituitary gland. TSH regulates production and secretion of the two forms of thyroid hormone, thyroxine (T4) and the more bioactive triiodothyronine (T3) by the thyroid gland.¹ The thyroid gland secretes mainly T4, whereas other tissues convert T4 to T3 at the cellular level.² Intracellular T3 levels regulate pituitary secretion and blood levels of TSH.³ Most circulating T4 and T3 is bound to transport proteins in plasma; it is the small free fraction (soluble hormone) that is measured through diagnostic tests.^{4,5}

TSH, free T4 and free T3, ordered in a step-wise fashion, are used to diagnose and monitor disorders of thyroid function: clinical conditions of thyroid hormone deficiency (hypothyroidism) or excess (hyperthyroidism).^{1,5} Tests assess abnormal function of the thyroid gland itself (primary dysfunction) or of its regulation by the pituitary gland or hypothalamus (central dysfunction).^{1,6}



Antibody tests can help investigate immune-mediated thyroid dysfunction. Thyroid peroxidase (TPO) antibodies can help confirm a diagnosis of Hashimoto's thyroiditis as a cause of primary hypothyroidism.³ However, this test seldom changes clinical management. There are some clinical situations where measurement of anti-TPO antibody level may be useful.⁵ For example, anti-TPO antibodies may indicate the presence of autoimmune thyroiditis in patients with a goitre or mildly elevated TSH. Being positive for anti-TPO antibodies increases the risk of developing overt hypothyroidism in people with subclinical hypothyroidism or those at risk of developing thyroid dysfunction such as people with autoimmune diseases (e.g. Type 1 diabetes), chromosomal disorders (e.g. Turner syndrome or Down syndrome) and people on certain medications such as lithium or amiodarone.^{3,5,7} If performed, and a person is anti-TPO antibody positive, there is no reason to repeat anti-TPO antibody testing.⁵

Use a TSH-centered approach to diagnose and monitor primary hypothyroidism

Diagnosis of primary hypothyroidism: Since TSH is regulated by thyroid hormones, TSH levels reliably predict thyroid hormone function.⁸ Unless there is clinical evidence to suspect central thyroid dysfunction (at the hypothalamus or pituitary level), which is rare, TSH should be the principal test to assess for primary thyroid gland dysfunction.⁹ In British Columbia, if "suspected hypothyroidism or hyperthyroidism" is selected on the standard out-patient requisition, clinical laboratories first measure plasma TSH; they proceed to measure free T4 only if TSH is abnormal.⁵ Usually the free T4 level confirms a diagnosis of hypothyroidism or hyperthyroidism. Free T3 is ordered only in clinically suspected hyperthyroidism when the TSH is suppressed, but the free T4 is not elevated.⁵ The TSH alone is not reliable in the diagnosis of central causes of hypothyroidism (e.g. hypopituitarism).^{6,10}

Monitoring primary hypothyroidism: For a patient with established primary hypothyroidism on levothyroxine monotherapy, TSH is sufficient to monitor replacement therapy. As TSH values change slowly, it is better to wait for at least 6 weeks following a change in thyroid hormone replacement dose before re-checking TSH and dose.³¹ Once TSH normalizes under treatment, annual repeat TSH suffices, unless there is a clinical change that might impact levothyroxine pharmacokinetics (e.g. pregnancy, significant weight changes, gastrointestinal disorders, food supplements containing calcium and iron).¹²

Serum TSH can vary by up to 40% between measurements - even when sampled at the same time of day - yet not indicate any change in thyroid function.¹³ TSH also varies by time of day.¹⁴ **Thus, one should expect changes within the reference range that reflect inherent biological variability, but are not clinically meaningful.** TSH also tends to rise with age, although most laboratories do not report age-specific reference ranges. Amongst 16,533 participants in the 1988-1994 US National Health and Nutrition Survey III, there was a shift towards higher serum TSH in older people. For example, the 97.5th percentile for TSH in people aged 20 to 29 was 3.56 mU/L, but rose to 7.49 mU/L for people over age 80. In this older group, 70% of people with TSH >4.5mU/L were within the reference range for their age.¹⁵

Do not screen routinely with thyroid function tests

A 2019 systematic review aiming to evaluate benefits and harms of screening to detect thyroid dysfunction found no studies on screening for thyroid disease.¹⁶ Screening in asymptomatic adults can lead to unnecessary blood draws, further tests, and treatments that do not confer clinical benefit.¹⁷ As such, Canadian guidelines recommend against "routine" thyroid function testing in adults.¹⁷ Guidelines in British Columbia suggest consideration of testing for patients with symptoms and signs that suggest thyroid disease or for people with specific risk factors which include advanced age (men over 60 or women over 50 years), personal or family history of thyroid disease, co-existing autoimmune diseases, history of neck irradiation, prior thyroid surgery or radioactive iodine ablation, drug therapies such as lithium and amiodarone, dietary factors (iodine excess or deficiency) and certain chromosomal or genetic disorders (Turner syndrome, Down syndrome, and mitochondrial disease).⁵ If initial TSH testing is normal, repeat testing is usually unnecessary unless there is a change in clinical condition.⁵

Subclinical hypothyroidism: Subclinical hypothyroidism (prevalence 4.3-8.5%)³ refers to the clinical situation where plasma TSH is elevated despite a normal plasma free T4. **Typically, this is associated with non-specific clinical symptoms, or no symptoms whatsoever.**^{3,18} While elevated TSH levels (particularly >10 mU/L) are associated with increased cardiovascular and mortality risks, there is insufficient evidence to show that treatment meaningfully affects clinical endpoints.¹⁹⁻²⁶ Furthermore, the TSH of many patients who initially display biochemical subclinical hypothyroidism will normalize without intervention.²⁷⁻²⁹

Of asymptomatic people with an elevated TSH, 62% had normal TSH levels at the second determination, versus only 2.9% who had a second highly elevated TSH.²⁹ In addition, thyroid overtreatment can be associated with harms including cognitive dysfunction, atrial fibrillation and

bone loss in post menopausal women.^{3,30} Hence Canadian guidelines recommend against treatment of asymptomatic adults for screen detected hypothyroidism.¹⁷ The British Medical Journal Rapid Recommendations also discourage thyroid hormone therapy for patients with subclinical hypothyroidism.³¹ **Treatment for subclinical hypothyroidism is generally recommended when TSH rises above 10 mU/L in patients less than 70 years of age.**¹⁵ This is based on a subgroup analysis of a meta-analysis which suggested lower all-cause and cardiovascular mortality with thyroid hormone therapy in that age group.²³

Hypothyroidism in pregnancy: There is clear evidence of benefit for treating a pregnant woman known to be hypothyroid.⁷ Treatment reduces adverse pregnancy outcomes including preterm delivery or miscarriage, and neuropsychological impairment of the offspring associated with hypothyroidism.^{32,33} If a woman has risk factors for developing thyroid dysfunction, TSH should be tested early in pregnancy.⁷

However, evidence is insufficient to support universal screening for thyroid disease during pregnancy.³⁴⁻³⁶ Early studies suggested that **subclinical hypothyroidism** during pregnancy might increase adverse pregnancy outcomes, including preterm delivery or miscarriage, and neuropsychological impairment of a child.^{33,37} However, treatment for subclinical hypothyroidism failed to show clinical benefit in randomized placebo controlled trials.³⁵ A meta-analysis of 3 randomized trials in women with subclinical hypothyroidism diagnosed in pregnancy also found no evidence for benefits of levothyroxine therapy on obstetrical, neonatal, childhood Intellectual Quotient or neurodevelopmental outcomes.³⁸ A recent retrospective Canadian cohort study showed that the current pattern of thyroid testing in pregnant women can contribute to overdiagnosis of hypothyroidism and over-treatment during pregnancy and post-partum.³⁹ In addition, over-treatment of pregnant women can increase harms such as preterm labour.^{40,41} **Hence, in pregnancy we lack evidence both for universal screening for thyroid disease, and for treatment of subclinical hypothyroidism.**

Vignette resolution: *You share the patient's concern about hypothyroidism. Finding nothing to suggest hypothalamic or pituitary dysfunction, you reassure her that the most useful test is a TSH, which you order, checking "suspected hypothyroidism" on the requisition. The TSH result is high, and the lab automatically reports a low free T4. You diagnose primary hypothyroidism, explain why testing for anti-TPO antibodies is not useful, and start levothyroxine, with a plan to re-check TSH and clinical status in 6-12 weeks.*

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Understanding Thyroid Tests

A Patient's Guide

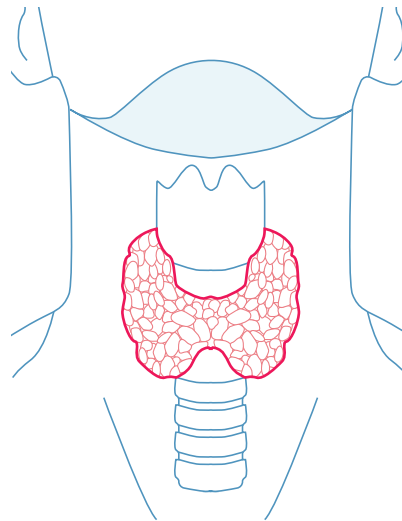
Thyroid tests

TSH test

- The main test is the thyroid stimulating hormone (TSH) test.
- This hormone sends signals from the brain to the thyroid.
- Changes in TSH can provide early warning if T3 and T4 hormones are too low or high.
- If TSH is in the normal range, other tests are not usually needed.

T3 and T4 tests

- If TSH is abnormal, your doctor will test the Free T4 hormone.
- Sometimes the Free T3 test is done for a suspected overactive thyroid gland.



What could your symptoms mean?

Too little thyroid hormone (hypothyroidism) or too much (hyperthyroidism) may cause symptoms. An underactive thyroid gland is much more common than an overactive thyroid gland.

Common symptoms

Hyperthyroidism



Hypothyroidism



Thyroid antibody tests

- Antibodies are part of our body's defense system and, at times, our body produces antibodies against itself, causing problems.
- Thyroid peroxidase antibody tests may be ordered to assess for low thyroid function caused by an autoimmune issue.
- Detecting this antibody does not change clinical treatment and is often not required. In certain situations, it may be used to help your doctor detect a risk of developing low thyroid function.

Common causes for hypothyroidism

The most common reasons for low thyroid function are related to problems with the thyroid gland. The problem is rarely related to the ability of your brain to send a signal to the gland.

Possible causes include:

- Autoimmune disease
- Surgical removal of the gland
- Radiation treatment

Medications and thyroid tests

- Birth control pills or pregnancy can affect T4 and T3 levels.
- It's best not to take biotin for 2 days before a blood test for thyroid function.



BIRTH CONTROL



BIOTIN

Treatment with synthetic T4 pills

- Hypothyroidism is treated with synthetic T4 pills (levothyroxine).
- If you are on T4 hormone replacement, only TSH testing is needed to monitor treatment.
- Your doctor/clinician should test TSH about 6-10 weeks after a change in medication.

Course Material for:

[Navigating Thyroid Testing in Primary Hypothyroidism](#)

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What could your symptoms mean?

Your doctor/clinician may recommend a blood test for your thyroid because you've noticed changes in your body or health that might be related to your thyroid being too active, or not active enough. Thyroid testing helps your doctor gather information to understand and address thyroid-related issues.

What happens if my thyroid test(s) are normal?

Thyroid testing is just one piece of information used to assess your state of health. If your thyroid tests are normal, your doctor may talk about other possible reasons for your symptoms and work with you to create a health plan.

Are there any harms of getting a thyroid blood test? Or of testing too often?

Even if your results are a bit outside the normal range, it doesn't automatically mean you need medication. Remember, what is 'normal' can be different for different people, particularly as we age. Thyroid levels can change over time, especially if you're sick with non-thyroid-related illnesses. Testing should only be done when your doctor is trying to figure out if changes in your health are related to your thyroid. Testing too often may cause hassle, stress, and unnecessary treatment. Unneeded thyroid medication can make you feel worse rather than better.

What if my thyroid blood test(s) are not normal?

Your doctor will explain the results and guide you through what each part means. The key indicator is TSH (thyroid stimulating hormone). If needed, you might have more tests to diagnose different thyroid conditions.

Is thyroid dysfunction life limiting or life threatening?

Generally, thyroid issues aren't life limiting or life threatening. With proper treatment, people with thyroid problems can lead healthy lives.

What are the types of thyroid conditions?

The most common disorder of the thyroid gland is an under active thyroid gland, usually due to an autoimmune condition where antibodies in your blood start to work against the thyroid gland. There are other causes of under active thyroid gland, which include prior surgical removal of thyroid gland, radiation, etc. Though less common, the thyroid gland can be over active, which requires treatment as well.

Will I need other tests, like more blood tests or an ultrasound of my thyroid?

It depends on the changes you're experiencing and what your initial test (TSH) showed. If your TSH is high or low, then your doctor may order more blood tests to assess the type and cause of the abnormality. Thyroid ultrasound tests are not typically needed for an assessment of thyroid function, unless your doctor feels an abnormality of the thyroid gland on physical examination.

When will I receive my results?

TSH and thyroid hormone tests can be run in most laboratories and you should be able to see your results within a few days. Although you can access your own results through the patient portal, we also recommend discussing the results with your doctor.