VITALS VAULT

A VITALS VAULT FIELD GUIDE

# Read your thyroid labs in 15 minutes

For anyone with a borderline TSH, thyroid symptoms or hormone replacement who wants to understand each test.

8

CHAPTERS

15 minutes

Every claim is tied to a named study.
References are on the last page.

Educational only. Not medical advice.

### THIS GUIDE IS FOR YOU IF

- You have a borderline or abnormal TSH and want to know what it means.
- You have thyroid symptoms but your report says 'normal'.
- You take thyroid hormone replacement and want to read your follow-up tests.
- You want sharper questions before your next appointment.

### HOW TO USE IT

Read chapter 2 first for the test table, then go to the chapter that matches your result. Take the question boxes and the log on the last page to your appointment. Everything here is for reading lab results, not for treatment decisions.

### WHAT IS INSIDE

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CHAPTER 1

# The thermostat: how TSH and thyroid hormones talk

THE ONE THING TO REMEMBER

**TSH is the signal, not the heat: it rises when thyroid hormone runs low and falls when there is plenty.**

Think of a home thermostat. The pituitary (a pea-sized gland under the brain) checks how much thyroid hormone is in your blood. If there is too little, it releases more TSH (thyroid-stimulating hormone), which tells the thyroid to work harder. If there is plenty, TSH falls. T3 in the blood helps turn the signal down.

The thyroid mostly makes T4 (the inactive storage form). Tissues trim one iodine off it to make T3 (the active form cells use). Over 99 percent of both hormones in blood is stuck to proteins. Only the free part, written fT4 and fT3, can enter cells, so most tests ask for the free ones. T4 has a half-life (time for half to clear) of about 8 days; T3, about 12 hours.

COMMON BELIEF

## *"TSH is what makes me feel tired or cold"*

WHAT THE EVIDENCE SAYS

TSH itself causes no symptoms. Symptoms come from too much or too little thyroid hormone. Blood levels stay steady day to day, but in animal studies tissue T3 changed about tenfold within hours, which a blood test cannot see.

WHAT A STUDY FOUND

Andersen and colleagues looked at how thyroid hormone levels vary within one person over time. They reported narrow individual variation, which suggests each person has a personal set-point. Limit: our source gives no sample size, and it does not say what a set-point means for health.

Andersen et al., 2002

ASK YOUR CLINICIAN

- Do I have earlier thyroid results to compare with this one?
- Were my results free (unbound) hormone or total hormone?

CHAPTER 2

# What each thyroid test measures

THE ONE THING TO REMEMBER

**TSH is the usual first test; free T4 shows what the gland makes; free T3, reverse T3 and antibodies answer narrower questions.**

Most clinicians start with TSH. If it is off, they usually add free T4, and antibodies when an immune cause is suspected. T3 plays little role in diagnosing an underactive thyroid, because the body defends T3 until late. Ranges below are typical printed ranges from one source. Labs differ, so use the range on your own report.

| Test | What it measures | Typical printed range |
|---|---|---|
| **TSH** | Pituitary signal telling the thyroid to work | 0.40 to 4.50 mIU/L |
| **Free T4** | Unbound storage hormone from the thyroid | 0.80 to 1.80 ng/dL |
| **Free T3** | Unbound active hormone | 2.30 to 4.20 pg/mL |
| **Reverse T3** | Inactive form, cleared within hours | 8.00 to 25.00 ng/dL |
| **TPO antibodies** | Immune proteins aimed at a thyroid enzyme | 0 to 9 IU/mL; labs differ widely |
| **Thyroglobulin antibodies** | Immune proteins aimed at the storage protein | 0 to 1.00 IU/mL; method-specific |

**WHAT A STUDY FOUND**

Two method comparisons (Jonklaas 2014; Welsh and Soldin 2017), as summarized by an endocrinologist, found free T4 immunoassays (lab methods using antibodies) reliable. Free T3 and reverse T3 methods agreed less, especially at low levels. One unpublished four-lab test of a single sample gave scattered reverse T3 values. Limit: expert summary, partly unpublished.

Jonklaas, Clin Biochem, 2014; Welsh and Soldin, Eur J Endocrinol, 2017

**COMMON BELIEF**

## *"Total T4 is as good as free T4"*

**WHAT THE EVIDENCE SAYS**

Estrogen, for example in pregnancy, raises the binding proteins that carry T4. Total T4 can then look high while free T4 is normal. Free T4 is not distorted this way.

**ASK YOUR CLINICIAN**

- **Which of these tests were on my report, and which were not?**
- **Which lab and method measured my free T3?**
- **Was this free T4 or total T4?**

CHAPTER 3

# Antibodies: what a positive result means and does not

THE ONE THING TO REMEMBER

**Thyroid antibodies point to an immune cause and support a diagnosis, but they are present without disease and absent with it.**

Antibodies (immune proteins aimed at a target) can be made against TPO, the enzyme that builds thyroid hormone, and against thyroglobulin, its storage protein. A third kind hits the TSH receptor. Hashimoto thyroiditis, an immune attack on the gland, is the most common cause of an underactive thyroid in the US. In Graves disease, the cause of most overactive thyroids in the West, antibodies mimic TSH.

| Antibody | Aims at | A positive result can point to |
|---|---|---|
| **TPO** | Enzyme that builds thyroid hormone | Hashimoto or Graves; may rise years early |
| **Thyroglobulin (Tg)** | Thyroid storage protein | Hashimoto; lower and temporary in viral thyroiditis |
| **TSH receptor (TRAb)** | The docking site for TSH | Graves disease; high in at least 99 percent |

WHAT A STUDY FOUND

In 522 female military personnel (87 later diagnosed with Hashimoto, 87 with Graves, 348 controls), 66 percent of future Hashimoto cases had raised TPO antibodies throughout the 7 years before diagnosis. 53 percent had raised Tg antibodies. Limit: military women only, one cohort.

Hutfless et al., 2011

**3.9x** **Higher odds of miscarriage in TPO-positive pregnant women with a normal TSH in one meta-analysis; preterm birth was 2.1 times. An association, not proof of cause.**

COMMON BELIEF

## *"No antibodies means my thyroid problem is not real"*

WHAT THE EVIDENCE SAYS

About 60 percent of people with an underactive thyroid have TPO antibodies, so about 40 percent do not. Surgery, radioactive iodine and unknown causes also happen. Some people with a normal thyroid have raised antibodies.

ASK YOUR CLINICIAN

- **Were TPO and thyroglobulin antibodies measured, and does it change the picture?**
- **Does my family history of immune disease matter here?**

CHAPTER 4

# Subclinical results and who progresses

THE ONE THING TO REMEMBER

**Subclinical means TSH is outside range while free T4 is normal; in one review about half progressed within 20 years.**

Subclinical (abnormal TSH, normal free T4) is found in about 4 to 10 percent of people in developed countries. On the high side, TSH stays above about 4 and up to 10 on repeat tests. Thyroid function should be stable for over 2 weeks with no acute illness, so one result is often repeated. Age matters too: one endocrinologist's rule of thumb is that after 50 the upper limit rises about 1 per decade. That is opinion, and guidelines vary.

**WHAT A STUDY FOUND**

In 2,779 adults followed 20 years (Whickham survey), doubling TSH from 2.5 to 5 mIU/L raised the chance of hypothyroidism from 1 percent to 4 percent. The risk was higher still with thyroid antibodies. Limit: observational, one community, and a rise in risk is not a diagnosis.

Vanderpump et al., Whickham 20-year follow-up, 1995

**WHAT A STUDY FOUND**

In 3,018 people followed 5 years, a TSH above 2 mIU/L predicted later subclinical hypothyroidism even when thyroid function started normal. Antibodies and excess iodine added risk. Limit: it shows who is more likely to drift upward, not that 2 is abnormal.

Teng et al., N Engl J Med, 2006

# 50%

**Share of people with subclinical hypothyroidism who progressed to overt disease within 20 years, in the figure one review cites. The source does not name the underlying studies.**

**COMMON BELIEF**

## *"Subclinical is harmless until TSH reaches 10"*

**WHAT THE EVIDENCE SAYS**

Treatment has traditionally waited for 10. But a meta-analysis of 11 studies (over 55,000 people) found more heart events as TSH rose, and others link it to cholesterol and blood pressure. A 2018 pooled analysis of 21 trials (2,192 adults) found hormone treatment moved TSH but not quality of life or symptoms.

**ASK YOUR CLINICIAN**

- **Is my TSH persistently high on repeat tests, or a one-off?**
- **Does my age change how my TSH is read?**
- **Do my antibodies or family history change how closely to follow this?**

CHAPTER 5

# Things that distort thyroid tests

THE ONE THING TO REMEMBER

**Illness, fasting, biotin, estrogen, steroids and other medicines can move thyroid numbers without a thyroid problem.**

TSH also moves with illness, age, sex, body weight, iodine intake and the lab method used. Iodine follows a U-shape: too little and too much can both disturb the thyroid (Farebrother 2019 review). One source says thyroid hormone handling also shifts with the body clock and fasting. The cards give no standard draw time, so note the time, whether you fasted, and any supplements next to each result.

| What changes | Test affected | What can happen |
|---|---|---|
| **Serious illness or surgery** | Free T3, reverse T3 | Free T3 falls, reverse T3 rises; usually settles |
| **Fasting or crash dieting** | Free T3, reverse T3 | T3 falls, reverse T3 rises, TSH may stay normal |
| **High-dose biotin** | Thyroid tests, TRAb | Can interfere; TRAb can read falsely high |
| **Estrogen or pregnancy** | Total T4 | Total T4 high, free T4 normal |
| **Steroids, blood thinners** | TSH, free T3 | TSH can fall; blood thinners can raise free T3 |
| **Mood stabilizers, iodine** | TSH | TSH can rise |

WHAT A STUDY FOUND

In 78 people with low free T4 and low or normal TSH, mean reverse T3 was 8.78 ng/dL in pituitary (central) hypothyroidism but 23.81 in non-thyroidal illness. The illness pattern resolved over time; the central pattern did not until T4 was given. Limit: small study of unusual patients.

Exley et al., 2021

COMMON BELIEF

## *"A low free T3 means my thyroid is failing"*

WHAT THE EVIDENCE SAYS

Low free T3 also follows calorie restriction, diabetes, heart, lung or liver disease and inflammation. Early hypothyroidism may not lower free T3 at all, because a high TSH pushes more T4 into T3.

ASK YOUR CLINICIAN

- **Could biotin or another supplement I take change this result?**
- **Was I ill, fasting or recently on a new medicine at the time of the draw?**

CHAPTER 6

# Normal TSH but still symptoms? Ranges and reverse T3

THE ONE THING TO REMEMBER

**Standard TSH range is about 0.4 to 4.5; narrower ranges are one group's view, and no source here proves a narrower range helps.**

Fatigue, feeling cold, hair loss, weight gain and brain fog are real. But blinded studies suggest symptoms alone cannot tell an underactive thyroid from other causes. Menopause is the biggest look-alike, and anemia, low iron and depression overlap. Doctors disagree on how to read a normal TSH in someone who feels unwell. Both views below are labeled.

| Range | TSH, mIU/L | Whose view |
|---|---|---|
| **Standard lab ranges** | 0.40 to 4.50 | Most labs and guidelines |
| **Upper limit over time** | 10, then 5–7, 4.5, 4.12 | Fell across decades of revisions |
| **Lowest-mortality band** | 1.2 to 1.95 | One NHANES analysis (association) |
| **Narrow range** | 1.0 to 2.0 | Some functional-medicine practitioners |
| **Proposed ceiling** | 2.5 | A lab-medicine academy and some researchers |

**WHAT A STUDY FOUND**

In 9,020 US adults, all-cause mortality followed a U-shape against TSH. It was lowest at 1.2 to 1.95 mIU/L, and higher at 0.34 to 1.19 and at 1.96 to 5.6. The high band was not split further. Limit: association only; TSH shifts with illness, drugs and pregnancy.

Inoue et al., JAMA Netw Open, 2020

**WHAT A STUDY FOUND**

In 108 adults with Hashimoto who were not on replacement and had normal thyroid hormones, versus 57 controls, TSH was similar (2.55 vs 2.19). Antibodies, vitality, fatigue and chilliness scores differed. Limit: cross-sectional, two Chinese centers, mostly young women, self-rated symptoms; it cannot show antibodies cause symptoms.

Li et al., Scientific Reports, 2024

Reverse T3 is the most argued test. It is an inactive form, and about a third of T4 is turned into it. It rises with illness, fasting and stress and usually settles afterward. One clinician orders it with TSH, free T4 and free T3 when worried. Another expert calls the assays unreliable and sees little use. Mainstream guidelines do not endorse routine testing. None of our sources shows that acting on a reverse T3 number improves outcomes.

ASK YOUR CLINICIAN

- Would a repeat TSH, free T4 or antibodies change anything for me?
- Could menopause, low iron or sleep explain my symptoms?

CHAPTER 7

# Thyroid and the rest of your panel

THE ONE THING TO REMEMBER

**Thyroid hormone touches cholesterol, iron and blood sugar, so thyroid status can show up in other results.**

The liver uses thyroid hormone to clear LDL (so-called bad cholesterol). An underactive thyroid raises total, LDL and non-HDL cholesterol, and cholesterol rises with TSH, most clearly with antibodies. An overactive thyroid lowers it; one 2020 meta-analysis found a mean total cholesterol of 158.7 mg/dL in overt hyperthyroidism. Many other things also move cholesterol.

| Result | Thyroid link | Limit |
|---|---|---|
| **LDL, total cholesterol** | Rise with an underactive thyroid | Many other causes |
| **Ferritin (iron storage protein)** | Low ferritin linked to hypothyroidism | Ferritin also rises with inflammation |
| **Fasting glucose, A1C** | Low-normal free T4 linked to higher A1C | Association in people with normal thyroids |
| **Diabetes** | 11% had thyroid disease (10,920 people) | Pooled analysis; wide ranges |
| **Anemia, liver enzymes, uric acid** | Can shift in overt hypothyroidism | Not specific to the thyroid |

**WHAT A STUDY FOUND**

In 24,765 adults, those with TSH of 2.93 mIU/L or higher, compared with a 0.47 to 1.48 reference group, had more body fat and central obesity, and higher blood pressure, triglycerides, cholesterol, insulin, hs-CRP, uric acid, A1C and HOMA-IR. Limit: observational; it cannot show TSH caused any of it.

Chang et al., J Clin Med, 2019

# 79,727

**People pooled in 19 studies linking subclinical hypothyroidism to insulin resistance, metabolic syndrome, high triglycerides and low HDL. Association only.**

Iron is a common blind spot. Low ferritin is linked to hypothyroidism and is common in autoimmune thyroid disease, sometimes through celiac disease. A review lists persistent symptoms in treated hypothyroidism among the symptoms of iron deficiency without anemia (Balendran and Forsyth 2021). The usual general-population cutoff is ferritin under 30 ug/L. Whether correcting low iron helps is mixed, and its cause always needs a look.

**ASK YOUR CLINICIAN**

- **Should my cholesterol be rechecked in light of my thyroid results?**
- **Was my ferritin checked, and was transferrin saturation too?**

CHAPTER 8

# Testing on replacement, and your question page

THE ONE THING TO REMEMBER

**On thyroid hormone replacement the usual goal is a normal TSH and free T4; what that means for you is your clinician's call.**

Replacement means taking thyroid hormone made outside the body. The usual standard is T4 alone, and the guideline goal is a normal TSH and free T4, which is not the same as feeling well. People sometimes ask about adding T3 or other forms. No guideline backs T3 alone. This guide gives no doses, brands or advice to start, stop or change anything.

| Check | What it shows | Note |
|---|---|---|
| **TSH** | Whether the thyroid signal is turned down | Cited target 0.3 to 3.0; some propose 0.4 to 2 |
| **Free T4** | Circulating T4 | Reliable method; pairs with TSH |
| **Free T3** | Active hormone | Methods vary between labs |
| **LDL, apoB** | How the liver is responding | May stay high with a normal TSH (one view) |
| **Ferritin** | Iron stores | Low iron linked to lingering symptoms |
| **Symptom log** | Trend over time | One value matters less than the trend |

COMMON BELIEF

## *"A normal TSH means treatment is working perfectly"*

WHAT THE EVIDENCE SAYS

Guidelines aim for a normal TSH and free T4. Some experts argue tissues can still run short of T3 and that cholesterol can lag. That rests on mechanism and observational data, not trials. Others warn that a TSH below 1 may affect bone density.

### WHAT A STUDY FOUND

In an NIH crossover study of 14 hypothyroid adults, swapping T4 for T3 at the same TSH (0.5 to 1.5) produced weight loss and lipid changes. Limit: very small, and long-term T3 alone is not routinely recommended. It shows TSH alone may not tell the whole story.

NIH investigators, T3 versus T4 crossover, year not stated

### ASK YOUR CLINICIAN

- Which TSH and free T4 range is my clinician aiming for, and why?
- Which lab and method will be used each time, so results compare?
- What should I note if symptoms persist despite normal numbers?
- Do my cholesterol or iron results fit with my thyroid results?

### SYMPTOM AND TEST LOG

Date and time of blood draw _____

Fasting or not _____

TSH _____

Free T4 _____

Free T3 (and lab or method) _____

Antibodies (TPO, Tg) _____

Medicines and supplements, including biotin _____

Energy, temperature, sleep, mood, bowels (0 to 10) _____

Illness, pregnancy or big diet change this month _____

THE WHOLE GUIDE ON ONE PAGE

# If you remember nothing else

1. TSH is a signal from the pituitary; it rises when thyroid hormone is low and falls when it is high.
2. Free T4 and free T3 are the unbound hormones; most T4 and T3 in blood is bound and inactive.
3. Antibodies support a diagnosis but can be present without disease and absent with it.
4. Subclinical means abnormal TSH with normal free T4; in one review about half progressed in 20 years.
5. Illness, fasting, biotin, estrogen and some medicines can move results without a thyroid problem.
6. Narrow TSH ranges are one group's view; the standard range is about 0.4 to 4.5.
7. Reverse T3 and free T3 methods vary between labs, and routine reverse T3 testing is contested.
8. Thyroid status can show in cholesterol, iron and blood sugar; keep dated results to see trends.

### WHAT THIS GUIDE CANNOT DO

This guide cannot say whether your thyroid is working, what any number means for you, or whether you need treatment. One result is a snapshot, and ranges differ by lab and method. It cannot settle open debates such as the best TSH range or reverse T3 testing. Only your clinician, with your history and repeat tests, can do that.

### A FREE NEXT STEP

**Read our short free page on what a fuller thyroid panel covers beyond TSH. It lists each test and what it answers, so you can see which ones your own report is missing.**

**vitalsvault.com/lp/thyroid**

## REFERENCES

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18. NIH investigators, T3 versus T4 crossover in 14 hypothyroid adults, year not stated
19. Biotin interference with thyroid and TSH receptor antibody assays, B vitamin testing review, source authors not stated
20. Meta-analysis of 19 studies (79,727 people), subclinical hypothyroidism and metabolic syndrome, authors not stated

This guide is educational. It is not medical advice and not a diagnosis, and it does not replace a clinician who knows your history. Study findings describe groups of people and may not apply to you.