What is the thyroid gland and how does it work?
The thyroid gland lies in the front of your neck just below your Adam’s apple. It is made up of two lobes, one on either side of your windpipe, joined by a small bridge of thyroid tissue called the isthmus. The thyroid secretes two main hormones into the bloodstream. One of these is thyroxine, which contains four atoms of iodine and is often called T4. This in turn is converted to triiodothyronine (T3), which contains three atoms of iodine. It is the T3 that is biologically active and regulates your body’s metabolism.

The amount of T4 and T3 secreted by your thyroid gland is regulated by the pituitary gland, which lies underneath your brain. The pituitary senses the level of thyroid hormones in your bloodstream, just as the thermostat in your living room senses the temperature. If the level drops just a little below normal the pituitary reacts by secreting a hormone called thyroid-stimulating hormone (TSH), which activates the thyroid gland to produce more T4. When the thyroid hormone levels rise above normal, the ‘thermostat’ senses this and the pituitary stops secreting TSH so that the thyroid makes less T4. TSH is also called thyrotropin.

What are thyroid function tests?
The usual blood tests done for thyroid function are TSH, T4 and sometimes T3. A blood sample is taken from a vein in the arm and sent off to the laboratory for analysis. Usually the ‘free’ or active portion of T4 and T3 is measured (i.e., FT4 and FT3). Laboratories use reference ranges to compare blood test results with results in the normal healthy population. Typical reference ranges for healthy adults are:

<table>
<thead>
<tr>
<th>Test</th>
<th>From</th>
<th>To</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSH</td>
<td>0.4</td>
<td>4.0</td>
<td>mU/L (milliunits per litre)</td>
</tr>
<tr>
<td>FT4</td>
<td>9.0</td>
<td>25.0</td>
<td>pmol/L (picomoles per litre)</td>
</tr>
<tr>
<td>FT3</td>
<td>3.5</td>
<td>7.8</td>
<td>pmol/L (picomoles per litre)</td>
</tr>
</tbody>
</table>

In pregnancy the serum TSH reference range is different from the general population and should ideally be based on reference ranges derived from healthy pregnant women in the same population. The ranges listed here are only a guide and will vary according to laboratory. There are different reference ranges for testing babies and young children.

How can blood tests be used to diagnose thyroid disorders?
Your doctor will interpret these tests, together with your symptoms and how you feel, in order to diagnose whether you have a thyroid disorder, how severe it is, and how to treat it. If your TSH and FT4 results are outside the reference range your doctor may order additional tests. Current guidelines do not advise the use of thyroid hormone replacement if thyroid hormone levels are within normal limits.

**TSH and FT4**
If the TSH level is **high** and the FT4 result is **low** this suggests an underactive thyroid (hypothyroidism) that requires treatment.

If the TSH level is **low** and the FT4 result is **high** this suggests an overactive thyroid (hyperthyroidism) that requires treatment.

If the TSH level is slightly raised but the FT4 level is still within the normal reference range this is called subclinical hypothyroidism or mild thyroid failure. It may develop into overt or clinical hypothyroidism; an additional test for thyroid antibodies will help to determine the risk. Some people with subclinical hypothyroidism, particularly those whose TSH level is greater than 10mU/l, may benefit from treatment with levothyroxine.
A low TSH with a low FT4 may be a result of a failure of the pituitary gland (secondary hypothyroidism caused by hypopituitarism) or a response to a significant non-thyroid illness.

**FT3**

This is usually only used in testing for hyperthyroidism or assessing its severity.

**Thyroid antibodies**

If the initial thyroid test results show signs of thyroid dysfunction and if there is a suspicion of an autoimmune thyroid disease, one or more thyroid antibody tests may be ordered. The main thyroid antibodies are **thyroid peroxidase antibodies** (TPOAb), **thyroglobulin antibodies** (TgAb), and **thyroid stimulating hormone receptor antibodies** (TSHR Ab, also known as TRAb). There is no standard reference range for thyroid antibodies because this depends on many different factors.

Other more specialised tests are **thyroglobulin** (Tg) (used in monitoring people who have been treated for differentiated thyroid cancer) and **calcitonin** (used in monitoring people with medullary thyroid cancer).

**How can blood tests be used to manage thyroid disorders?**

The aims of treatment are to make you feel better and to ensure that you come to no long-term harm from your thyroid hormone replacement. The blood test for TSH, which is the most sensitive marker of your thyroid status, is used as a biochemical marker to ensure that your thyroid hormone replacement is adequate.

It is recommended that patients on thyroid hormone replacement should keep their TSH within the reference range. Some people feel better with a TSH reading in the lower part of the reference range and a FT4 level towards the upper part of the reference range. Over-replacement (e.g., if the TSH becomes undetectable) may cause reduced bone mineral density ("osteoporosis") and long-term harm to the cardiovascular system. The target is different in thyroid cancer where the aim in selected patients is to keep the TSH level below the reference range.

Occasionally patients only feel well if the TSH is below normal or suppressed. This is usually not harmful as long as it is not completely undetectable and/or the FT3 is clearly normal. There are also certain patients who only feel better if the TSH is just above the reference range. Within the limits described above, it is recommended that patients and their supervising doctors set individual targets that are right for their particular circumstances.

If you have been diagnosed with hypothyroidism you will start treatment with levothyroxine - a synthetic version of the thyroxine (T4) produced by the thyroid gland.

If you have hyperthyroidism the available treatments are antithyroid drugs to reduce the production of thyroid hormones; surgery to remove all or part of the thyroid gland; or radioactive iodine to reduce the activity of the thyroid. Your doctor will discuss treatment options with you.

At the start of treatment your doctor will carry out blood tests usually every few weeks. The results will help to fine-tune your treatment. You will normally have less frequent tests when you are stable on your treatment. In hypothyroidism, a TSH test once a year will check that levels are within the reference range. In hyperthyroidism the usual tests are TSH and FT4; how often these take place will depend on the treatment.

You will have additional tests if the results are abnormal, and you should tell your doctor about any change in your health between blood tests. If your results are normal, but you still don’t feel entirely well, ask your doctor whether there is room for a slight adjustment of your dose. This can be considered if your TSH level can be kept within the reference range. You should not, however, alter your dose without discussing this with your doctor.
Once you start on levothyroxine it may take several months before your symptoms improve even if the tests are biochemically satisfactory. This is especially the case in patients with a history of Graves’ disease who may have been hyperthyroid for many months and who may take a considerable time to adjust to feeling ‘normal’ with biochemically satisfactory tests following radioiodine or surgery.

What can affect the results of thyroid function tests?
Thyroid function tests can be influenced by medications and illnesses. Let the person taking your blood test know of anything that might affect the readings, especially:

- Any serious illness such as heart attack, infection, trauma, serious liver disease or kidney failure
- Medication used to treat thyroid disorders, especially when taking too much or too little
- Any other medication you are taking, including: the contraceptive pill, steroid hormones, anticonvulsants, anti-inflammatory drugs, lithium (used for certain mental disorders) and amiodarone (used to control irregularities of the heart beat)

When should I have a thyroid function blood test?
You should make an appointment with your GP and ask for a blood test if you have:

- Symptoms of an over- or under-active thyroid
- Swelling or thickening in the neck
- An irregular or fast heart rate
- High cholesterol (which causes atherosclerosis – a build-up of fat in the arteries)
- Osteoporosis (fragile or thinning bones)
- Fertility problems, abnormal menstrual cycles, recurrent miscarriage, low libido
- Family history of autoimmune disorders, e.g., type 1 diabetes, vitiligo, etc

Or if you are

- Feeling unwell after having a baby
- Planning pregnancy or in early pregnancy (and you have a family history or personal history of thyroid disorders, a past history of postpartum thyroiditis, or type 1 diabetes)

You should have a blood test once a year, or more frequently if your doctor advises, if:

- You have a diagnosed thyroid disorder
- You have had previous treatment for an overactive thyroid (radioactive iodine, thyroid surgery, medication)
- You have had irradiation to the head and neck after surgery for head and neck cancer
- Before you have treatment with amiodarone or lithium, then 6-12 months during treatment and 12 months after treatment


Some important points….
- Blood tests are currently the most accurate way to diagnose and manage thyroid disorders
- Your symptoms and how you feel are an important part of the diagnosis
- It is important for your health that the TSH level is within the reference range
- If you are taking medication for a thyroid disorder, there may be scope to fine-tune your treatment so that you feel better
- If you have a diagnosed thyroid disorder or have had previous treatment for an over-active thyroid, it is important to have a blood test every 12 months, or as advised by your doctor
• If you have a thyroid disorder you should have a blood test in early pregnancy or if you are planning a pregnancy
• If you are taking medication, do not alter your dose without discussing this with your doctor

Thyroid problems often run in families and if family members are unwell they should be encouraged to discuss with their own GP whether thyroid testing is warranted.

If you have questions or concerns about your thyroid disorder, you should talk to your doctor or specialist as they will be best placed to advise you. You may also contact the British Thyroid Foundation for further information and support, or if you have any comments about the information contained in this leaflet.

The British Thyroid Foundation
www.btf-thyroid.org

The British Thyroid Foundation is a registered charity: England and Wales No 1006391, Scotland SC046037

Endorsed by:
The British Thyroid Association - medical professionals encouraging the highest standards in patient care and research
www.british-thyroid-association.org

The British Association of Endocrine and Thyroid Surgeons - the representative body of British surgeons who have a specialist interest in surgery of the endocrine glands (thyroid, parathyroid and adrenal)
www.baets.org.uk

First issued: 2008
Revised: 2011, 2015, 2018

© 2018 BRITISH THYROID FOUNDATION