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Definition

British Medical Journal (BMJ) Best Practice describes thyroid function in the following way: *'The thyroid gland produces, stores, and secretes thyroxine (T4) and triiodothyronine (T3) through a negative feedback process involving the hypothalamus and pituitary gland. Thyroid dysfunction can result when any part of this process is affected, and is usually characterised by the presence of high or low levels of thyroid-stimulating hormone (TSH, secreted by the pituitary gland) and free thyroid hormones.'*¹

Hyperthyroidism occurs when there is an excess of circulating thyroid hormones (T3 and T4) due to an overactive thyroid gland. This is referred to as thyrotoxicosis.

- **Primary hyperthyroidism** occurs when thyrotoxicosis is caused by an abnormality of the thyroid gland. An example of this is Graves' disease, an autoimmune condition.
- **Secondary hyperthyroidism** occurs when thyrotoxicosis is caused by abnormal stimulation of a normal thyroid gland.²

Hypothyroidism is the result of impaired production of the thyroid hormones.

- **Primary hypothyroidism** (which accounts for 95 percent of cases) occurs when the thyroid gland is unable to produce thyroid hormones because of iodine deficiency (iodine is a vital component of thyroid hormones) or an abnormality in the gland itself.
- **Secondary (or central) hypothyroidism** is the result of insufficient production of TSH.³

For further information about the definitions of each of these conditions, and about the overt and subclinical presentations of each, access the National Institute for Health and Care Excellence (NICE) clinical knowledge summaries (CKS) [Hyperthyroidism – Definition](#) and [Hypothyroidism – Definition](#).

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Prevalence and incidence

Hyperthyroidism

It has been reported that in Europe, the total prevalence (diagnosed and undiagnosed) of hyperthyroidism is 0.75 percent. A consensus guideline states the prevalence of hyperthyroidism in women is 0.5 to 2 percent, and it is ten times more common in women than in men.

In England, the prevalence of subclinical hyperthyroidism was found to be 2.1 percent in a cross-sectional screening survey of 5950 adults aged over 65 years.⁴

Hypothyroidism

Primary hypothyroidism is also ten times more common in women than in men. It has been reported that in Europe, the total prevalence (diagnosed and undiagnosed) of hypothyroidism is three percent, with an incidence rate of 370 per 100,000 per year in women and 72.5 per 100,000 per year in men.

Secondary hypothyroidism is rare, with an estimated incidence of between 1 per 20,000 and 1 per 80,000 people in the general population.

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Signs and symptoms

The NICE CKS [Hyperthyroidism](#) and [Hypothyroidism](#) outline the background, symptoms, diagnosis and management of hyperthyroidism and hypothyroidism.

Watch the following two videos produced by the British Thyroid Foundation. In the first video, we hear from a professor of endocrinology; in the second, we hear from a GP. The first video focuses on hyperthyroidism, the second on hypothyroidism. Both videos introduce us to patient journeys and listen to how they experienced symptoms. There is a third video by the British Thyroid Foundation where we will hear from a GP about the clinical aspects and treatments of hyperthyroidism.

[British Thyroid Foundation – Patient journeys hyperthyroidism introduction with Simon Pearce](#)



[British Thyroid Foundation – Patient journeys hypothyroidism introduction with Scott Wilkes](#)



[British Thyroid Foundation – A doctor's guide to hyperthyroidism](#)



**British Thyroid
Foundation**

A doctor's guide to hyperthyroidism

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Causes/risk factors

Hyperthyroidism

There are several causes of *primary hyperthyroidism*; the most common are Graves' disease, thyroid nodules, and medicines such as amiodarone and lithium (after long-term use).

Causes of *secondary hyperthyroidism* include high levels of a hormone called human chorionic gonadotrophin, which can stimulate the thyroid gland and suppress TSH; tumours on the pituitary gland; and a rare condition called thyroid hormone resistance syndrome, where the pituitary gland is resistant to thyroid hormones.⁵

Risk factors include:

- female sex
- family history of thyroid disease
- smoking (which increases the risk of toxic nodular goitre, Graves' disease and Graves' orbitopathy)
- low iodine intake, which can cause a goitre (this is particularly likely to occur if iodine intake increases)
- autoimmune disease such as type 1 diabetes mellitus.⁶

For further information, access the NICE CKS [Hyperthyroidism – Causes](#) and [Hyperthyroidism – Risk factors](#).

Hypothyroidism

Causes of *primary hypothyroidism* include:

- iodine deficiency
- autoimmune thyroiditis (where the immune system attacks the thyroid)
- therapies and surgery that damage the thyroid
- medicines used to treat hyperthyroidism
- medicines such as iodine, amiodarone, lithium, interferons, thalidomide and rifampicin
- transient thyroiditis (transient swelling of the thyroid)

- thyroid infiltrative disorders
- congenital hypothyroidism.⁷

It should be noted that about 15 percent of people treated with anti-thyroid medicines for Graves' disease (such as carbimazole and propylthiouracil) will develop hypothyroidism 10 to 20 years later.⁷

Causes of *secondary hypothyroidism* relate to pituitary and hypothalamic dysfunction.⁷

For more information, access the NICE CKS [Hypothyroidism – Causes](#).

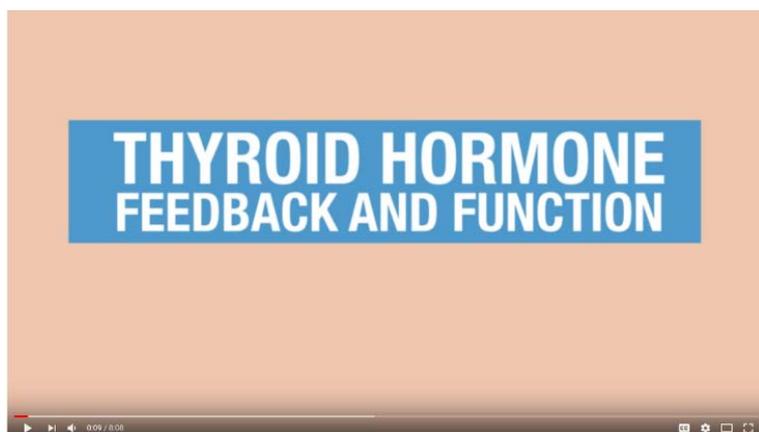
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Pathophysiology (mechanism of disease)

Thyroid hormones are essential for normal growth, development and cellular metabolism. Circulating thyroid hormone levels are normally controlled through the process of negative feedback on the hypothalamus and pituitary gland.²

The following video gives an overview of how thyroid hormones are produced and function in a person who does not have thyroid dysfunction.

[Human Physiology – Thyroid hormone feedback and function](#)



When this process becomes disrupted due to one of the previously discussed causes of thyroid dysfunction, thyroid dysfunction occurs. In this case, the production and serum concentration of TSH, T3 and T4 may be deranged.

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Prognosis and complications

The prognosis for both conditions is variable depending on whether the conditions are overt or subclinical.

Access the NICE CKS [Hyperthyroidism – Prognosis](#) and [Hypothyroidism – Prognosis](#), which cover the prognosis for each condition in detail.

In addition to individual complications for each condition, both hyper and hypothyroidism are linked to an increased risk of [heart failure](#) and cardiac complications. Hyperthyroidism increases the risk of [atrial fibrillation](#), and hypothyroidism is linked to [coronary heart disease](#) and [stroke](#).^{8,9}

Access the NICE CKS [Hyperthyroidism – Complications](#) and [Hypothyroidism – Complications](#), which cover complications for each condition in detail.

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Diagnosis/detection

Initial assessment may be in the form of a clinical history; this includes checking for signs and symptoms. It should be noted that signs of hypothyroidism may be subtle and non-specific, and some people, especially the elderly, may be asymptomatic.

Next, thyroid function tests can be arranged; these include measuring blood serum levels of TSH, free (unbound) T4 and sometimes free T3.

The standard reference ranges are shown below, although they will vary according to the laboratory analysing the sample.

Test	Reference range
TSH	0.4 to 4.0 milliunits/litre (mU/L)
Free T4	9.0 to 25.0 picomoles/litre (pmol/L)
Free T3	3.5 to 7.8 picomoles/litre (pmol/L) ¹⁰

If TSH level is low and free T4 level is high, this suggests hyperthyroidism.¹⁰ In this case, there is less negative feedback to the thyroid to reduce the production of T4. If TSH level is high and free T4 level is low, this suggests hypothyroidism.¹⁰ In this case, the lack of free T4 means that the pituitary gland continues to produce TSH.

For more information about thyroid function tests, including what is observed in subclinical hypothyroidism, access the British Thyroid Foundation's [Thyroid function tests](#) page.

The Welsh Centre for Pharmacy Professional Education [Biochemistry: Section 3](#) e-learning covers thyroid function tests. It aims to provide learners with a basic awareness of important blood tests and how to interpret them to support the diagnosis and management of patients.

To apply this learning to a case study, access CPPE's *Primary hyperthyroidism case study* e-learning via the CPPE [Biochemistry](#) gateway page. Here, you will find information about which blood results should be reviewed when assessing a person's thyroid function, how these blood results differ when a person has a thyroid disorder, and how to interpret these blood results in order to recommend clinical and evidence-based interventions for patients in relation to their therapeutic medication.

The Association for Clinical Biochemistry (ACB), the British Thyroid Association (BTA) and the British Thyroid Foundation (BTF) [UK Guidelines for the use of thyroid function tests](#) provides guidance aimed at primary care physicians, specialist physicians, endocrinologists and clinical biochemists. It is a useful resource if you would like to learn more about thyroid function testing.

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Management

The aims of treatment for thyroid conditions are to manage symptoms and achieve normal levels of thyroid hormones and TSH.

The following *Pharmaceutical Journal* article offers more detail on the changes in the production of thyroid hormones in hyper and hypothyroidism, and the causes of this: [Thyroid disorders: causes, diagnosis and treatment](#).

Another *Pharmaceutical Journal* article covers [Thyrotoxicosis and hyperthyroidism: causes, diagnosis and management](#).

The *British National Formulary* offers two treatment summaries for [antithyroid drugs](#) and [thyroid hormones](#), which link to the individual monographs for each therapy.

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Patient support

The [British Thyroid Foundation](#) is a charity dedicated to supporting people with thyroid disorders, and helping their families and people around them to understand the condition. They also offer a series of [quick guides](#) which offer information about thyroid disorders and related issues.

[Thyroid UK](#) is a charity that offers quality information and support to people with both diagnosed and undiagnosed thyroid disorders.

The NHS website has [Overactive thyroid \(hyperthyroidism\)](#) and [Underactive thyroid \(hypothyroidism\)](#) pages.

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Further resources

The [British Thyroid Association](#) is the only national professional organisation in the UK composed of research doctors and consultants who are accredited for having completed higher professional training in thyroid and other endocrine diseases. They offer a page dedicated to [Professional resources](#). They also offer [Current BTA guidelines and statements](#), with links to BTA guidelines and guidelines from other bodies.

The British Thyroid Foundation's article [Older patients and thyroid disease](#) explores the diagnosis and treatment of thyroid disorders in older people.

The NICE page [Thyroid disorders](#) links to all NICE products on thyroid disorders and includes any guidance and advice.

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External websites

CPPE is not responsible for the content of any non-CPPE websites mentioned on this page or for the accuracy of any information to be found there.

All web links were accessed on 19 June 2023.

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