

WHAT ARE HORMONES?

A hormone is a specific molecule that acts as a chemical messenger in the endocrine system. Hormones are produced by specific organs and glands and are secreted into the blood or other body fluids. Most hormones are carried by the circulatory system to different areas of the body, where they influence specific cells and organs. Hormones regulate various biological activities including growth; development; reproduction; energy use and storage; and water and electrolyte balance.

ENDOCRINE - hormone signaling

Hormones that are circulated in the blood come in contact with a number of cells. However, they only influence certain target cells. Target cells have specific receptors for a specific hormone. Target cell receptors can be located on the surface of the cell membrane or inside of the cell. When a hormone binds to a receptor, it causes changes within the cell that influence cellular function. This type of hormone signaling is described as **endocrine** signaling because the hormones influence target cells over a distance. Not only can hormones impact distant cells, but they can also influence neighboring cells. Hormones act on local cells by being secreted into the interstitial fluid that surrounds cells. These hormones then diffuse to nearby target cells. This type of signaling is called **paracrine** signaling. In **autocrine** signaling, hormones don't travel to other cells but cause changes in the very cell that releases them.

TYPES OF HORMONES

Hormones can be classified into two main types: peptide hormones and steroid hormones.

- **Peptide Hormones**

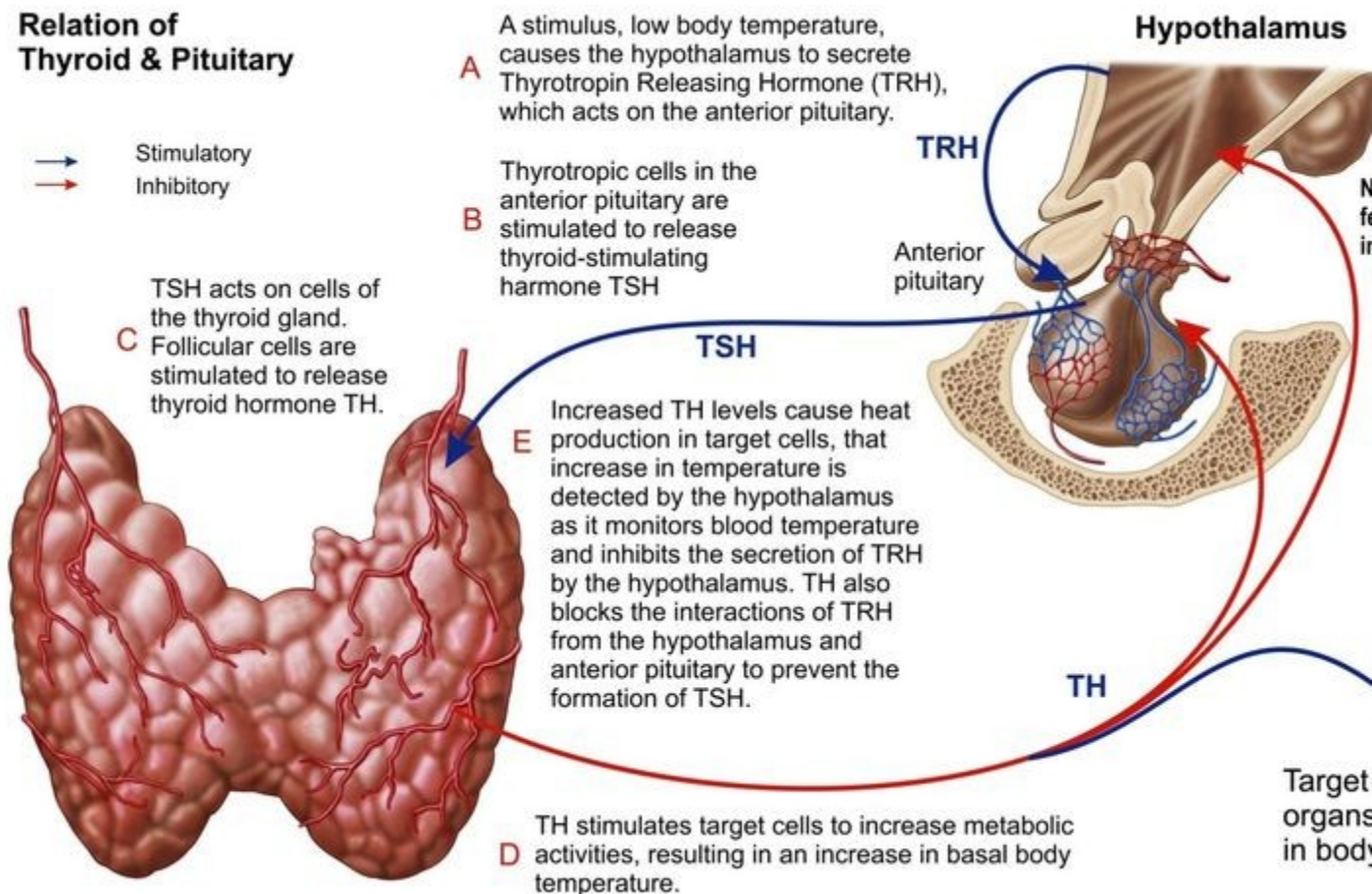
These protein hormones are composed of amino acids. Peptide hormones are water-soluble and are unable to pass through the cell membrane. Cell membranes contain a phospholipid bilayer which prevents fat-insoluble molecules from diffusing into the cell. Peptide hormones must bind to receptors on the cell's surface, causing changes within the cell by affecting enzymes within the cell's cytoplasm. The binding of the hormone to the cell membrane receptor initiates the production of a second messenger molecule inside the cell, which carries the chemical signal within the cell. Human growth hormone is an example of a peptide hormone.

- **Steroid Hormones**

Steroid hormones are lipid-soluble and able to pass through the cell membrane to enter a cell. Steroid hormones bind to receptor cells in the cytoplasm and the receptor-bound steroid hormones are transported into the nucleus. The steroid hormone-receptor complex binds to another specific receptor on the chromatin within the nucleus. The complex calls for the production of certain RNA molecules called messenger RNA (mRNA) molecules, which code for the production of proteins. Steroid hormones cause certain genes to be expressed or suppressed by influencing gene transcription within a cell. **Sex hormones** (androgens, estrogens, and progesterone) produced by male and female gonads are examples of steroid hormones.

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HORMONE REGULATION



Thyroid System Hormones. Stocktrek Images/Getty Images

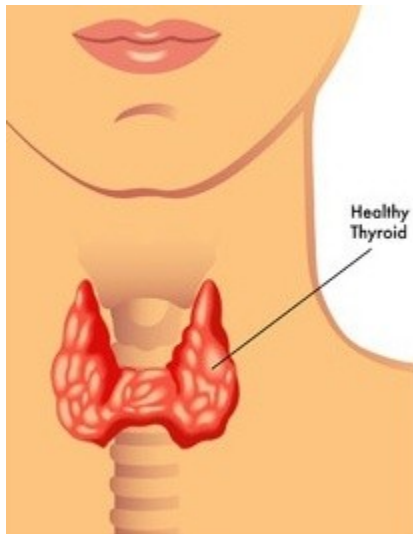
HORMONE REGULATION

Hormones may be regulated by other hormones, by glands and organs, and by a negative feedback mechanism. Hormones that regulate the release of other hormones are called **tropic hormones**. The majority of tropic hormones are secreted by the anterior pituitary in the brain. The hypothalamus and thyroid gland also secrete tropic hormones. The hypothalamus produces the tropic hormone thyrotropin-releasing hormone (TRH), which stimulates the pituitary to release thyroid stimulating hormone (TSH). TSH is a tropic hormone that stimulates the thyroid gland to produce and secrete more thyroid hormones.

Organs and glands also aid in hormonal regulation by monitoring blood content. For example, the pancreas monitors glucose concentrations in the blood. If glucose levels are too low, the pancreas will secrete the hormone glucagon to raise glucose levels. If glucose levels are too high, the pancreas secretes insulin to lower glucose levels.

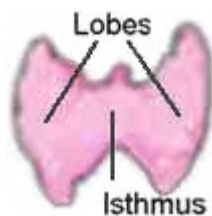
In **negative feedback** regulation, the initial stimulus is reduced by the response it provokes. The response eliminates the initial stimulus and the pathway is halted. Negative feedback is demonstrated in the regulation of red blood cell production or erythropoiesis. The kidneys monitor oxygen levels in the blood. When oxygen levels are too low, the kidneys produce and release a hormone called erythropoietin (EPO). EPO stimulates red bone marrow to produce red blood cells. As blood oxygen levels return to normal, the kidneys slow the release of EPO resulting in decreased erythropoiesis.

Functions, Symptoms of Hyperthyroidism and Hypothyroidism



The thyroid gland is a butterfly-shaped organ located in the base of your neck. It releases hormones that control metabolism—the way your body uses energy. The thyroid's hormones regulate vital body functions, including:

- Breathing
- Heart rate
- Central and peripheral nervous systems
- Body weight
- Muscle strength
- Menstrual cycles
- Body temperature
- Cholesterol levels
- Much more!



The thyroid gland is about 2-inches long and lies in front of your throat below the prominence of thyroid cartilage sometimes called the Adam's apple. The thyroid has two sides called lobes that lie on either side of your windpipe, and is usually connected by a strip of thyroid tissue known as an isthmus. Some people do not have an isthmus, and instead have two separate thyroid lobes.

How the Thyroid Gland Works

The thyroid is part of the endocrine system, which is made up of glands that produce, store, and release hormones into the bloodstream so the hormones

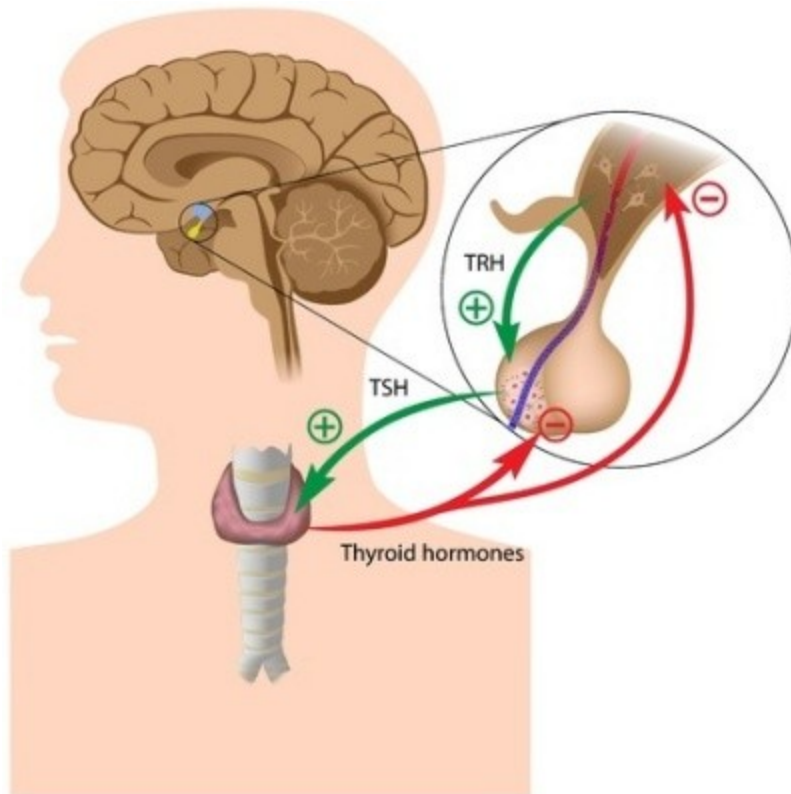
can reach the body's cells. The thyroid gland uses iodine from the foods you eat to make two main hormones:

- Triiodothyronine (T3)
- Thyroxine (T4)

It is important that T3 and T4 levels are neither too high nor too low. Two glands in the brain—the hypothalamus and the pituitary communicate to maintain T3 and T4 balance.

The hypothalamus produces TSH Releasing Hormone (TRH) that signals the pituitary to tell the thyroid gland to produce more or less of T3 and T4 by either increasing or decreasing the release of a hormone called thyroid stimulating hormone (TSH).

- When T3 and T4 levels are low in the blood, the pituitary gland releases more TSH to tell the thyroid gland to produce more thyroid hormones.
- If T3 and T4 levels are high, the pituitary gland releases less TSH to the thyroid gland to slow production of these hormones.



Why You Need a Thyroid Gland

T3 and T4 travel in your bloodstream to reach almost every cell in the body. The hormones regulate the speed with which the cells/metabolism work. For example, T3 and T4 regulate your heart rate and how fast your intestines process food. So if T3 and T4 levels are low, your heart rate may be slower

than normal, and you may have constipation/weight gain. If T3 and T4 levels are high, you may have a rapid heart rate and diarrhea/weight loss.

Listed below are other symptoms of *too much* T3 and T4 in your body [hyperthyroidism](#)

- Anxiety
- Irritability or moodiness
- Nervousness, hyperactivity
- Sweating or sensitivity to high temperatures
- Hand trembling (shaking)
- Hair loss
- Missed or light menstrual periods

The following is other symptoms of *too little* T3 and T4 in your body [hypothyroidism](#)

- Trouble sleeping
- Tiredness and fatigue
- Difficulty concentrating
- Dry skin and hair
- Depression
- Sensitivity to cold temperature
- Frequent, heavy periods
- Joint and muscle pain

As we have seen from our [overview of normal thyroid physiology](#), the thyroid gland produces T4 and T3. But this production is not possible without stimulation from the pituitary gland (TSH) which in turn is also regulated by the hypothalamus's TSH Releasing Hormone. Now, with radioimmunoassay techniques it is possible to measure circulating hormones in the blood very accurately. Knowledge of this thyroid physiology is important in knowing what thyroid test or tests are needed to diagnose different diseases. No one single laboratory test is 100% accurate in diagnosing all types of thyroid disease; however, **a combination of two or more tests can usually detect even the slightest abnormality of thyroid function.**

For example, **a low T4 level** could mean a diseased thyroid gland - or a non-functioning pituitary gland which is not stimulating the thyroid to produce T4. Since the pituitary gland would normally release TSH if the T4 is low, a high TSH level would confirm that the thyroid gland (not the pituitary gland) is responsible for the hypothyroidism.

If the T4 level is low and TSH is not elevated, the pituitary gland is more likely to be the cause for the hypothyroidism. Of course, this would drastically affect the treatment since the pituitary gland also regulates the

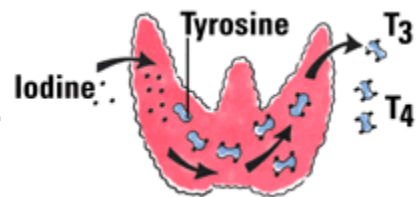
body's other glands (adrenals, ovaries, and testicles) as well as controlling growth in children and normal kidney function. Pituitary gland failure means that the other glands may also be failing and other treatment than just thyroid may be necessary. The most common cause for the pituitary gland failure is a tumor of the pituitary and this might also require surgery to remove.

- Modern measurement of thyroid hormones is done by a new technique, radioimmunoassay (RIA), discovered by Dr. Solomon Berson and Dr. Rosalyn Yalow. They were awarded the 1977 Nobel Prize in Medicine for this discovery which revolutionized the study of thyroid disease as well as the entire field of endocrinology.

The following are commonly used thyroid tests

Measurement of Serum Thyroid Hormones: T4 by RIA

T4 by RIA (radioimmunoassay) is the most used thyroid test of all. It is frequently referred to as a T7 which means that a resin T3 uptake (RT3u) has been done to correct for certain medications such as birth control pills, other hormones, seizure medication, cardiac drugs, or even aspirin that may alter the routine T4 test. The T4 **reflects the amount of thyroxine in the blood**. If the patient does not take any type of thyroid medication, this **test is usually a good measure of thyroid function**.



Measurement of Serum Thyroid Hormones: T3 by RIA

As stated on our thyroid hormone production page, thyroxine (T4) represents 80% of the thyroid hormone produced by the normal gland and generally represents the overall function of the gland. **The other 20% is triiodothyronine measured as T3 by RIA**. Sometimes the diseased thyroid gland will start producing very high levels of T3 but still produce normal levels of T4. Therefore measurement of both hormones provides an even more accurate evaluation of thyroid function.

Thyroid Binding Globulin

Most of the thyroid hormones in the blood are attached to a protein called thyroid binding globulin (TBG). If there is an excess or deficiency of this protein it alters the T4 or T3 **measurement** but does not affect the **action** of the hormone. If a patient appears to have normal thyroid function, but an unexplained high or low T4, or T3, it may be due to an increase or decrease of TBG. Direct measurement of TBG can be done and will explain the abnormal value. Excess TBG or low levels of TBG are found in some families as an hereditary trait. It causes no problem except falsely elevating or lowering the T4 level. These people are frequently misdiagnosed

as being hyperthyroid or hypothyroid, but they have no thyroid problem and need no treatment.

Measurement of Pituitary Production of TSH

Pituitary production of TSH is measured by a method referred to as IRMA (immunoradiometric assay). Normally, low levels (less than 5 units) of TSH are sufficient to keep the normal thyroid gland functioning properly. When the thyroid gland becomes inefficient such as in early hypothyroidism, the TSH becomes elevated even though the T4 and T3 may still be within the "normal" range. **This rise in TSH represents the pituitary gland's response to a drop in circulating thyroid hormone; it is usually the first indication of thyroid gland failure.** Since TSH is normally low when the thyroid gland is functioning properly, the failure of TSH to rise when circulating thyroid hormones are low is an indication of impaired pituitary function. The new "sensitive" TSH test will show very low levels of TSH when the thyroid is overactive (as a normal response of the pituitary to try to decrease thyroid stimulation). **Interpretations of the TSH level depends upon the level of thyroid hormone;** therefore, the TSH is usually used in combination with other thyroid tests such as the T4 RIA and T3 RIA.

TRH Test

In normal people TSH secretion from the pituitary can be increased by giving a shot containing TSH Releasing Hormone (TRH...the hormone released by the hypothalamus which tells the pituitary to produce TSH). A baseline TSH of 5 or less usually goes up to 10-20 after giving an injection of TRH. Patients with too much thyroid hormone (thyroxine or triiodothyronine) will not show a rise in TSH when given TRH. This "TRH test" is presently the most sensitive test in detecting early hyperthyroidism. Patients who show too much response to TRH (TSH rises greater than 40) may be hypothyroid. This test is also used in cancer patients who are taking thyroid replacement to see if they are on sufficient medication. It is sometimes used to measure if the pituitary gland is functioning. **The new "sensitive" TSH test (above) has eliminated the necessity of performing a TRH test in most clinical situations.**

Iodine Uptake Scan

A means of measuring thyroid function is to measure how much iodine is taken up by the thyroid gland (RAI uptake). Remember, cells of the thyroid normally absorb iodine from our blood stream (obtained from foods we eat) and use it to make thyroid hormone (described on our [thyroid function page](#)). Hypothyroid patients usually take up too little iodine and hyperthyroid patients take up too much iodine. The test is performed by giving a dose of radioactive iodine on an empty stomach. The iodine is concentrated in the thyroid gland or excreted in the urine over the next few hours. The amount of iodine that goes into the thyroid gland can be measured by a "Thyroid Uptake". Of course, patients who are taking thyroid medication will not take

up as much iodine in their thyroid gland because their own thyroid gland is turned off and is not functioning. At other times the gland will concentrate iodine normally but will be unable to convert the iodine into thyroid hormone; therefore, interpretation of the iodine uptake is usually done in conjunction with blood tests.

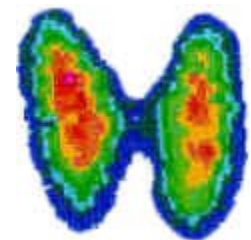
Thyroid Scan

Taking a "picture" of how well the thyroid gland is functioning requires giving a radioisotope to the patient and letting the thyroid gland concentrate the isotope (just like the iodine uptake scan above). **Therefore, it is usually done at the same time that the iodine uptake test is performed.**

Although other isotopes, such as technetium, will be concentrated by the thyroid gland; these isotopes will not measure iodine uptake which is what we really want to know because the production of thyroid hormone is dependent upon absorbing iodine. It has also been found that thyroid nodules that concentrate iodine are rarely cancerous; this is not true if the scan is done with technetium. Therefore, all scans are now done with radioactive iodine. Both of the scans above show normal sized thyroid glands, but the one on the left has a "HOT" nodule in the lower aspect of the right lobe, while the scan on the right has a "COLD" nodule in the lower aspect of the left lobe (outlined in red and yellow). Pregnant women should not have thyroid scans performed because the iodine can cause development troubles within the baby's thyroid gland.



Two types of thyroid scans are available. A camera scan is performed most commonly which uses a gamma camera operating in a fixed position viewing the entire thyroid gland at once. This type of scan takes only five to ten minutes. In the 1990's, a new scanner called a Computerized Rectilinear Thyroid (CRT) scanner was introduced. The CRT scanner utilizes computer technology to improve the clarity of thyroid scans and enhance thyroid nodules. It measures both thyroid function and thyroid size. A life-sized 1:1 color scan of the thyroid is obtained giving the size in square centimeters and the weight in grams. The precise size and activity of nodules in relation to the rest of the gland is also measured. CTS of the normal thyroid gland In addition to making thyroid diagnosis more accurate, the CRT scanner improves the results of thyroid biopsy. The accurate sizing of the thyroid gland aids in the follow-up of nodules to see if they are growing or getting smaller in size. Knowing the weight of the thyroid gland allows more accurate radioactive treatment in patients who have Graves' disease.



Thyroid Scans are used for the following reasons:

- Identifying nodules and determining if they are "hot" or "cold".
- Measuring the size of the goiter prior to treatment.

- Follow-up of thyroid cancer patients after surgery.
- Locating thyroid tissue outside the neck, i.e. base of the tongue or in the chest.

Thyroid Ultrasound

Thyroid ultrasound refers to the use of high frequency sound waves to obtain an image of the thyroid gland and identify nodules. It tells if a nodule is "solid" or a fluid-filled cyst, but it will not tell if a nodule is benign or malignant. Ultrasound allows accurate measurement of a nodule's size and can determine if a nodule is getting smaller or is growing larger during treatment. Ultrasound aids in performing thyroid needle biopsy by improving accuracy if the nodule cannot be felt easily on examination. Several more pages are dedicated to the [use of ultrasound in evaluating thyroid nodules](#).

Thyroid Antibodies

The body normally produces antibodies to foreign substances such as bacteria; however, some people are found to have antibodies against their own thyroid tissue. A condition known as [Hashimoto's Thyroiditis](#) is associated with a high level of these thyroid antibodies in the blood. Whether the antibodies cause the disease or whether the disease causes the antibodies is not known; however, the finding of a high level of thyroid antibodies is strong evidence of this disease. Occasionally, low levels of thyroid antibodies are found with other types of thyroid disease. When Hashimoto's thyroiditis presents as a thyroid nodule rather than a diffuse goiter, the thyroid antibodies may not be present.

Thyroid Needle Biopsy

This has become the most reliable test to differentiate the "cold" nodule that is cancer from the "cold" nodule that is benign ("hot" nodules are rarely cancerous). It provides information that no other thyroid test will provide. While not perfect, it will provide definitive information in 75% of the nodules biopsied. A very extensive discussion of [Thyroid Needle Biopsy is found on another page](#).

Follicle stimulating hormone

[Follicle stimulating hormone is produced by the pituitary gland. It regulates the functions of both the ovaries and testes. Lack or insufficiency of it can cause infertility or subfertility both in men and women.](#)

What is follicle stimulating hormone?

Follicle stimulating hormone is one of the gonadotrophic hormones, the other being [luteinising hormone](#). Both are released by the [pituitary gland](#) into the bloodstream. Follicle stimulating hormone is one of the hormones essential to pubertal development and the function of women's [ovaries](#) and men's [testes](#). In women, this hormone stimulates the growth of ovarian follicles in the [ovary](#) before the release of an egg from one follicle at [ovulation](#). It also increases [oestradiol](#) production. In men, follicle stimulating hormone acts on the Sertoli cells of the testes to stimulate sperm production (spermatogenesis).

How is follicle stimulating hormone controlled?

The production and release of follicle stimulating hormone is regulated by the levels of a number of circulating hormones released by the ovaries and testes. This system is called the hypothalamic-pituitary-gonadal axis. [Gonadotrophin-releasing hormone](#) is released from the [hypothalamus](#) and binds to receptors in the anterior pituitary gland to stimulate both the synthesis and release of follicle stimulating hormone and luteinising hormone. The released follicle stimulating hormone is carried in the bloodstream where it binds to receptors in the testes and ovaries. Using this mechanism follicle stimulating hormone, along with luteinising hormone, can control the functions of the testes and ovaries.

In women, when hormone levels fall towards the end of the menstrual cycle, this is sensed by nerve cells in the hypothalamus. These cells produce more gonadotrophin-releasing hormone which in turn stimulates the pituitary gland to produce more follicle stimulating hormone and luteinising hormone and release these into the bloodstream. The rise in follicle stimulating hormone stimulates the growth of the follicle in the ovary. With this growth, the cells of the follicles produce increasing amount of oestradiol and inhibin. In turn, the production of these hormones is sensed by the hypothalamus and pituitary gland and less gonadotrophin-releasing hormone and follicle stimulating hormone will be released. However as the follicle matures, and more and more [oestrogen](#) is produced from the follicles, it stimulates a surge in luteinising hormone and follicle stimulating hormone which stimulates the release of an egg from a mature follicle - ovulation.

Thus, during each menstrual cycle there is a rise in follicle stimulating hormone secretion in the first half of the cycle that stimulates follicular growth in the ovary. After ovulation the ruptured follicle forms a *corpus luteum* that produces high levels of [progesterone](#). This inhibits the release of follicle stimulating hormone. Towards the end of the cycle the *corpus luteum* breaks down, progesterone production declines and the next menstrual cycle begins when follicle stimulating hormone starts to rise again.

In men, the production of follicle stimulating hormone is regulated by the circulating levels of [testosterone](#) and inhibin, both produced by the testes. Follicle stimulating hormone regulates testosterone levels and when these rise they are sensed by nerve cells in the hypothalamus so that gonadotrophin-releasing hormone secretion and consequently follicle stimulating hormone is decreased. The opposite occurs

when testosterone levels decrease. This is known as a negative feedback control so that the production of testosterone remains steady. The production of inhibin is also controlled in a similar way but this is sensed by cells in the anterior pituitary gland rather than the hypothalamus.

What happens if I have too much follicle stimulating hormone?

Most often, raised levels of follicle stimulating hormone are a sign of malfunction in the ovary or [testis](#). If the gonads fail to create enough oestrogen, testosterone and/or inhibin, the correct feedback control of follicle stimulating hormone production from the pituitary gland is lost and the levels of both follicle stimulating hormone and luteinising hormone will rise. This condition is called **hypergonadotrophic-hypogonadism**, and is associated with primary ovarian failure or testicular failure. This is seen in conditions such as Kallmann's syndrome in men and [Turner syndrome](#) in women.

In women, follicle stimulating hormone levels also start to rise naturally in women around the menopausal period, reflecting a reduction in function of the ovaries and decline of oestrogen and progesterone production.

There are very rare pituitary conditions that can raise the levels of follicle stimulating hormone in the bloodstream. This overwhelms the normal negative feedback loop and can cause ovarian hyperstimulation syndrome in women. Symptoms of this include enlarging of the ovaries and a potentially dangerous accumulation of fluid in the abdomen (triggered by the rise in ovarian steroid output), which leads to pain in the pelvic area.

What happens if I have too little follicle stimulating hormone?

In women, a lack of follicle stimulating hormone leads to incomplete development at puberty and poor ovarian function (primary ovarian failure). In this situation ovarian follicles do not grow properly and do not release an egg, thus leading to infertility. Since levels of follicle stimulating hormone in the bloodstream are low, this condition is called **hypogonadotrophic-hypogonadism**.

Sufficient follicle stimulating hormone action is also needed for proper sperm production. In the case of complete absence of follicle stimulating hormone in men, lack of puberty and infertility due to lack of sperm (azoospermia) can occur. Partial follicle stimulating hormone deficiency in men can cause [delayed puberty](#) and limited sperm production (oligozoospermia), but fathering a child may still be possible. If the loss of follicle stimulating hormone occurs after puberty, there will be a similar loss of [fertility](#).

in women, this **hormone stimulates** the growth of ovarian **follicles** in the ovary before the release of an egg from one **follicle** at ovulation. It also increases

oestradiol production. In men, **follicle stimulating hormone** acts on the Sertoli cells of the testes to **stimulate** sperm production (spermatogenesis).

Physiological and pathological aspects of the effect of human chorionic gonadotropin on the thyroid

Abstract

Human chorionic gonadotropin (hCG) is a glycoprotein hormone that has structural similarity to TSH. At the time of the peak hCG levels in normal pregnancy, serum TSH levels fall and bear a mirror image to the hCG peak. This reduction in TSH suggests that hCG causes an increased secretion of T4 and T3.

Women with hyperemesis gravidarum often have high hCG levels that cause transient hyperthyroidism. In the vast majority of such patients, there will be spontaneous remission of the increased thyroid function when the vomiting stops in several weeks. When there are clinical features of hyperthyroidism, it is reasonable to treat with antithyroid drugs or a beta-adrenergic blocker, but treatment is rarely required beyond 22 weeks of gestation.

Hyperthyroidism or increased thyroid function has been reported in many patients with trophoblastic tumors, either hydatidiform mole or choriocarcinoma. The diagnosis of hydatidiform mole is made by ultrasonography that shows a 'snowstorm' appearance without a fetus. Hydatidiform moles secrete large amounts of hCG proportional to the mass of the tumor. The development of hyperthyroidism requires hCG levels of >200 U/ml that are sustained for several weeks. Removal of the mole cures the hyperthyroidism. There have been many case reports of hyperthyroidism in women with choriocarcinoma and high hCG

levels. The principal therapy is chemotherapy, usually given at a specialized center. With effective chemotherapy, long-term survival exceeds 95%.

A unique family with recurrent gestational hyperthyroidism associated with hyperemesis gravidarum was found to have a mutation in the extracellular domain of the TSH receptor that made it responsive to normal levels of hCG.

Female Hormone Profile

The Female Hormone Profile is a hormone test for menstruating women or women that have not gone through the menopause.

The female hormones include oestrogen and progesterone, and levels of these hormones vary according to a certain pattern during the menstrual cycle.

If there is a problem with the hormonal cycle, then it can lead to problems such as irregular periods, heavy periods, absent periods, PMS, or infertility.

This test is valuable in giving us information about the hormonal cycle, which enables us to rationalise treatment in the best possible way.

Who Should Have the Test?

The test is available to all women before menopause.

It would be particularly valuable for those with the following problems:

- Any period problems, including absent periods, irregular periods, heavy periods, painful periods, or any others.
- Pre-menstrual syndrome or PMS.
- Difficulty conceiving or infertility.

For those with any of these problems, then it could be argued that they should have the test every 12 - 2

Target Organs of Estrogen and Progesterone

The Uterus - Estradiol prepares the uterus for conception, produces a threefold to fivefold increase in the thickness of its inner lining, and also

promotes uterine gland development and mucus secretion. Progesterone causes a swelling of the uterine lining, an increase in glycogen (a complex sugar) content, and an increase in the mucus secreted by the uterus. If conception does not occur, the uterine lining is shed, resulting in the menstrual flow.

Fallopian tubes - Sex hormones stimulate the Fallopian tubes to move the egg toward the uterus. The fallopian tubes also secrete fluids that nourish the egg, the sperm, and ultimately the embryo when fertilization occurs.

Vagina - Estrogens promote the thickening of the vaginal lining and increase its secretions, which makes the lining more resistant to infections.

Breasts - Before puberty, the breasts grow only in proportion to the rest of the body, but under the influence of estradiol and progesterone during puberty, the breasts develop to maturity. During the menstrual cycle, excess estradiol causes breast swelling and tenderness.

Bones - In the adult female, estradiol and progesterone improve the incorporation of calcium and magnesium into bone. This is often why doctors prescribe estrogen for menopausal women.

Kidney - Estrogens cause the body to retain sodium, which results in fluid buildup. Conversely, progesterone causes a loss of excess sodium and retained fluid. Before a menses begins, there may be a relative excess of estrogen over progesterone, which commonly leads to several of the PMS-associated complaints.

Liver - Estradiol has stimulatory effects on liver proteins which may reduce thyroid hormone availability and increase the risk for cardiovascular disease. Estradiol also slows the process of liver detoxification of various harmful substances.

Miscellaneous - Estradiol can elevate blood sugar in certain susceptible individuals. Progesterone can increase the appetite and has a general calming effect on the nervous system, especially at night.

Thyroid hormones

Thyroid stimulating hormone - TSH

Free T4

Free T3

Reproductive Hormone

Beta HCG

Prolactin

FSH

Leutinizing hormone

Oestradiol

Progesterone

Total testosterone

Free testosterone

Hypertension

Aldosterone

Antidiuretic hormone

Cortisol