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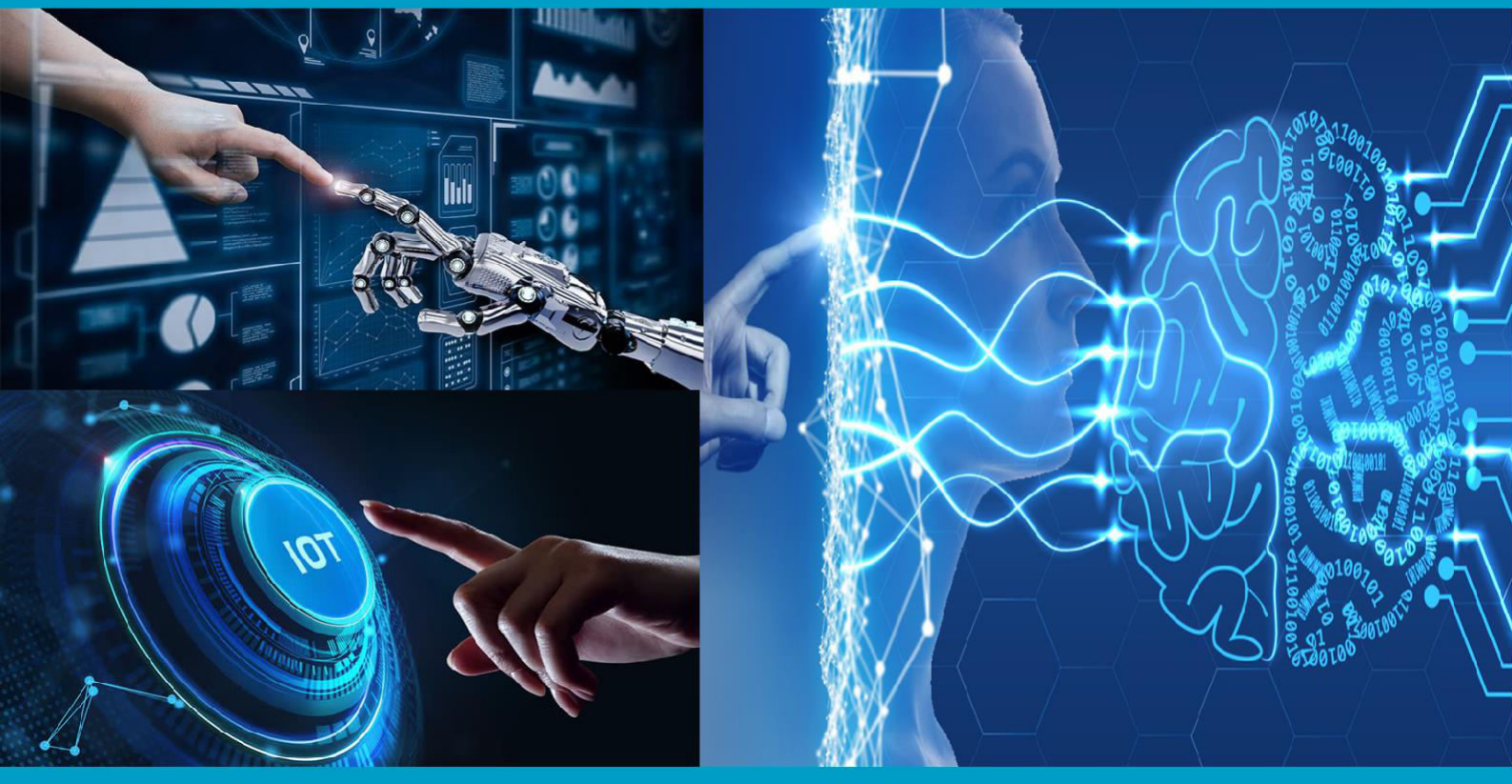

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Role of Hormonal Imbalance in Human Weight Management

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ABSTRACT: Hormones regulate your appetite in order to help your body maintain energy levels. Some hormones stimulate hunger. Others signal that you've had enough to eat, inhibiting food intake. An imbalance in hormones involved in appetite control may lead to weight gain or weight loss**.** Hormones are chemical messengers that regulate processes in our body. They are one factor in causing obesity. The hormones leptin and insulin, sex hormones and growth hormone influence our appetite, metabolism (the rate at which our body burns kilojoules for energy), and body fat distribution. People who are obese have levels of these hormones that encourage abnormal metabolism and the accumulation of body fat.
A system of glands, known as the endocrine system, secretes hormones into our bloodstream. The endocrine system works with the nervous system and the immune system to help our body cope with different events and stresses. Excesses or deficits of hormones can lead to obesity and, on the other hand, obesity can lead to changes in hormones.

KEYWORDS: hormones, imbalance, weight, management, human, immune, metabolism, accumulation

I. INTRODUCTION

The hormone leptin is produced by fat cells and is secreted into our bloodstream. Leptin reduces a person's appetite by acting on specific centres of their brain to reduce their urge to eat. It also seems to control how the body manages its store of body fat.
Because leptin is produced by fat, leptin levels tend to be higher in people who are obese than in people of normal weight. However, despite having higher levels of this appetite-reducing hormone, people who are obese aren't as sensitive to the effects of leptin and, as a result, tend not to feel full during and after a meal. Ongoing research is looking at why leptin messages aren't getting through to the brain in people who are obese. Insulin, a hormone produced by the pancreas, is important for the regulation of carbohydrates and the metabolism of fat. Insulin stimulates glucose (sugar) uptake from the blood in tissues such as muscles, the liver and fat. This is an important process to make sure that energy is available for everyday functioning and to maintain normal levels of circulating glucose.[1,2]

In a person who is obese, insulin signals are sometimes lost and tissues are no longer able to control glucose levels. This can lead to the development of type II diabetes and metabolic syndrome. Body fat distribution plays an important role in the development of obesity-related conditions such as heart disease, stroke and some forms of arthritis. Fat around our abdomen is a higher risk factor for disease than fat stored on our bottom, hips and thighs. It seems that oestrogens and androgens help to decide body fat distribution. Oestrogens are sex hormones made by the ovaries in pre-menopausal women. They are responsible for prompting ovulation every menstrual cycle.[3,4]

Men and postmenopausal women do not produce much oestrogen in their testes (testicles) or ovaries. Instead, most of their oestrogen is produced in their body fat, although at much lower amounts than what is produced in pre-menopausal ovaries. In younger men, androgens are produced at high levels in the testes. As a man gets older, these levels gradually decrease.

The changes with age in the sex hormone levels of both men and women are associated with changes in body fat distribution. While women of childbearing age tend to store fat in their lower body ('pear-shaped'), older men and postmenopausal women tend to increase storage of fat around their abdomen ('apple-shaped'). Postmenopausal women who are taking oestrogen supplements don't accumulate fat around their abdomen. Animal studies have also shown that a lack of oestrogen leads to excessive weight gain. The pituitary gland in our brain produces growth hormone, which influences a person's height and helps build bone and muscle. Growth hormone also affects metabolism (the rate at

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which we burn kilojoules for energy). Researchers have found that growth hormone levels in people who are obese are lower than in people of normal weight. Obesity is also associated with low-grade chronic inflammation within the fat tissue. Excessive fat storage leads to stress reactions within fat cells, which in turn lead to the release of pro-inflammatory factors from the fat cells themselves and immune cells within the adipose (fat) tissue. Obesity is associated with an increased risk of a number of diseases, including cardiovascular disease, stroke and several types of cancer, and with decreased longevity (shorter life span) and lower quality of life. For example, the increased production of oestrogens in the fat of older women who are obese is associated with an increase in breast cancer risk, indicating that the source of oestrogen production is important.[5,6]

People who are obese have hormone levels that encourage the accumulation of body fat. It seems that behaviours such as overeating and lack of regular exercise, over time, 'reset' the processes that regulate appetite and body fat distribution to make the person physiologically more likely to gain weight. The body is always trying to maintain balance, so it resists any short-term disruptions such as crash dieting.

Various studies have shown that a person's blood leptin level drops after a low-kilojoule diet. Lower leptin levels may increase a person's appetite and slow down their metabolism. This may help to explain why crash dieters usually regain their lost weight. It is possible that leptin therapy may one day help dieters to maintain their weight loss in the long term, but more research is needed before this becomes a reality.[7,8]

There is evidence to suggest that long-term behaviour changes, such as healthy eating and regular exercise, can re-train the body to shed excess body fat and keep it off. Studies have also shown that weight loss as a result of healthy diet and exercise or bariatric surgery leads to improved insulin resistance, decreased inflammation and beneficial modulation of obesity hormones. Weight loss is also associated with a decreased risk of developing heart disease, stroke, type II diabetes and some cancers.

II. DISCUSSION

A hormonal imbalance happens when you have too much or too little of one or more hormones. It’s a broad term that can represent many different hormone-related conditions.

Hormones are powerful signals. For many hormones, having even slightly too much or too little of them can cause major changes to your body and lead to certain conditions that require treatment.

Some hormonal imbalances can be temporary while others are chronic (long-term). In addition, some hormonal imbalances require treatment so you can stay physically healthy, while others may not impact your health but can negatively affect your quality of life.[9,10]

Dozens of medical conditions are caused by hormone issues. For most hormones, having too much or too little of them causes symptoms and issues with your health. While many of these imbalances require treatment, some can be temporary and may go away on their own. Some of the most common hormone-related conditions include:

- **Irregular menstruation (periods)**: Several hormones are involved in the menstrual cycle. Because of this, an imbalance in any one or several of those hormones can cause irregular periods. Specific hormone-related conditions that cause irregular periods include polycystic ovary syndrome (PCOS) and amenorrhea.
- **Infertility**: Hormonal imbalances are the leading cause of infertility in people assigned female at birth. Hormone-related conditions such as PCOS and anovulation can cause infertility. People assigned male at birth can also experience hormonal imbalances that affect fertility, such as low testosterone levels (hypogonadism).
- **Acne**: Acne is primarily caused by clogged pores. While many factors contribute to the development of acne, hormone fluctuations, especially during puberty, are a significant factor. Oil glands, including those in the skin on your face, get stimulated when hormones become active during puberty.
- **Hormonal acne (adult acne)**: Hormonal acne (adult acne) develops when hormonal changes increase the amount of oil your skin produces. This is especially common during pregnancy, menopause and for people who are taking testosterone therapy.

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- **Diabetes**: In the United States, the most common endocrine (hormone-related) condition is diabetes. In diabetes, your pancreas doesn't make any or enough of the hormone insulin or your body doesn't use it properly. There are several different kinds of diabetes. The most common are Type 2 diabetes, Type 1 diabetes and gestational diabetes. Diabetes requires treatment.
- **Thyroid disease**: The two main types of thyroid disease are hypothyroidism (low thyroid hormone levels) and hyperthyroidism (high thyroid hormone levels). Each condition has multiple possible causes. Thyroid disease requires treatment.
- **Obesity**: Many hormones can affect how your body signals that you need food and how your body uses energy, so an imbalance of certain hormones can result in weight gain in the form of fat storage. For example, excess cortisol (a hormone) and low thyroid hormones (hypothyroidism) can contribute to obesity.[11,12]

Because your body makes over 50 different hormones — all of which contribute to important bodily functions — you could experience several different symptoms depending on which hormonal imbalance you have.

It's important to know that many of the following symptoms could be caused by other conditions, not just from a hormonal imbalance. If you ever notice a change in your day-to-day health and are experiencing new, persistent symptoms, it's important to talk to your healthcare provider — no matter what you think the cause might be.

Common hormonal imbalances include those that affect your metabolism. Your metabolism consists of the chemical reactions in your body's cells that change the food you eat into energy. Many different hormones and processes are involved in metabolism.[13,14]

Symptoms of hormonal imbalances that affect your metabolism include:

- Slow heartbeat or rapid heartbeat (tachycardia).
- Unexplained weight gain or weight loss.
- Fatigue.
- Constipation.
- Diarrhea or more frequent bowel movements.
- Numbness and tingling in your hands.
- Higher-than-normal blood cholesterol levels.
- Depression or anxiety.
- Being unable to tolerate cold temperatures or warm temperatures.
- Dry, coarse skin and hair.
- Thin, warm and moist skin.
- Irregular body fat distribution.
- Darkened skin in your armpit or the back and sides of your neck (acanthosis nigricans).
- Skin tags (small skin growths).
- Extreme thirst and frequent urination.

People assigned female at birth (AFAB) can have imbalances of the sex hormones estrogen and progesterone, which the ovaries produce. They can also have excess testosterone and androgens. An imbalance in sex hormones can cause the following symptoms in people AFAB:

- Acne on your face, chest and/or upper back.
- Hair loss.
- Heavy periods.
- Hirsutism (excess body hair).
- Hot flashes.
- Infertility.
- Irregular periods.
- Loss of interest in sex.

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- Vaginal atrophy.
- Vaginal dryness.[15,16]

People assigned male at birth (AMAB) can have an imbalance of testosterone, which the testes produce, and other sex hormones, which can cause the following symptoms:

- Decrease or loss of body hair.
- Erectile dysfunction (ED).
- Gynecomastia (enlarged breast tissue).
- Infertility.
- Loss of interest in sex.
- Loss of muscle mass.

Certain hormone imbalances can cause weight gain, including:

- **Hypothyroidism**: This condition happens when you have low levels of thyroid hormone, which causes your metabolism to slow down. This can cause weight gain.
- **Cushing's syndrome**: This is a rare condition that happens when your body has too much of a hormone called cortisol. It results in rapid weight gain in your face (sometimes called "moon face"), belly, back of your neck (sometimes called "buffalo hump") and chest.
- **Menopause**: During menopause, many people assigned female at birth gain weight due to hormonal changes that cause their metabolism to slow down. It's important to remember that this type of "hormonal imbalance" is natural and an expected part of life.

Several other factors contribute to weight gain.[17,18]

Certain hormonal imbalances can cause anxiety, including:

- **Hyperthyroidism**: If you have hyperthyroidism, it means your body has too much thyroid hormone. Excess thyroid hormone speeds up your metabolism. This can cause anxiety, in addition to unusual nervousness, restlessness and irritability.
- **Cushing's syndrome**: While it's not as common of a symptom, Cushing's syndrome (excess cortisol) can cause anxiety, as well as depression and irritability.
- **Adult-onset growth hormone deficiency**: Adults with growth hormone deficiency often report having anxiety and/or depression.

Several other conditions and factors can cause anxiety. It's important to talk to your healthcare provider if you're experiencing anxiety.

III. RESULTS

Throughout your life — and even throughout the day — your hormone levels naturally rise and fall.

Certain periods of life cause more dramatic changes and fluctuations in hormones, including:

- Puberty.
- Pregnancy.
- Menopause.

However, there are several other reasons why your hormone levels may be irregular at unexpected times. Some of the most common causes of fluctuating or imbalanced hormone levels include:

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- Stress.
- Certain medications.
- Steroid use.

These hormonal imbalances are more likely to be temporary or fixable with a change in medication or properly managing stress.

Chronic hormone-related conditions can have several different possible causes. In general, the main conditions or situations that cause medically significant hormone imbalances include:

- Tumors, adenomas or other growths.
- Damage or injury to an endocrine gland.
- Autoimmune conditions.[19,20]

Any kind of growth on a gland or organ that produces hormones, such as a tumor, adenoma or nodule, could affect its ability to do so. Rare endocrine tumors form in glands or in cells that produce hormones and can cause hormone imbalances. Some of the rare endocrine tumors include:

- Adrenocortical carcinoma: An adrenocortical carcinoma (ACC) is a cancerous adrenal tumor that forms in the adrenal cortex. It sometimes causes excess hormone production.
- **Carcinoid tumors**: Carcinoid tumors are a type of neuroendocrine tumor (NET) that grows from neuroendocrine cells. Neuroendocrine cells receive and send messages through hormones to help your body function.
- **Medullary thyroid cancer**: Medullary thyroid cancer (MTC), is cancer that forms in the inside of your thyroid (the medulla). The medulla contains special cells called parafollicular C cells that produce and release hormones.
- **Pheochromocytoma**: A pheochromocytoma is a rare tumor that forms in the middle of one or both of your adrenal glands (adrenal medulla). The tumor is made of a certain type of cell called chromaffin cells, which produce and release certain hormones. They're usually benign but can be cancerous.
- **Paraganglioma**: A paraganglioma (also known as an extra-adrenal pheochromocytoma) is a rare neuroendocrine tumor that forms near your carotid artery, along nerve pathways in your head and neck and in other parts of your body. The tumor is made of chromaffin cells, which produce and release certain hormones.[21,22]

An adenoma is a benign (noncancerous) tumor. Many adenomas are nonfunctioning, meaning they don't produce hormones. But some can produce excess hormones. These are called functioning adenomas. Adenomas that affect your endocrine system and cause hormone imbalances include:

- Pituitary adenomas: Pituitary adenomas can cause an imbalance in any of the hormones your pituitary gland makes. For example, pituitary adenomas are the most common cause of acromegaly (excess growth hormone in adults).
- **Adrenal adenomas**: The most common cause of Cushing's syndrome (excess cortisol) is an adrenal adenoma on the adrenal cortex.
- Parathyroid adenomas: A parathyroid adenoma can cause primary hyperparathyroidism (excess parathyroid hormone).

Growths other than tumors and adenomas on endocrine glands can cause hormone imbalances. For example, thyroid nodules, an unusual growth (lump) of cells in your thyroid gland, can cause hyperthyroidism or hypothyroidism.[23,24]

Any kind of damage or injury to an endocrine gland can cause hormone imbalances — usually a lack (deficiency) of hormones. Damage could result from the following conditions or situations:

- **Accidental damage from surgery**: For example, approximately 75% of hypoparathyroidism (low parathyroid hormone) cases are from accidental damage to your parathyroid glands from neck or thyroid surgery.

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- **Excessive blood loss or lack of blood flow to an endocrine gland**: Lack of blood flow can cause tissue to die (necrosis). For example, Sheehan's syndrome, a cause of hypopituitarism, can happen when a person experiences severe blood loss after childbirth.
- **Bacterial or viral illness**: For example, hypopituitarism can be a complication of bacterial meningitis, though this is rare.
- **Radiation therapy**: Radiation therapy for cancer treatment can damage endocrine glands. For example, up to 50% of people treated for head and neck cancer with radiation therapy develop hypothyroidism.
- **Brain or head trauma (also called traumatic brain injury, or TBI)**: Situations such as a vehicle accident, a fall or contact sports can cause head trauma and brain injuries, which can cause damage to your pituitary gland or hypothalamus.

IV. CONCLUSIONS

Healthcare providers typically order blood tests to check hormone levels since your endocrine glands release hormones directly into your bloodstream.

Certain hormone levels vary drastically throughout the day, so providers may order other tests to measure your levels, such as a glucose tolerance test or insulin tolerance test.

Treatment for a hormonal imbalance will depend on what's causing it.[25,26]

If you have lower-than-normal hormone levels, the main treatment is hormone replacement therapy. Depending on which hormone is deficient, you may take oral medication (pills) or injection medication.

For example, if you have low thyroid hormone levels (hypothyroidism), your provider can prescribe synthetic thyroid hormone pills. If you have growth hormone deficiency, you'll likely have to take injections (shots) of synthetic growth hormone.

If you have higher-than-normal hormone levels, there are many treatment options depending on the cause. Options include medication, surgery, radiation therapy or a combination of any of these.

For example, if you have a prolactinoma, a benign (noncancerous) tumor that causes excess prolactin (a hormone), your provider may prescribe a medication to shrink the tumor or you may need surgery to remove it.

Many health conditions that involve hormonal imbalances, such as diabetes and thyroid disease, require medical treatment.

Many nutritional supplements in stores claim to treat different hormonal imbalances, but few of them have been scientifically proven to have a beneficial effect. It's important to always talk to your healthcare provider first about taking supplements.

Aside from medical treatment, your provider may recommend certain lifestyle changes to help manage a hormonal imbalance, such as managing your stress levels and getting routine exercise.

Primary healthcare providers can diagnose and help you manage many hormonal imbalances, but you may benefit from seeing an endocrinologist.

An endocrinologist is a healthcare provider who specializes in endocrinology, a field of medicine that studies conditions related to your hormones. They can diagnose endocrine (hormone) conditions, develop treatment and management plans and prescribe medication.

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While many hormonal imbalances aren't preventable, there are certain things you can do to optimize your overall health, which could help keep your hormones balanced, including:

- Maintaining a healthy weight.
- Eating a balanced, healthy diet.
- Exercising regularly.
- Managing your stress.
- Getting enough quality sleep.
- Managing your chronic health conditions well (if applicable).
- Quitting smoking or using tobacco products, if you smoke.[26]

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