

Impact of zinc on thyroid metabolism

Introduction

Thyroid gland is the most important endocrine gland in human body which performs various functions. Thyroid hormones such as thyroxin and triiodothyronine are essential various metabolic functions and also required for normal functions of body tissues. These thyroid hormones affect metabolic rate and consumption on oxygen.¹ The most important constituent of thyroid hormones is iodine. The geographical areas where the amount of iodine is less thyroid dysfunction and diseases are very common. Thyroid disease is the commonest endocrine disorder in the whole world. Thyroid diseases are caused due to over secretion and under secretion of thyroid hormones. These diseases are more common in females.^{2,3} Zinc is essential trace element for human body in limited amount. It is essential for normal functioning of metabolic homeostasis, immune system, cell stimulation, enzyme activity, protection against oxidative stress, and neural transmission.^{4,5} It works as co-enzyme factor for many enzymes which are involved in various metabolic processes and it is essential for sensitizing the tissues to thyroid hormone.⁶ Zinc is also involved in cell differentiation, proliferation, cell repairing and renewal. The importance of zinc in endocrine system is that it effect on growth, endocrine homeostasis, and thyroid function and on glucose metabolism.⁷ Deficiency of zinc in the body may result in decreased levels of secretion of thyroid hormones which affects the normal metabolism of the body and resting metabolic rate. Some of the studies shown that deficiency of zinc is associated with enhanced the expression of hepatic thyroxine-5'-monodeiodinase enzyme activity which catalyses the thyroid hormone inactivation.^{8,9}

Hypothyroidism and zinc

Zinc is essential trace element for normal levels of thyroid hormones such as triiodothyronine (T3), tetraiodothyronine (T4), and thyroid stimulating hormone (TSH) (Table 1). Some of the studies showed that zinc deficiency leads decrease in T3 level. The well known effect of zinc on some endocrine glands such as pituitary- a master gland and on hypothalamus is that it appears a role in the synthesis of releasing hormone such as thyrotrophic releasing hormone (TRH). Some of the studies showed that in hypothyroidism alteration in zinc level. Patients with thyroid cancer have significantly low level s of zinc.¹⁰⁻¹² In Hypothyroidism metabolic rate gets reduce which results in adverse effect on organ system (Table 2).¹³ Hypothyroidism can lead to number of complications in humans such as:

- Mental health issues such as depression and also cause the slow functioning of brain.
- Heart problems because of increase in the level of Low density lipoprotein (LDL) cholesterol. Sometimes it causes heart failure and enlarges heart.
- In hypothyroidism the low levels of thyroid hormone can alter the process of ovulation which leads to infertility in women.

Hyperthyroidism and zinc

Consumption of high amount of zinc can contribute to

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hyperthyroidism or Graves' disease because zinc acts as a stimulator to the thyroid gland. Patients suffering from hyperthyroidism have higher amount of urinary excretion of zinc.¹⁴ Over activity of thyroid gland or some other causes leads to hyperthyroidism (Table 3). When tissues are exposed to higher concentrations of thyroid hormones then some physiological, clinical and biochemical alterations occur in the body (Table 4). Many studies shown that hyperthyroidism affects many organ systems.¹⁵ Some of the researchers reported that zinc is a fundamental component of enzymatic antioxidant system with several antioxidant properties. Zinc is required in the body for optimal activity of many hormones like thyroid hormone.^{16,17}

Table 1 Causes of Hypothyroidism

Autoimmune disease	Radiation Therapy
Thyroid surgery	Treatment for hyperthyroidism
Medications	Pregnancy
Iodine deficiency	Pituitary disorder
Congenital disorder	

Table 2 Symptoms of Hypothyroidism

Elevated blood cholesterol level	Muscle weakness, Muscle aches and stiffness
Slowed heart rate	Depression
Excessive sleepiness	Constipation
Irregular menstrual periods	Weight gain
Thinning of hair	Dry skin and puffy face

Table 3 Causes of Hyperthyroidism

Excessive intake of iodine	Hyperfunctioning of thyroid nodules
Thyroid cancer	Alteration in the secretion of TSH
Inflammation in the thyroid gland	Grave's disease
Postpartum thyroiditis	Toxic thyroid adenoma

Table 4 Symptoms of Hyperthyroidism

Fast and Irregular heartbeat	Vomiting , Nausea
Difficulty in sleeping	Weight loss
Increased appetite	Dizziness and shortness of breath
Brittle hair and hair loss	Development of breast in men
Congestive heart failure	Protruding eyes
Fertility problems	Paralysis
Increased sweating	Light menstrual periods

Acknowledgment

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Conflict of interest

None.

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