

# THE IMPACT OF DIET AND ENVIRONMENTAL FACTORS ON HASHIMOTO'S THYROIDITIS

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## ABSTRACT

Hashimoto's Thyroiditis, also known as Hashimoto's Disease, is an autoimmune disease that causes the thyroid gland to be underactive. An underactive thyroid gland leads to hypothyroidism, in which antibodies made by the immune system attack the thyroid gland, leading to an accumulation of white blood cells and damage to the gland. This means that a lower number of thyroid hormones are produced. Typically the most common cause of hypothyroidism, Hashimoto's Thyroiditis is estimated to have an incidence rate of 0.8/1000 per year for men and 3.5/1000 per year for women (Mincer and Jialal). Although there are some therapies to manage the disease like thyroid hormone replacement and levothyroxine, there is no permanent cure as the medication would have to be continued for life (Wartofsky). The development of Hashimoto's Disease can be linked to family history/genes and viral infections such as Hepatitis C. Environmental and lifestyle factors like exercise, chemicals, and drugs can also be connected to the progression of Hashimoto's Thyroiditis. Additionally, there is evidence to support the idea that dietary components, like sugars and gluten, also play a role in the symptoms and development of Hashimoto's Disease. This paper explores the impact of dietary components and environmental influences, like viral infections, on Hashimoto's Thyroiditis.

## I. INTRODUCTION

Autoimmune diseases occur when the immune system attacks healthy tissues and cells rather than harmful antigens, as the body is not able to distinguish between healthy and harmful. Though the specific reason for autoimmune disease development has not yet been pinpointed, there may be some connection between the development and prevalence of autoimmune diseases and factors like diet, chemicals, drugs, genetics, stress, and viral infections (Campbell). There are many different autoimmune diseases and each one has a different incidence rate that is impacted by these factors.

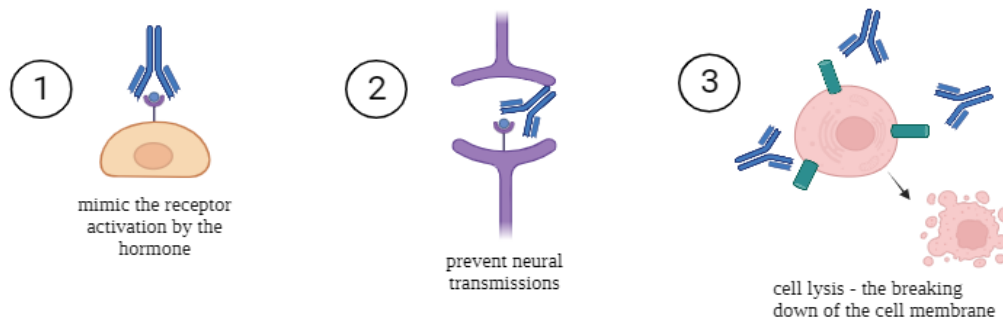
Autoimmune diseases can affect any organ or part of the body, including tissues, blood vessels, joints, muscles, skin, and endocrine glands (Medline Plus). For example, the thyroid gland can be targeted, resulting in diseases such as Hashimoto's Disease, also known as Hashimoto's Thyroiditis. Hashimoto's Disease is an autoimmune disorder that impacts the production of thyroid hormones, resulting in hypothyroidism. Hypothyroidism, a condition in which the number of thyroid hormones produced is limited due to an underactive thyroid gland, can cause symptoms such as a puffy face, slow heart rate, cold sensitivity, high cholesterol, and muscle weakness (Miller). In a healthy body, thyroid hormones play a huge role in the regulation of energy, so when the number of hormones is limited, symptoms are felt throughout the body (Mayo Clinic). Though it is unclear what specifically causes Hashimoto's, research suggests that there is a link between Hashimoto's Disease and dietary components and environmental factors like viral infections (Campbell).

## II. HASHIMOTO'S DISEASE: BACKGROUND

Hashimoto's Thyroiditis is an autoimmune disease that causes hypothyroidism, in which the underactive thyroid gland does not make enough thyroid hormones. In rare cases, it can also lead to hyperthyroidism, which is an overactive thyroid. In Hashimoto's Disease, the body's antibodies—proteins designed to remove foreign substances, or antigens, from the body—attack

the thyroid gland itself, which causes a significant accumulation of white blood cells and damage to the gland (Cleveland Clinic). As a result of the damage and stress, the thyroid gland becomes underactive and does not produce an optimum amount of thyroid hormones.

Antibodies play a significant role in cells and autoimmune diseases. They are present in healthy people as well, but in rare cases, they can lead to the development of autoimmune diseases. Antibodies present in autoimmune diseases, also known as autoantibodies, can have various different effects on the cell, as seen in Figure 1. They can induce cell lysis, which is when the cell membrane breaks down. Antibodies can also prevent neural transmissions between neurons, which could be the root of certain neurological autoimmune diseases. In addition to this, antibodies can mimic receptor activation by the hormone, which can lead to hyperthyroidism (Ludwig et al.). Though the specific cause of Hashimoto's Thyroiditis has not yet been confirmed, it is clear that antibodies play a major role in the development of the disease.

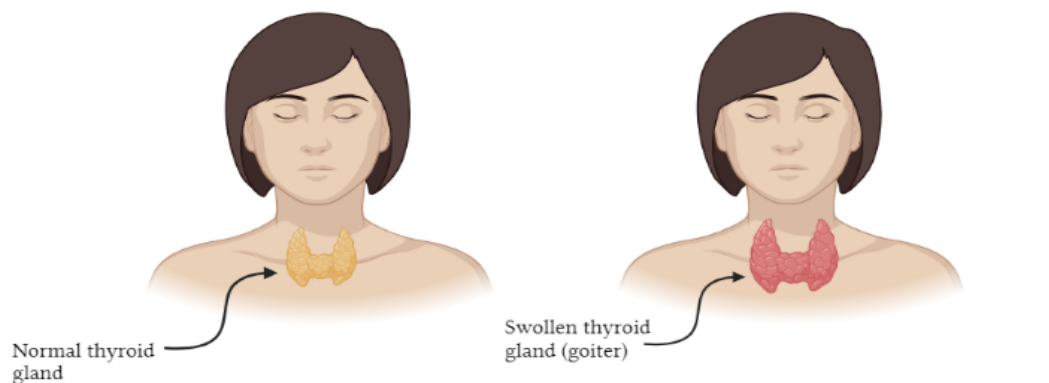


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**Figure 1: The image on the left depicts the antibody (blue) mimicking the receptor on a cell to induce or stimulate hormones in some diseases. The center image depicts the antibody (blue) blocking neural transmission between two neurons. The image on the right depicts antibodies (blue) attacking the cell, resulting in cell lysis. This means that the cell membrane is destroyed, which releases contents like DNA and proteins from the cell.**

Although Hashimoto's Disease targets the thyroid gland, almost all other parts of the body are affected in some way since thyroid hormones play a significant role in how the body regulates and uses energy throughout the body. Because of this, when there is a decreased number of thyroid hormones, symptoms are felt throughout the body. Common symptoms of autoimmune thyroiditis include fatigue, sensitivity to temperatures (especially cold), joint and muscle pain, dry skin, weight gain, and thinning hair (Wartofsky). In addition to this, the thyroid gland itself may enlarge, also known as goiter, giving the appearance of swelling in the front of

the neck and a feeling of fullness in the throat as shown in Figure 2 (Wartofsky). Hypothyroidism can also impact the heart, resulting in irregular heartbeats and an enlarged heart. Additionally, fertility issues might occur, including a higher risk of miscarriage and preterm birth. Prolonged untreated hypothyroidism can lead to a life-threatening condition known as myxedema, which results in drowsiness and eventually lethargy and unconsciousness (Mayo Clinic).



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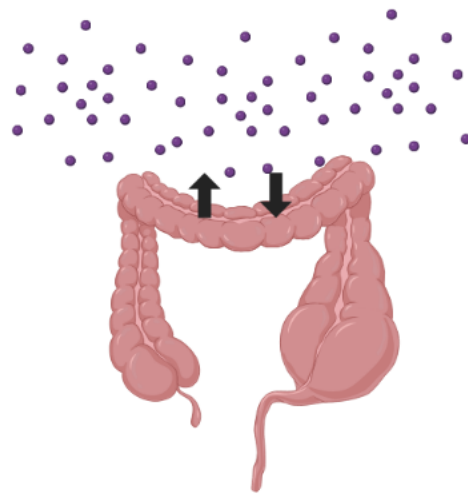
**Figure 2: The image on the left depicts a normal thyroid gland with proper function. The image on the right depicts an enlarged thyroid gland (goiter) typically seen in autoimmune thyroiditis.**

Hashimoto's Disease is more common in women than men and is typically seen in those between the ages of 30 and 50 years old (Wartofsky). Although the reason why some people get the disease is unknown, it can be noted that those with a family history of autoimmune thyroiditis are more prone to developing Hashimoto's (Wartofsky). Although heredity is linked to the incidence of the disease, a specific gene has not yet been identified ("Hashimoto's Thyroiditis"). There is no definite cure for the disease, but there are specific therapies and treatments that can be utilized to minimize symptoms and improve the function of the thyroid. One such medication is levothyroxine sodium. Levothyroxine functions as a natural thyroid hormone, so it acts as compensation for the underactive gland caused by the disease (Wartofsky).

### III. DIET

One's diet and gut microbiota greatly impact an individual's health and overall way of living. Evidence suggests that an imbalance in gut microbiota can be linked to the development of diseases since they produce abundant amounts of bioactive compounds that impact an

individual's health (Conlon and Bird). The incidence of autoimmune disease is increasing in Westernized societies, which suggests that there is an environmental factor such as diet triggering the growth. Western diets typically contain food high in salt, sugars, trans fatty acids, proteins, and cholesterol. These diets are made up of high quantities of fast foods and processed foods. Many of the Western diet staple foods contain additives used to maintain the texture, taste, quality, and looks of certain foods ("Food Additives"). These additives could increase intestinal permeability through the leaky gut junction. When this happens, toxins, food, bacteria, and antigens can easily pass through the intestines [Figure 3] (Mazzucca et al.).



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**Figure 3: Eating a large number of foods that are high in fatty acids, proteins, cholesterol, and sugars has been thought to increase intestinal permeability, leading to leaky gut syndrome. This could possibly lead to the passage of toxins and antigens into the intestines.**

It is plausible that bacteria possibly containing immunogenic antigens could pass through the intestines as a result of increased permeability of the leaky tight junction, leading to the development of autoimmune disease in the body. A diet lacking in fiber from fruits, vegetables, legumes, and whole grains, like the Western diet and fast foods, could contribute to leaky gut syndrome as it increases the chance of the passage of toxins and bacteria. To prevent this, a high intake of such fibers found in fruits, vegetables, and legumes is essential to support healthy microbiota and proper gut and intestine function (Mazzucca et al.).

A study conducted with a population of 65,981 people "found an association of the vegan diet with a lower risk of self-reported hypothyroidism. Another recent study showed that higher animal fat and butter intake are associated with the risk of positivity to TPOAb and/or TgAb antibodies using 1,887 participants, whereas diet rich in vegetables, dried fruit, nuts and muesli consumption decreased that risk" (Kaličanin et al.); The TPOAb and TgAb antibodies, when found in high quantities, are what are used to diagnose an individual with Hashimoto's

Thyroiditis and hypothyroidism (“Thyroid Antibodies: MedlinePlus Lab Test Information”). A diet that consists mainly of fast foods and a limited amount of fresh produce with high fiber content puts individuals at a greater risk of developing autoimmunity. As seen in a study conducted with 200 people, 81 of whom were diagnosed with Hashimoto’s and the remaining were not, those who regularly consumed animal products like red meat, fish, and dairy, had Hashimoto’s Thyroiditis. The control subjects in the study, those who did not have Hashimoto’s, reported an increased intake of plant-based foods like legumes, fruits, and vegetables, in their regular diet. These findings suggest that increased consumption of animal products is positively correlated to the incidence of autoimmunity and hypothyroidism (Ruggeri).

Not only are foods a critical factor in the incidence of Hashimoto’s Thyroiditis, but vitamins and minerals such as iodine, selenium, and vitamin D are also associated with the disease. The thyroid gland normally functions by absorbing iodine in order to synthesize and produce thyroid hormones. Iodine is a factor that plays a major role in the incidence of Hashimoto’s Disease as moderate to high levels of iodine facilitate the polarization of T cells to Th17 cells. On the other hand, extreme levels of iodine can inhibit the development of regulatory T cells, which help prevent autoimmunity (Li et al.). Because of this, having a high concentration of iodine, typically a median urinary iodine concentration of greater than 300 micrograms, is known to increase the incidence of Hashimoto’s Thyroiditis (Kaličanin et al.). Therefore, it is essential to maintain the median urinary iodine concentration to between 100 and 200 micrograms in order to ensure proper iodine intake and function (Delange et al.). People with Hashimoto’s Disease may have a swollen thyroid gland, or goiter, and since iodine is processed by this gland, an inflamed gland will likely get worse as it processes the iodine (Wentz). In order to manage the symptoms of Hashimoto’s and goiter, it is crucial to be aware of iodine intake in order to lessen the stress on the thyroid gland.

In addition to iodine, selenium is another component associated with the incidence of Hashimoto’s Disease. If selenium intake is less than 40 micrograms a day, there is an increased risk of developing Hashimoto’s Thyroiditis (Kaličanin et al.). In a normally functioning gland, selenium is used for its antioxidant function and metabolism of thyroid hormones. When levels of selenium decrease, the function of selenoproteins also decreases, meaning the synthesis of thyroid hormones is limited (Ventura et al.). Selenoproteins are a major factor in the production of growth factors and hormones, specifically thyroid hormones (Bellinger et al.). If these proteins do not work properly due to a deficiency in selenium, it could result in hypothyroidism and/or Hashimoto’s Disease due to the decrease in thyroid hormone production. A normal range of selenium in adults is anywhere between 120-160 micrograms, whereas an adult with selenium deficiency would be in the range of 80-120 micrograms, or even lower (Wimmer et al.).

The thyroid gland is known for being the organ with the highest amount of selenium per gram of tissue in adults, so when these levels decrease, the body is greatly impacted by the deficiency. Levels of selenium in individuals vary from person to person depending on the characteristics and nature of the geography, soil composition, diet, and population (Ventura et al.). Therefore, maintaining healthy levels of selenium is essential to preventing thyroid diseases such as hypothyroidism and Hashimoto’s Thyroiditis. This can be done through selenium supplements, which can be found in foods like Brazil nuts, eggs, seafood, mushrooms, and cereals (Mikulska et al.).

Vitamin D deficiency is also associated with Hashimoto’s Thyroiditis. When vitamin D levels reach below 30 nanograms/milliliter (ng/mL), there is an increased risk of developing Hashimoto’s Disease (Kaličanin et al.). Normally, vitamin D levels should be above 20 ng/mL in

order to ensure proper and healthy function of the body. Levels above 50 ng/mL are considered too much and could potentially cause health problems. Extremely high levels of vitamin D, typically above 150 ng/mL, can lead to symptoms of nausea, vomiting, dehydration, pain, and loss of appetite (“Office of Dietary Supplements - Vitamin D”). A study conducted with Hashimoto’s Disease patients found that they had lower vitamin D levels as compared to someone without the disease. Vitamin D is not only associated with Hashimoto’s, but also with other autoimmune diseases like rheumatoid arthritis, multiple sclerosis, inflammatory bowel disease, and type 1 diabetes (Mackawy et al.). In order to prevent the possibility of acquiring such diseases, it is important to maintain healthy levels of all vitamins and minerals in the body through regular monitoring and intake of supplements.

#### **IV. ENVIRONMENTAL FACTORS**

In addition to diet, vitamins, and minerals, another factor that plays a role in the incidence of Hashimoto’s Thyroiditis is viral infections. Viral infections trigger strong immune responses, and rarely, a lack of control of the immune response could result in adverse reactions, targeting the antigens on the host itself (Sundaresan et al.). This is the basis for autoimmune disease since the body attacks itself. Hepatitis C is one such virus as it is associated with numerous different immune and autoimmune diseases such as rheumatoid arthritis and thyroid disease (McMurray and Elbourne). Although there is no direct evidence and correlation between hepatitis C and Hashimoto’s Disease, there are some connections made to the virus and thyroid cells and diseases in general.

Hepatitis C virus (HCV) may interfere “with the functions and mechanisms of self-recognition both on the immune system and thyroid cells, where HCV may directly destroy thyroid tissue or mimic the structure of some components of the thyroid gland, starting the autoimmune disease” (Pastore et al.). When the virus mimics the structure and components of the thyroid gland, it could be one reason for the body to attack itself; it can not differentiate between what it is supposed to attack, in this case, the virus, and what it is not supposed to attack. This kind of self-destruction of the thyroid gland is one plausible trigger for the development of autoimmune thyroid disease. It can also be noted that autoimmune thyroid diseases are common in patients previously diagnosed with hepatitis C (Pastore et al.). Patients with chronic hepatitis C are more likely to get hypothyroidism and have positive antithyroid antibodies when compared to anyone else, such as a person with hepatitis B (Morohoshi et al.). In additional research, “subsets of autoimmune hepatitis patients are infected with HCV and evidence suggests that the HCV is a causative agent of antithyroid antibodies and autoimmune thyroid disease.” Despite this connection between the virus and Hashimoto’s, a cause-and-effect relationship has not yet been identified (McMurray and Elbourne).

#### **V. CONCLUSION**

The incidence of Hashimoto’s Thyroiditis can be influenced by various factors such as diet, vitamins, minerals, and viral infections. To ensure the best possible chance of preventing Hashimoto’s and/or alleviating symptoms, it is essential to maintain a healthy diet and balanced nutrition. Avoiding fast foods with additives and instead implementing regular fruits, vegetables, nuts, and produce high in fiber content will help support gut health, which in turn, reduces the possibility of developing autoimmune diseases such as Hashimoto’s Thyroiditis (Mazzucca et al.). In addition to food intake and diet regulation, frequently monitoring levels of vitamins and minerals in the body is essential to keeping the body healthy and less prone to disease. Making

sure the median urinary iodine concentration, selenium, and vitamin D amounts are all within normal limits can help prevent the development of Hashimoto's Disease. If iodine concentrations exceed normal limits, there is an increased risk of Hashimoto's (Kaličanin et al.). Low vitamin D levels have also been connected to Hashimoto's Thyroiditis patients, suggesting that this vitamin plays an important role in the development of the disease (Mackawy et al.). There is also a connection between viral infections such as hepatitis C and Hashimoto's since people with a history of this infection are more likely to develop hypothyroidism (Pastore et al.). Despite identifying this connection, a clear cause-and-effect relationship has not yet been determined between the two factors. Further research is required to determine the exact cause of Hashimoto's Thyroiditis and develop the information already known about diet and environmental factors.

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