General population attitudes and knowledge of Hashimoto’s disease

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GENERAL POPULATION ATTITUDES AND KNOWLEDGE OF HASHIMOTO'S DISEASE

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Table of Contents

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I am deeply thankful to my family, especially my parents, for all of their support, unconditional love and constant encouragement during these challeging yet rewarding years.

I would also like to express my gratitude to the friends I have made along the way, who have enriched my experience and become cherished members of my extended family.

LIST OF ABBREVIATIONS

T4 - thyroxine

T3 - triidothyronine

HLAs - Human leukocyte antigens

TSH - Thyroid stimulating hormone

TPOAb - thyroid peroxidase antibodies

GFD - gluten-free diet

TgAb - thyroglobulin antibodies

1. INTRODUCTION

1.1. Thyroid health

1.1.1. Hypothyroidism

Hypothyroidism develops when insufficient thyroid hormones are secreted for the body's daily requirements and it currently affects around 5% of the general population (1,2). Interestingly, deficiency of iodine has been recognized as the most common source of all thyroid disorders. However, in patients with iodine sufficiency, Hashimoto's disease is the commonest source of thyroid dysfunction. The thyroid has many roles such as secreting thyroid hormones, thyroxine (T4) and triiodothyronine (T3). The body is dependent on the release of T3, which therefore increases the metabolic rate and protein synthesis in many different organs and in tissues. Hashimoto's disease is recognized as an autoimmune disease, caused by antibody-mediated immune processes which attack and destroy the thyroid cells, leading to fibrosis of the thyroid gland (3).

1.1.2. Etiology and risk factors

Hashimoto's is a multifactorial disease, which signifies that it includes both genetic and environmental factors. Environmental triggers may include nutrient imbalances, heavy metal exposure, toxins and certain medications (4,5). Excessive iodine intake provokes thyroid autoimmunity; this can be seen in areas with increased dietary iodine. Some drugs are also known to provoke or exacerbate autoimmunity in the thyroid gland. Such as Interferon α, which is commonly used in the treatment of chronic hepatitis. The Hepatitis C infection itself can also trigger autoimmunity that can put patients at risk of hypothyroidism (6). Also, the major histocompatibility complex on chromosome region 6p21 encodes the Human leukocyte antigens (HLAs). The HLA is composed of different immune response genes and is a highly polymorphic region. Several of these susceptibility genes are associated with Hashimoto's thyroiditis, such as; HLA-DR3, HLA- DR5 and HLA-DQ7. Another major immune-regulatory gene associated with HT is found on chromosome 2q33 (7).

Women are often more affected with hypothyroidism than males, with a female-to-male ratio of 10:1 (4). It has also been found to be more common in patients already presenting with an autoimmune disease, such as type 1 diabetes, autoimmune gastric atrophy, coeliac disease, and multiple autoimmune endocrinopathies. Patients with Down's syndrome or Turner's syndrome also have an increased risk of hypothyroidism. However, it has been observed that tobacco smoking and moderate alcohol intake are associated with a reduced risk of

hypothyroidism (8–11). The Figure 1 summarizes a few of the different triggers described above and how they lead to thyroid autoimmunity (6).

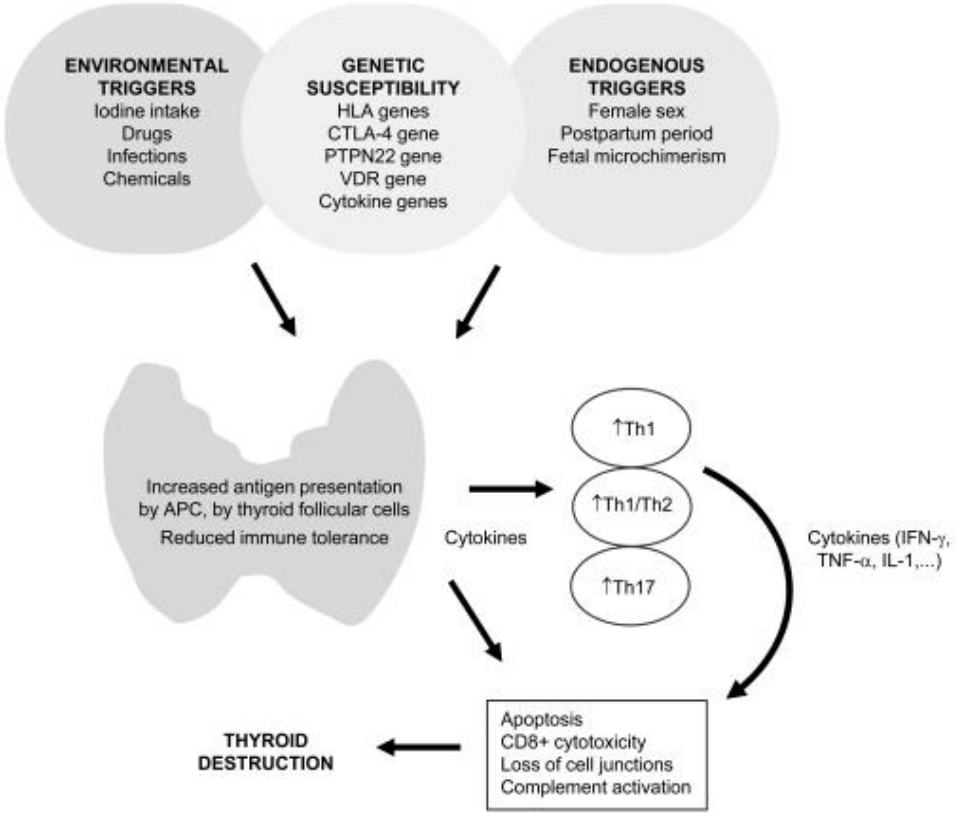

Figure 1. An overview of thyroid autoimmunity mechanisms. Source: Mincer DL, Jialal I. Hashimoto Thyroiditis. Nutrients. 2010;25:10-9.

1.1.3. Clinical presentation

The manifestations of Hashimoto's disease, like many chronic conditions, often present initially with nonspecific symptoms. These can vary from psychological symptoms including mood fluctuations, depression, difficulty concentrating, and cognitive fog to physiological changes such as dry skin, hair loss, persistent fatigue even following adequate rest, fluctuations in body weight, and disruptions in bowel habits (12). However, symptoms can vary widely depending on age, sex, and the time elapsed before diagnosis. Older adults tend to exhibit fewer and less specific signs than younger individuals, making diagnosis challenging. Although an increase in symptom severity, especially a change in seven or more symptoms over the past year, significantly raises the likelihood of hypothyroidism, no single symptom reliably identifies the conditionClick or tap here to enter text.. The most severe symptom is myxedema

coma. This condition was first identified in the 1900s and occurred as a result of prolonged untreated severe hypothyroidism. Today it is considered rare, but still noteworthy due to its devastating course with a mortality rate of 40% despite treatment. Myxedema coma can cause progressive lethargy, hypothermia, bradycardia, altered mental status, multiple organ dysfunction syndrome and eventually death (13,14).

Severe primary hypothyroidism, although very rare, may result in pituitary hyperplasia, potentially accompanied by secondary adrenal insufficiency and related symptoms such as amenorrhea (15). Hypothyroidism impacts almost all major organs, particularly the cardiovascular system being affected. It can cause increased vascular resistance, reduced cardiac output, decreased left ventricular function and alterations in cardiovascular contractility markers. Compared to euthyroid individuals, hypothyroid patients are more prone to myocardial injuries and pericardial effusions. Additionally, these patients often exhibit higher rates of cardiovascular risk factors and metabolic syndrome features, such as hypertension, increased waist circumference, and dyslipidemia. Elevated levels of total cholesterol, low-density lipoprotein, and homocysteine are also associated with hypothyroidism (1). Other symptoms include neurosensory, musculoskeletal, and gastrointestinal issues. The broad effects of thyroid hormone deficiency mean that hypothyroidism can exacerbate other conditions, such as increasing the prevalence of statin intolerance compared to those without hypothyroidism (16).

1.1.4. Diagnosis

Primary hypothyroidism is defined by elevated thyroid stimulating hormone (TSH) levels above the reference range (commonly 0.4-4.0 mlU/L) and reduced free thyroxine levels. TSH levels fluctuate throughout the day, peaking in the evening, and severe hypothyroidism disrupts this regularity. Seasonal variations are also observed, with TSH levels being higher in winter and spring than in autumn and summer. Although not required for diagnosis, measuring thyroid peroxidase antibodies can confirm autoimmune primary hypothyroidism (17,18). On thyroid sonography, hypothyroidism shows a hypoechogenic pattern, with a micronodular gland and lobulated contours, which can be visualized in Figure 2 (19).

Figure 2. Ultrasound of a patient with Hashimoto's thyroiditis. Source: Yuen HY, Wong KT, Ahuja AT. Sonography of diffuse thyroid disease. Australas J Ultrasound Med. 2016;19(1):13–29.

1.1.5. Treatment

Initiating treatment for hypothyroidism typically hinges on the manifestation of clinical symptoms alongside biochemical confirmation of the condition's severity. Levothyroxine stands as the foremost therapeutic option. The recommended starting dose for overt hypothyroidism ranges from 1.5 to 1.8 micrograms per kilogram of body weight. Following treatment initiation, TSH levels are reassessed after 4 to 12 weeks initially, then semiannually, and eventually annually upon stabilization (20). Dose adjustments informed by laboratory findings, should acknowledge the potential for pronounced TSH fluctuations in specific patient groups, such as those with lower body weight or advanced age (21).

The primary objectives of treatment encompass the normalization of TSH levels and the alleviation of physical and psychological symptoms, all while steering clear of both under- and-overtreatment. Nonetheless, a substantial proportion of patients prescribed levothyroxine (estimated between 35% to 60%), fail the achieve the desired TSH range, indicating either excessive or insufficient treatment. Overmedication, leading to either subclinical or overt hyperthyroidism, can precipitate adverse health outcomes like atrial fibrillation and osteoporosis, notably among elderly and postmenopausal women. Conversely, under treatment,

characterized by persistent thyroid hormone deficiency, heightens the risk of cardiovascular aliments and lingering symptoms (22).

1.2. Mood disorders in autoimmune thyroiditis

Mental health, often underestimated in this context, emerges as a substantial factor in Hashimoto's disease development. Chronic stress profoundly impacts bodily physiology, with mental well-being intricately linked to physical condition, as evidenced by various biological markers. Chronic stress is known to influence immune system functionally; however, unlike in Grave's disease, research on its specific impact in Hashimoto's disease remains lacking (22,23). Depression, ranging from mild to severe manifestations, emerges as a prevalent phenomenon within the realm of euthyroid chronic autoimmune hypothyroidism. Moreover, a noteworthy observation is the frequent comorbidity of depressive and anxious states, which tends to manifest concurrently in patients with Hashimoto's disease during the euthyroid phase, accounting for over 90% of cases of autoimmune hypothyroidism. This intricate interplay of mood disturbances underscores the multifaceted nature of autoimmune thyroid disorders, shedding light on the delicate relationship between thyroid function and mental health (24).

Clinical and epidemiological investigations indicate that there may be a correlation between elevated levels of thyroid autoantibodies and the heightened prevalence of mood disorders observed in thyroid-related conditions. Results from a case control study showed that individuals diagnosed with Hashimoto's disease exhibited notably elevated rates of lifetime anxiety disorders (25).

There remains a substantial gap in knowledge regarding whether the observed links between minor or overt thyroid irregularities and psychiatric conditions are directly influenced by thyroid hormone or not. This knowledge gap holds significant clinical relevance, as grasping the complicated relationship among thyroid status, autoimmunity, and psychiatric disorders is imperative in clinical practice (27). Alongside the direct genetic associations between thyroid function and psychiatric disorders, several studies have hinted at the pivotal role of genetic factors in numerous other autoimmune diseases and psychiatric conditions (26–28).

1.3. Nutrition recommendations in thyroid health

With the introduction of many trendy new diets that have become popular over the 21st century, the gluten-free diet (GFD) is among the most fashionable (5,29). One study was conducted to search the PubMed database to find accurate information on the relationship

between a GFD and many autoimmune diseases. In their search, no foundation to establish a gluten-free diet was discovered. However, the most approved diet is an anti-inflammatory diet rich in fruit and vegetable (vitamins and minerals) and low in animal sourced foods (5,29).

The association of gluten with Hashimoto's disease arises from association between gliadin and the thyroid antigens. Gluten removal is often recommended for patients with lymphocytic thyroiditis due to its link with other autoimmune diseases such as celiac disease and non-celiac gluten intolerance. Celiac disease is found more frequently among Hashimoto's patients. Hence, suspected cases of celiac disease should undergo diagnostic testing before adopting a gluten-free diet to avoid false results. Implicit forms of celiac disease should also be considered to address potential nutritional deficiencies and medication absorption issues. Additionally, individuals with celiac disease should be screened for Hashimoto's thyroiditis due to potential immune system cross-reactions (30,31).

Molecular mimicry can lead to immune system cross-reactivity, where antibodies against food antigens resemble body tissues, potentially exacerbating or initiating the disease. However, GFD is highly restrictive and challenging to maintain, potentially leading to nutritional deficiencies. While some evidence supports the use of a GFD in select patients, current research doesn't universally recommend its adoption for all Hashimoto's disease patients due to the associated challenges and inconclusive findings (22,29).

Support from a dietitian is essential when implementing a gluten-free diet to prevent nutritional deficiencies in iron, calcium, zinc, manganese, selenium, vitamin D, B12, folate and magnesium. Deficiencies in these minerals are common in the general population and crucial for immune system and thyroid function (29). In Figure 3, we can observe that even after applying the GFD, nutritional deficiencies are bound to occur, which can therefore lead to an increased risk of exacerbation of Hashimoto's disease (32).

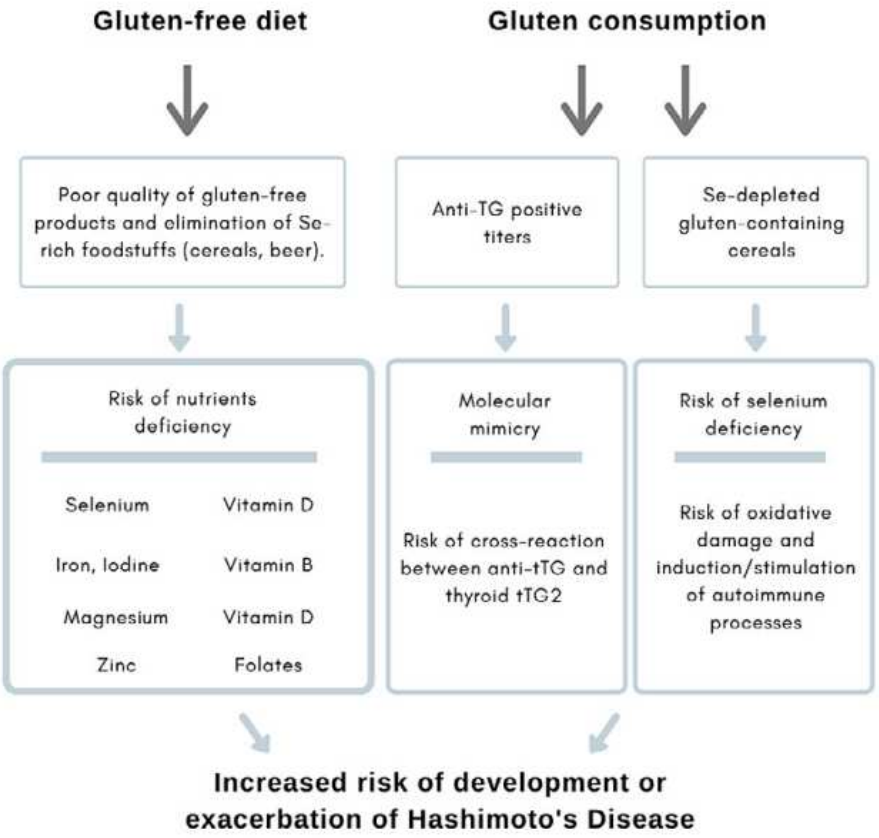

Figure 3. Relationship between Hashimoto's disease on a gluten-free diet or gluten consumption. Source: Ihnatowicz P, Drywień M, Wątor P, Wojsiat J. The importance of nutritional factors and dietary management of Hashimoto's thyroiditis. Ann Agric Environ Med. 2020;27(2):184-93.

Current understanding suggests that dietary habits can influence the risk of various inflammatory and immune conditions, including autoimmune diseases. However, there's a notable lack of comprehensive research specifically addressing the role of diet in Hashimoto's thyroiditis. While a few studies have explored the relationship between dietary habits and the prevalence of Hashimoto's, recent findings indicate a potential link between animal fat consumption and elevated levels of thyroid peroxidase antibodies (TPOAb) and/ or thyroglobulin antibodies (TgAb). Animal fats, rich in saturated fatty acids, may trigger inflammatory responses, impacting the expression of pro-inflammatory factors, contributing to the development and progression of chronic diseases. In rat models, high-fat diets have been shown to increase TSH levels and disrupt thyroid function, suggesting a possible association between excessive animal fat consumption and hypothyroidism. This suggests that an anti-inflammatory diet, may help reduce antibody levels in these patients (5).

Nutritional interventions in Hastimoto's thyroiditis typically involve dietary restrictions, such as lactose elimination, which has been linked to decreased TSH levels and exacerbated symptoms. Lactose intolerance affects approximately 75.9% of patients with Hashimoto's thyroiditis. This dietary adjustment becomes especially crucial for individuals taking levothyroxine, as lactose intolerance reduces the drug's bioavailability, necessitating higher doses. Therefore, patients on levothyroxine therapy or those with elevated TSH levels should undergo lactose tolerance testing and eliminate lactose if necessary (33).

It is essential to ensure a sufficiently high protein intake that meets daily requirements, especially in the presence of disease. For individuals with Hashimoto's disease, augmenting whole meal protein consumption through unprocessed sources such as meat, sea fish (particularly fatty fish), and eggs may aid in managing excess body weight (22).

Protein malnutrition, when concurrent with inadequate energy intake, exacerbates iodine deficiency in malnourished children, patients with Hashimoto's disease experiencing caloric-protein malnutrition may exhibit elevated levels of TSH more frequently than well-nourished individuals. This occurrence stems from the body's natural adaptive response to protein and energy deficiencies (34,35)

Oxidative stress arises primarily from free radicals, whose levels escalate as a result of various factors such as smoking, alcohol consumption, ionizing radiation, and heavy metal accumulation, including iron, copper, and zinc. Contaminants in food, particularly processed varieties rich in glycation end products, also contribute to oxidative stress. Moreover, postprandial fluctuations in blood glucose and lipids, as well as pathological conditions like obesity, exacerbate this stress (36,37). Oxidative stress triggers the release of inflammatory cytokines, amplifying cellular damage and potentially leading to programmed cell death (apoptosis). Glutathione, a vital antioxidant molecule, is notably reduced in patients with Hasimoto's disease. Glutathione supplementations emerges as a potential therapeutic avenue for reducing thyroid antibodies and mitigating the autoimmune response (38,39). Dietary interventions also show promise in modulating oxidative damage, with increased consumption of fruits and vegetables associated with reduced blood oxy lipid levels and decreased body mass index (22).

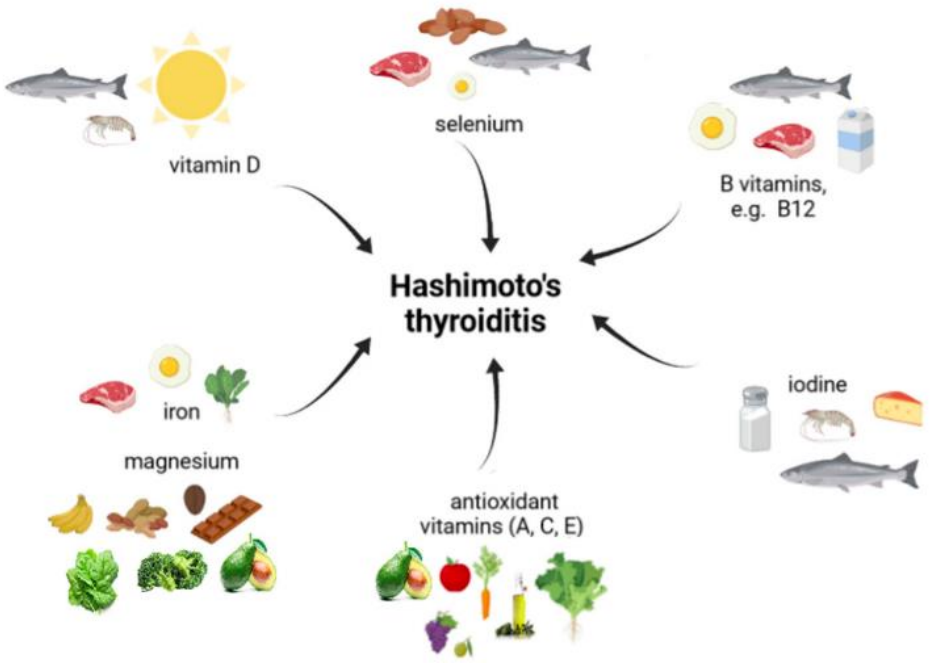

Figure 4. Nutritional microelements in HT. Source: Mikulska AA, Karaźniewicz-łada M, Filipowicz D, Ruchała M, Główka FK. Metabolic Characteristics of Hashimoto's Thyroiditis Patients and the Role of Microelements and Diet in the Disease Management—An Overview. Int J Mol Sci. 2022. doi: 10.3390/ijms23179610.

Iodine is a very important microelement of the thyroid gland involved in the synthesis of T3 and T4. This microelement also plays a significant role in pregnancy as it supports the fetal nervous system development. Pregnant women have an increased iodine requirement, typically 30% higher than that of non-pregnant individuals. In attempt to solve iodine deficiency, iodine has been added to salt over the course of the 20th century. However, due to the increase of hypertension and CVD, it is advised to reduce salt intake, which is a main source of iodine (40,41). Other main sources of iodine include seafood, fish, milk, dairy products, vegetables and fruits. The World health organization recommends an intake of 150 µg/day in adults (42,43).

It has been proven that excessive iodine intake or over-supplementation exceeding 1 mg daily will induce thyroid failure leading to the Wolff-Chaikoff effect, including thyroid autoimmunity. For that reason, it is not recommended in Hashimoto's thyroiditis patients. Excessive iodine can induce cellular toxicity, leading to damage, apoptosis, or necrosis, attributed to its potential oxidation effects and role in oxidative stress. In vitro studies on cells from HT patients revealed that excessive iodine suppressed autophagy processes stimulated

apoptosis and increased free radical production. It is very important to monitor the iodine levels in the body to prevent both iodine deficiency and iodine excess (44,45).

Selenium is considered an essential micronutrient with important antioxidant and anti-inflammatory properties. The thyroid gland has the highest selenium content per gram of tissue out of any organ as it expresses selenoproteins such as glutathione peroxidases and iodothyronine deiodinases. In Hashimoto patients, selenium supplementation, more particularly in the form of selenomethionine, may be beneficial. The most common foods that contain selenium are meat, marine and freshwater fish, eggs, seafood, cereal, dairy products, onions, garlic, plants of the Brassica genus (broccoli, cabbage and cauliflower) and yeast. The highest concentrations of selenium are found in brazil nuts and mushrooms (46–48). Selenium promotes regulatory cell activity, inhibiting the release of interleukin (IL)-2, which triggers autoreactive T-cells and B-lymphocytes to produce thyroid antibodies. Additionally, selenium is implicated in blocking inflammatory cytokine secretion by T lymphocytes. Selenium supplementation is expected to reduce the levels of circulating thyroid autoantibodies, as well as diminishing the rise of TSH levels and improving health-related quality of life. In studies on rats, selenium supplementation alongside excess iodine prevented thyroid pathology and reversed iodine-induced changes (22).

Mice exposed to iodine for 8 weeks developed autoimmune hypothyroidism; however, when selenium was introduced for another 8 weeks, thyroid mass returned to normal, along with a decrease in anti-thyroglobulin antibodies. Proper selenium intake may mitigate iodine's adverse effects. Studies indicate that blood selenium levels below 60 µg/L or above 140 µg/L elevate the risk deficiency-related diseases (e.g., autoimmune disorders like Hashimoto's thyroiditis, cancer) or selenium excess-related conditions (e.g., hyperlipidemia, type 2 diabetes). Optimal selenium nutrition (60-140 µg/L) is crucial for health and may counteract iodine toxicity. Selenium deficiency renders the thyroid gland vulnerable to iodine's effects, necessitating selenium's presence to counteract iodine-induced damage and autoimmune stimulation (22,29,46,47,49)

Zinc plays a crucial role in thyroid hormone production, and its deficiency can disrupt hormone levels while increasing antibody titers against thyroid antigens. Replenishing zinc levels in Hashimoto's disease patients can restore normal thyroid function. Hair loss, a characteristic feature of zinc deficiency in hypothyroidism, can be mitigated by improving zinc nutrition. Pumpkin seeds, flax seeds, and whole grain cereals like whole meal bread, millet, and buckwheat are among the richest sources of zinc (22,50,51).

Iron deficiency frequently accompanies Hashimoto's disease and often manifests as anemia. After binding hem, a specific enzyme, thyroid peroxidase, contributes to thyroid hormone production. The main source of iron is found in red meat. Other iron rich foods are found in poultry, eggs, fish, cereals, legumes, vegetables and fruits. So far, there is no association found between iron deficiency and thyroid autoimmunity. However, many patients with HT are deficient in iron due to associated diseases such as celiac disease or autoimmune gastritis which causes iron loss and a decrease in iron absorption. A deficiency in iron can impede thyroid hormone synthesis, resulting in elevated TSH levels and increased gland volume. This suggests that anemia may heighten the risk of developing thyroid disorders. Nonetheless addressing iron deficiency can improve thyroid function (22,29,52,53)

Magnesium is an important trace element as it is one of the most abundant elements in the human body and a cofactor for more than 300 enzymes that control diverse biochemical processes. This mineral is found in spinach, broccoli, avocado, legumes, nuts, almonds, seeds, bananas, and whole grains. A cross-sectional study was performed with 1257 participants, they concluded that low serum magnesium levels were associated with an escalated risk of TgAb positivity, the prevalence of Hashioto's thyroiditis, and hypothyroidism. On the other hand, no relationship was found between TPOAb and magnesium levels. With regards to immune function, magnesium exhibits anti-inflammatory properties, diminishing levels of reactive C protein and antibodies against thyroglobulin. Notably, severe magnesium deficiency escalates the likelihood of Hashimoto's disease development, potentially exacerbating symptoms in affected individuals due to immune system dysregulation (22,29,54,55)

In the human body, vitamin D can be obtained endogenously after exposure to UBV radiation (sunlight) on the skin, and exogenously from food such as fatty fish (salmon and mackerel) fish liver oils, meat, eggs dairy products and sun dried mushrooms. Vitamin D deficiency is a worldwide issue, it is defined by a serum 25-hydroxyvitamin D [25(OH)D] level below 50 nmol / L or 20 ng / mL. As of today, it is still unclear whether vitamin D plays a role in the pathogenesis of HT. However, epidemiological studies done in 2021, have found an association between the presence of thyroid autoantibodies and vitamin D deficiency. Supplementing HT patients with vitamin D reduces the concentration of anti-thyroid antibodies. Its roles include cell proliferation, cell differentiation and immunomodulation (22,29). It was discovered that patients with Hashimoto's, compared to healthy patients, had a remarkably higher concentration of cytokines secreted by the proinflammatory Th1 and Th17 cells, interferon-gamma and IL-17. It was observed that vitamin D deficiency is involved in the pathological mechanism of the development of Hashimoto's disease and that sufficient vitamin

D concentration leads to appropriate immune tolerance due to regulation of CD4+ T-cell differentiation. Patients with the disease often exhibit significantly lower blood vitamin D levels compared to healthy individuals, possibly influenced by dietary habits or disease progression. Thus, there is a critical need for public education regarding vitamin D, considering that a mere 5 ng/mL increase in blood levels is associated with a 19% reduction in the risk of developing hypothyroidism in lymphocytic thyroiditis (56–58)

Patients with this autoimmune disease may experience an elevated risk of developing anemia, particularly when concurrent autoimmune conditions such as pernicious anemia or atrophic gastritis are present. Vitamin B12 is naturally occurring in animal-based foods such as meat, fish, eggs, milk, and dairy products (29,59,60)

2. OBJECTIVES

The aim of this research was to investigate general population attitudes and knowledge regarding Hashimoto disease, particularly the association between diet or dietary supplements with thyroid health.

HYPOTHESIS:

1. Majority of participants will be familiar with parameters which might be checked to test thyroid function.

2. Majority of participants will be knowledgeable on dietary patterns which could have positive impact on thyroid health.

3. Low proportion of participants will be knowledgeable on dietary supplements which could have positive impact on thyroid health.

3. MATERIALS AND METHODS

Participants and Procedure:

This study was approved by the Ethics Committee of the University of Split School of Medicine (USSM, ur.br.:2181-198-03-04-24-0071) and conducted according to the principles established by the Code of Medical Ethics and Deontology (Official Gazette 55/08 and 139/15), Helsinki Declaration.

The research was conducted at University of Split School of Medicine, in June 2024. The survey data was collected with Google form which was sent to participants through social media. The study included a total of 448 people from Croatia. All participants provided informed consent before completing on-line questionnaires.

Survey

The survey, conducted in Croatian, consisted of 13 questions. The first question inquired about the participant's age, offering the following ranges: 18-20, 21-30, 31-40, 41-50, 51-60, 61-70, and over 71. The second question asked the participant's gender, with options for male or female. The third question addressed the participant's academic level.

The fourth question asked whether the participant suffers from a chronic disease, requiring a yes or no response. Similarly, the fifth question inquired if the participant had ever had their thyroid hormones checked, with a yes or no response. The sixth question asked if the participant has a thyroid disease, and the seventh asked if they take thyroid medication; both required yes or no responses. The eighth question asked if the participant takes any thyroid supplements, while the ninth inquired if they follow any special dietary regimes for thyroid function, both requiring yes or no answers.

The tenth question listed parameters participants might check to test thyroid function, including FSH, LH, TSH, ferritin, T3, and T4. The eleventh question asked participants if they believed diet affects the course of thyroid disease, with a yes or no response. The twelfth question explored which eating habits participants thought positively affect thyroid health, with options such as increased intake of fruits, vegetables, gluten, milk, and red meat. The final question, asked which food supplements participants believed positively impact thyroid health, listing options like vitamin D, selenium, ashwagandha, vitamins C and E, iodine, inositol, and magnesium.

Data Collection and Consent:

Participants were informed about the study through written Informed Consent forms, detailing the research objectives and questionnaire completion process. Questionnaires were coded, ensuring confidentiality of personal data, accessible only to the researcher. Consent was implied by completing the study's measurement instruments and selecting the "accept" option. Participants were free to withdraw at any point during questionnaire completion.

Participants criteria:

The study enrolled the general population of Croatia of all ages. Inclusion criteria were limited to the Croatian population. Exclusion criteria included people not living in Croatia and minors.

Data analysis:

Data were presented as whole numbers, mean, proportions and standard deviation, where appropriate. Data was entered in spreadsheet in Microsoft Office Excel where tables and figures were obtained and descriptive analysis was performed.

4. RESULTS

The study included a total of 448 participants, majority of which were female participants. Their demographic characteristics are presented in Table 1.

Table 1. Demographic characteristics of the respondents

Characteristics	N (%)
Gender	
Female	418 (93.7)
Male	28 (6.3)
Age (years)	
18 - 20	29 (6.5)
21 - 30	270 (60.3)
31 - 40	103 (23)
41 - 50	38 (8.5)
51 - 60	8 (1.8)
61 - 70	0
>71	0
Education	
Primary education	5 (1.1)
Secondary education	116 (26.4)
Bachelor's degree	71 (16.1)
Master degree	227 (51.6)
Doctoral education	21 (4.8)

Majority of participants had their hormone levels checked in the past, as presented in Figure 5. Almost fifth of all participants, 74 (16.6%) reported having a thyroid disease and 45 of them actually take thyroid medication. Out of the 74 who have a thyroid disease, 27 of them are taking dietary supplements. Only 16 out of the 74, 20.3%, with a thyroid condition are following a special dietary regimen for their thyroid health. Meanwhile, 59 (79.7%) of them believe that diet affects the course of the disease.

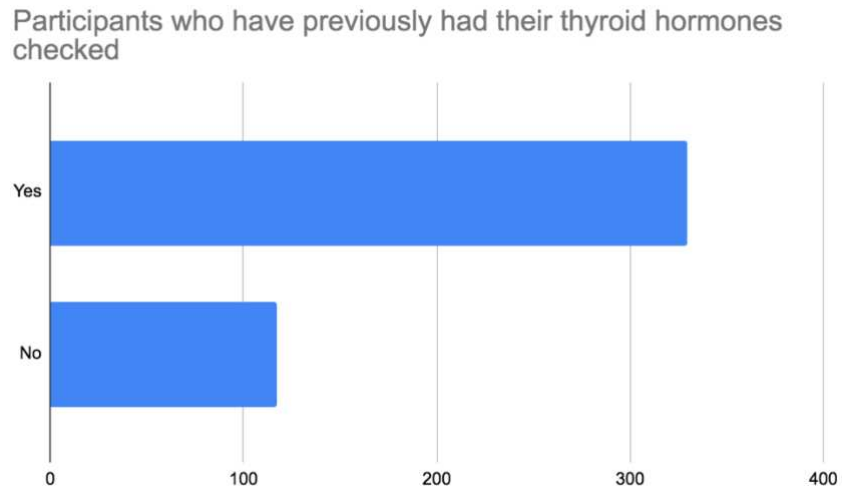

Figure 5. Total number of participants who checked their thyroid hormones in the past

Out of the 330 participants who have had their thyroid hormones checked, 282 of them believed that diet affects the course of thyroid disease. These results show that among individuals with thyroid disease, 27 (6.1%) use dietary supplements, while among those without thyroid disease, 47 (10.5%) use them. Furthermore, 60.8% of patients reported taking thyroid medication Overall, 20.6% of participants use dietary supplements, with 79.4% not using them. Also, results have showed that among individuals who believe diet affects thyroid function, 59 (13.4%) have thyroid disease, while among those who do not believe diet affects thyroid function, 39 (8.8%) have thyroid disease. Overall, 91.2% of participants have an opinion on diet affecting thyroid function, with 8.8% having no opinion.

Figure 6 shows beliefs of general population on association between particular food intake and thyroid health. Majority of participants reported increased vegetables intake is associated with thyroid health, and food component least likely reported as associated with thyroid health was gluten.

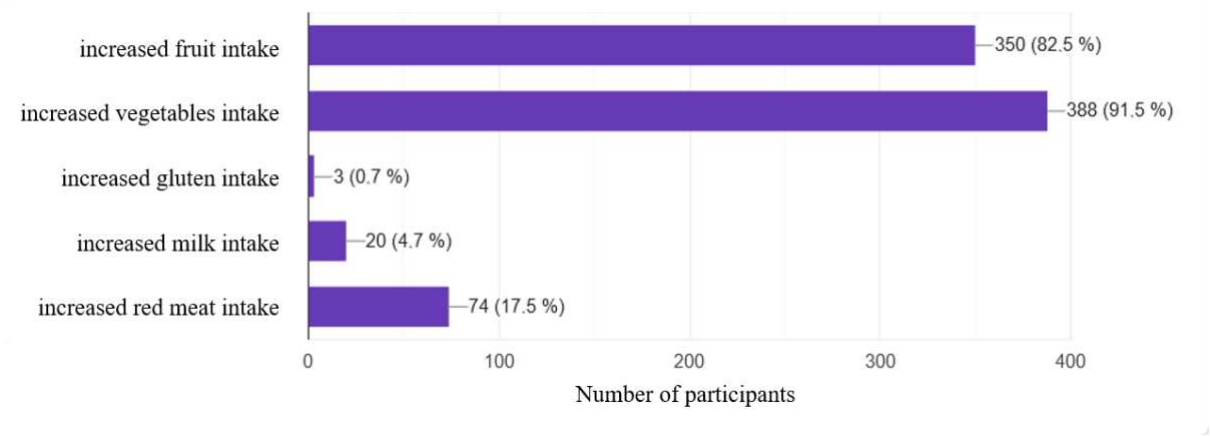

Figure 6. Participants belief on dietary patterns which have positive impact on thyroid health

Figure 7 shows beliefs of general population on dietary supplements which could have positive effect on thyroid health. Majority of participants reported iodine has positive effect on thyroid health (62.3%), and Ashwaganda was least likely associated with positive effects on thyroid health.

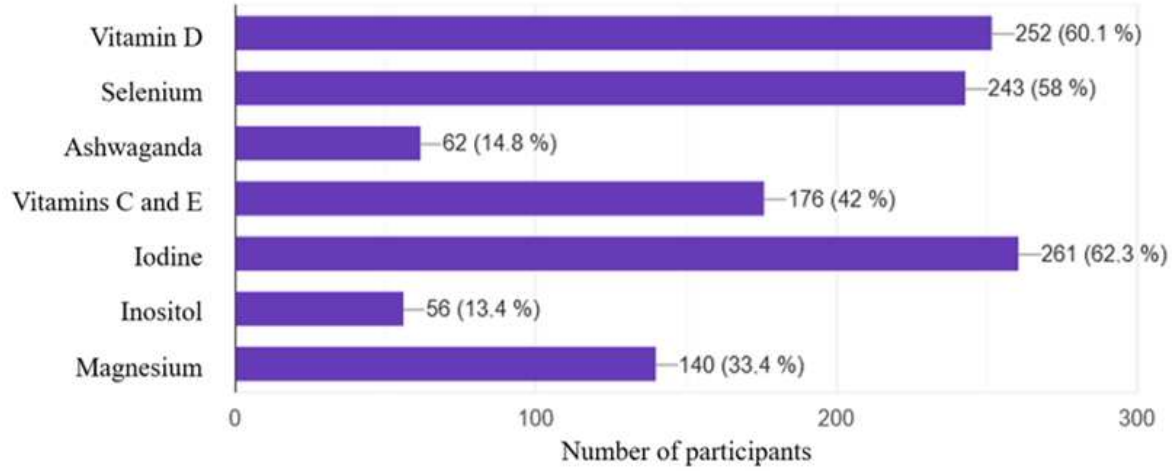

Figure 7. Participants belief on dietary supplements with positive impact on thyroid health

5. DISCUSSION

The study included 448 participants, with a predominant representation of females and younger individuals. This skew towards younger participants may reflect the demographic most likely to engage with health surveys or those more concerned about thyroid health. The majority of cases found in the present study are in the 21-30 age group. As we know, the prevalence of hypothyroidism increases with age, from 0.3% among the younger population to 5.9% in individuals over 80 (8) However this isn't seen in our study, probably because of the lack of usage of social media in the older population.

The study revealed that a significant portion of participants is aware of the importance of diet and supplements in managing thyroid health, with 79.7% of respondants with thyroid disease believing that diet affects the course of thyroid disease. People with autoimmune thyroid disease tend to seek non-pharmacological forms of treatment. This is encouraging, as proper dietary management and nutritional supplementation can play a crucial role in maintaining thyroid function and overall health, supporting the prevention and management of thyroid disorders (12).

Results of our study have showed that 60.8% of participants reported taking thyroid medication. This high rate of medication use is consistent with clinical guidelines that recommend pharmacological treatment for managing thyroid dysfunction. Levothyroxine is recommended as the treatment of choice due to its effectiveness and safety profile (21). Additionally, some of patients with thyroid disease reported using dietary supplements in our study, indicating an interest in supplemental approaches to thyroid health. However, only small proportion of participants follow a specific dietary regimen for thyroid health. This gap between belief and practice suggests that while many participants recognize the potential benefits of diet, there may be barriers to implementing dietary changes. These barriers could include lack of knowledge, difficulty in changing eating habits, or insufficient support from healthcare providers. Following a gluten free diet still remains controversial in the management of Hashimoto's disease, as the benefits have been found to be inconclusive (22).

The study aimed to investigate whether participants' beliefs regarding the impact of diet and supplements on thyroid health differ based on their history of thyroid hormone checks and adherence to dietary practices. Our results suggest that participants who have had their thyroid hormones checked are more likely to believe in the positive impact of diet and supplements on

thyroid health. This aspect of the study is crucial, as it reflects the level of understanding and involvement in their health management. Patients who are engaged in managing their thyroid health through periodic hormone checks are known to demonstrate higher adherence to dietary and supplemental interventions to improve thyroid function (20). Knowledge gaps in this area could be addressed through targeted educational initiatives, which could further reinforce the importance of diet and supplements in managing thyroid conditions.

Healthcare providers should emphasize the importance of dietary management alongside medication and supplements. Public health campaigns could focus on providing clear, accessible dietary guidelines and support for individuals with thyroid conditions. For example, emphasizing the benefits of specific nutrients and foods that support thyroid function, such as iodine-rich foods, selenium, and zinc, could enhance dietary adherence and reduce the incidence of thyroid disease (23). Additionally, addressing common misconceptions and providing practical tips for incorporating these foods into daily diets could further support individuals in managing their thyroid health through diet.

Our results highlight significant beliefs and practices regarding thyroid health among participants, revealing a strong belief in the impact of diet that does not always translate into practice. Bridging this gap through targeted education and support could enhance thyroid health management, ultimately improving outcomes for individuals with thyroid conditions. Increased awareness and proactive health behaviors, supported by routine thyroid hormone checks and comprehensive dietary guidance, are essential for optimal thyroid health.

This study has several limitations. The sample predominantly consisted of females (93.7%) and younger adults, which may not fully represent the general population. The reliance on self-reported data can introduce bias, and the convenience sampling method limits the generalizability of the findings. Future research should aim for a more balanced demographic representation and consider longitudinal studies to assess the long-term impact of dietary practices on thyroid health. Furthermore, expanding the study to include qualitative methods, such as interviews or focus groups, could provide deeper insights into the barriers and facilitators of dietary management in individuals with thyroid conditions. Understanding these factors could inform the development of more effective educational and support interventions.

6. CONCLUSIONS

1. Thyroid disease was most common in participants of younger age.
2. Minority of participants reported following specific dietary regimens for thyroid health.
3. Majority of participants checked their thyroid hormones in the past.
4. Largest proportion of participants believed vegetables have positive impact on thyroid health.
5. Largest proportion of participants believed iodine has positive impact on thyroid health.

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8. SUMMARY

Objectives: The aim of this research was to investigate general population attitudes and knowledge regarding Hashimoto disease, particularly the association between diet or dietary supplements with thyroid health.

Materials and Methods: The study was approved by the Ethics Committee of the University of Split, School of Medicine, and conducted in June 2024. Data collection utilized an online survey distributed via social media to 448 participants from Croatia. Participants provided informed consent before completing the questionnaire.

Results: The study included predominantly female participants (93.7%), primarily aged between 21 to 30 years (60.3%), and holding master's degrees (51.6%). Out of 448 participants, 74 (16.6%) reported having thyroid disease. Among those with thyroid conditions, 79.7% believed that diet impacts the course of thyroid disease. However, only 20.3% followed specific dietary regimens for thyroid health, despite 60.8% using thyroid medication and 36.5% using dietary supplements. Participants who had their thyroid hormones checked were more likely to believe in the positive impact of diet and supplements on thyroid health. Overall, 91.2% of participants had an opinion on diet affecting thyroid function, with a significant proportion associating increased vegetable intake with positive thyroid health, while gluten was least associated. Additionally, iodine was reported by the majority (62.3%) as having a positive effect on thyroid health, whereas Inositol and Ashwagandha were the least associated with positive effects.

Conclusion: This study highlights varied beliefs and practices regarding thyroid health management among the Croatian population. It underscores the need for targeted educational initiatives to bridge gaps between belief and practice in diet and thyroid health. Enhancing awareness and support through clear dietary guidelines and healthcare provider education could improve outcomes for individuals managing thyroid conditions. Future research should consider diverse demographic representation and qualitative methods to explore barriers and facilitators of dietary management in thyroid health.

9. CROATIAN SUMMARY

Naslov: Stavovi i znanja o Hashimotovoj bolesti u općoj populaciji

Ciljevi: Cilj ovog istraživanja bio je istražiti stavove i znanje opće populacije o Hashimotovoj bolesti, posebno vezu između prehrane ili dodataka prehrani i zdravlja štitnjače.

Materijali i metode: Istraživanje je odobreno od strane Etičkog povjerenstva Medicinskog fakulteta Sveučilišta u Splitu i provedeno je u lipnju 2024. godine. Prikupljanje podataka provedeno je putem internetske ankete distribuirane putem društvenih mreža.. Sudionici su dali informirani pristanak prije nego što su ispunili upitnik.

Rezultati: U istraživanju su sudjelovale pretežno žene (93,7%), uglavnom u dobi od 21 do 30 godina (60,3%) i s magistarskom diplomom (51,6%). Od 448 sudionika, 74 (16,6%) je prijavilo bolest štitnjače. Među onima s bolestima štitnjače, 79,7% vjeruje da prehrana utječe na tijek bolesti štitnjače. Međutim, samo 20,3% slijedi specifične prehrambene režime za zdravlje štitnjače, iako 60,8% koristi lijekove za štitnjaču, a 36,5% koristi dodatke prehrani. Sudionici koji su provjeravali hormone štitnjače češće su vjerovali u pozitivan utjecaj prehrane i dodataka na zdravlje štitnjače. Ukupno, 91,2% sudionika imalo je mišljenje o utjecaju prehrane na funkciju štitnjače, pri čemu značajan udio povezuje povećan unos povrća s pozitivnim zdravljem štitnjače, dok je gluten najmanje povezan. Osim toga, jod je većinom (62,3%) prijavljen da ima pozitivan utjecaj na zdravlje štitnjače, dok su inozitol i ashwagandha najmanje povezani s pozitivnim učincima.

Zaključak: Ovo istraživanje ističe različita uvjerenja i prakse u vezi sa zdravljem štitnjače među hrvatskom populacijom. Naglašava potrebu za ciljanom edukacijom kako bi se premostio jaz između uvjerenja i prakse u prehrani i zdravlju štitnjače.